ITD's Permitted Truck Negotiated Rulemaking Comments

Below is a listing of the comments submitted. To review the comments, please go to the listed page numbers. Thank you!

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May 16, 2016

Ramon Hobdey-Sanchez, (ramon.hobdey-sanchez@itd.idaho.gov)
Idaho Transportation Department
3311 W. State St., P.O. Box 7129
Boise, ID 83707

RE: Comments regarding potential rulemaking for permitting and safety for "over-legal" vehicles.

Dear Mr. Hobdey-Sanchez;

Thank you for this opportunity to comment on a potential formal negotiated rulemaking regarding "over-legal" vehicles.

The Milk Producers of Idaho (MPI) is a dairy trade association comprised of dairy operations and other associated businesses interested in the success of the dairy industry in Idaho (trucking firms, milk processing etc.). MPI and its members were involved in the development and passage of the original pilot project for more efficient trucks and with the legislation that passed in 2014 allowing for the process for 129,000 lb vehicles on Idaho roads as well with the legislation from this past session allowing for the more efficient vehicles on the interstate.

The members of MPI have a strong interest in maintaining an efficient effective system of product distribution within the state of Idaho and therefore are very interested in any proposed changes to existing regulations or development of new regulations that will impact that distribution system. It is with that background that we respectfully submit the following comments:

Need for new regulations: The members of MPI do not agree that a negotiated rulemaking is necessary to integrate 129,000 lb. trucks onto the Idaho Interstate Highway system. Both the U.S. Congress and the Idaho Legislature have passed legislation to allow for the more efficient trucks to operate on the Interstate system in Idaho. It is the opinion of the members of MPI that the current rules regulating all trucks over 80,000 lb. are sufficient and should apply to the "over-legal" vehicles as presently written.

There is no evidence that these trucks provide any additional safety hazards on Idaho highways. In fact the evidence (ITD's own 10 year study) shows that these more efficient trucks do not create any additional safety hazards nor do they cause any additional harm to the roadway itself.

MPI members strongly feel that the only change to the rules that ITD would need is to eliminate the phrase "over-legal" and apply the current rules to all vehicles up to 129,000 lb.

Should the ITD determine that changes to the rules are necessary, MPI makes the following suggestions:

- **All current exemptions remain in place.**
- **Any permits that may be required for vehicles up to 129,000 lb. be issued at the state level and not require any permit from the local jurisdictions on all state approved routes.**
- **The phrase "over-legal" is stricken from the regulations for all vehicles up to 129,000 lb. since these vehicles are now legal under both federal and state laws.**
- **The current number of inspections is sufficient to protect the public. The more efficient trucks (129,000 lb) will decrease the overall number of trucks. Therefore it is logical that the current number of inspections will statistically provide a higher percentage of inspections than currently exist.**
- **Any adopted rules be no more stringent or broader in scope than Federal regulation.**

The members of MPI will participate in any negotiated rulemaking, should the ITD determine that a rulemaking is necessary, and we will appreciate notification of any such rulemaking.

Thank you again for the opportunity to offer comments.

Respectfully submitted.

J. Brent Olmstead

J. Brent Olmstead, President
Milk Producers of Idaho
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cc: Governor C.L. Otter
Senator Bert Brackett
Representative Joe Palmer

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May 23, 2016

Ramon Hobdey-Sanchez
Idaho Transportation Department
P.O. Box 7129
Boise, ID 83707

RE: Potential Negotiated Rulemaking: Permits and Safety Requirements for Regular and Over-legal Vehicles on Idaho Highways

The Idaho Hay and Forage Association represents farmers and ranchers from throughout Idaho who produce hay and forage products. Idaho's hay and forage industry has changed considerably in recent years. Because of the growth of the dairy and livestock industry Idaho has recently become a hay import state and unable to grow all of the necessary commodities to meet the demands of dairy and cattle producers. The result has been the need for more efficient transportation of our commodities on Idaho's roads.

The Idaho Hay and Forage Association has commented and stood in full support of increasing the interstate weight limitations for 129,000 pound trucks in Idaho. We have also commented and supported the increase through drawn out debate on the state level, supported the increase through the pilot project, supported the studies conducted by ITD that have found no additional safety hazards or added negative impact to highways, and have provided written support to the Idaho State delegation to Congress asking for 129,000 pound trucks on highways. We are unaware of any justifiable concerns that directly impact the limit of 129,000 pound vehicles that are not already delineated and covered, in detail, by the current regulations and standards for vehicles over 80,000 pounds.

Our association frequently participates in the rules making process and works with a number of state agencies when rules are promulgated. It has been the policy of our elected officials, state agencies and their constituents, to refuse to set a course in which state agency rules expand outside of or further regulate, that which is required by the Federal Government. We see no need to go forward with the negotiated rules process and the Idaho Hay and Forage Association supports the application of the current rules already in place.

We understand the need for minor changes, such as removing the phrase "over-legal" to coincide with both the intent of state enacted legislation and of congress. In the same manner and with the same intent in mind, we suggest inspections and rules for the vehicles remain the same as currently exist. Any permits that may be required for vehicles up to 129,000 pounds be issued at the state level and remain out of local jurisdictional purview on all state approved routes and current exemptions remain in place.

Thank you for the opportunity to comment on this very important issue to our growers and membership. Idaho will need to move more hay and forage commodities in the future and these larger trucks will be economically positive for producers, for the end users who purchase these commodities, and for Idaho's agriculturally based economy.

Sincerely,

Will Ricks

Will Ricks, President

Cc: Governor C.L. Otter
Senator Bert Brackett
Representative Joe Palmer

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May 23, 2016

Ramon Hobdey-Sanchez
Idaho Transportation Department
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RE: Potential Negotiated Rulemaking: Permits and Safety Requirements for Regular and Over-legal Vehicles on Idaho Highways

The Idaho Cooperative Council (ICC) represents farmer-owned agriculture cooperatives, both local and regional, operating throughout Idaho. Because of these cooperatives, specifically, sugar beet, dairy and grain cooperatives, we see the need for establishing additional routes in Idaho and are asking for your support of increasing the interstate weight limitations to 129,000 pounds. The Idaho Cooperative Council has been an active member of the 129,000 Pound Truck Coalition supporting the designated pilot routes throughout Idaho over the past decade.

ICC does not agree with the opinion that there should or needs to be negotiated rules for 129,000 pound trucks. The recent and successful pilot project routes in Idaho over a number of years have shown that the demand on the roads and bridges has not been impacted by the weights of these heavier trucks because of the displacement of increased axels. However, the heavier trucks have resulted in the added benefit of fewer trucks on Idaho roads, increasing the safety of our communities. Over a short time period we will see substantial cost savings to all those moving commodities from the farm to the market in Idaho.

Corresponding to the sentiments already mentioned, ICC includes the following suggestions:

- If rules are promulgated, reconsider the schedule and the sequence of events relating to participants, comments and stakeholder meetings
- Removal of the "over-legal" language in relation to 129,000 pounds
- Inspections and rules for the vehicles remain consistent with those vehicles covered by vehicles above 80,000 pounds - current inspection procedures should remain as is
- Permitting be consistent and done through the state avoiding jurisdictional issues - these inconsistencies always impair business and create winners and losers
- Avoid state agency rules that expand outside of or further regulate that which is required by the Federal Government

Idaho's agriculture industry must remain competitive and we understand that allowing the increase of interstate weight limitations for 129,000 pound trucks with the current rules already in place is vitally important to doing business on behalf of Idaho farmers and ranchers.

Sincerely,

Jack Ingram, President

Cc: Governor C.L. Otter
Senator Bert Brackett
Representative Joe Palmer

May 23, 2016

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RE: Negotiated Rulemaking on Over-legal Permitting on the Interstate

Dear Mr. Hobdey-Sánchez;

Thank you for the opportunity to comment on the state's efforts to implement Senate Bill 1229, which allows Idaho to permit vehicles up to 129,000 on the Interstate system. As a dairy cooperative with nearly 500 dairy member-owners (with a total of 67 member-owners located in Idaho) this bill is important in helping us move raw milk efficiently from our farms to our 11 processing plants throughout the Northwest, including ones in Boise, Jerome and Caldwell, Idaho. In addition our marketing and processing subsidiary Darigold, produces and transports a full line of dairy-based products for retail, food service, commodity and specialty markets.

The federal transportation act that arbitrarily froze Idaho weight limit at 105,500 pounds in 1991 left Idaho at a significant economic and logistical disadvantage compared to our surrounding states. As an organization that transport products across state-lines, we have supported 129,000 pound trucks since the initiation of the early pilot projects and supported legislation allowing these trucks on state and federal highways in Idaho. We believe that all that is needed to implement Senate Bill 1229 is a rule that extends Idaho Transportation Department's (ITD) current ability to permit approved state routes to the Interstate system.

We believe that Senate Bill 1229 is safe and efficient for the following reasons:

- The current requirements the state has on 129,000 pound vehicles were established to improve safety and limit impact on infrastructure
- Idaho conducted a 10-year pilot project that showed no damage to roads, no impacts on safety
- The pilot project included legislation that required certain safety and equipment requirements
- Regulatory requirements among the states should be harmonious whenever possible
- Other states have been running on higher truck weights for decades without incident

Again, thank you for the opportunity to comment on the Idaho Transportation Department's negotiated rulemaking on over-legal permits on the Interstate. If you need to contact me, please call (206) 805-6866 or email me at steve.matzen@darigold.com.

Sincerely,

Steve Matzen, Sr. Vice President

KBC Transport LLC

208-926-4843 PO Box 340 Kooskia, Id. 83539 208-926-4269 (fax)

April 29, 2016

RE: ITD Negotiated Rulemaking Regarding Overlegal Permitting and Safety Requirements

KBC Transport LLC would like to submit the following comments on Negotiated Rulemaking process concerning safety requirements of haul routes.

1.) Sight Distance on Roads

All roads meeting criteria to haul 129 GVW must have a minimum sight distance of 400 feet at 60 mph or 200 feet at 30 mph. This is based on stopping distance for loaded trucks. Federal Motor Vehicle Safety Standard (FMVSS) 121 adopted August 1, 2013, required new trucks over 85 GVW to stop within 310 feet. The average reaction time to apply braking is anywhere from 1.5 seconds to 2.5 seconds per various sources. At 60 mph the rate of speed is 87 feet per second. So 1.5 second reaction time is an additional 131 feet. Combined stopping distance for a loaded truck on dry pavement would be 441 feet at 60 mph or 220 feet at 30 miles per hour. Stopping distance on wet pavement or icy conditions increases this distance significantly. I have debated these numbers with ITD engineers in Lewiston. We have not agreed on an exact number, but we all agree minimum stopping distance at 60 mph of 400 feet or 200 feet at 30 mph. It makes no sense to approve a roadway for higher weight, when trucks cannot stop in time to avoid a hazard.

2.) Shoulder Width on Roads

Minimum shoulder width for 129 GVW route should be 2 feet. The shoulder can either be paved or hard pack road surface so as not to drag truck over embankment if shoulder gives away. Shoulder's narrower than this creates an unacceptable margin of error for drivers to avoid road hazards or unintentional drifting by drivers not paying attention. We would agree that 18 inches would be acceptable but 1 foot shoulders or narrower creates an unacceptable risk to the public.

3.) Passing Lanes on Roads

We would propose requirement for passing lanes on 129 GVW routes for any grade greater than 5% and 2 miles or longer. These passing lanes should be a minimum of 400 feet long (4 times length 129 GVW Configuration). So grade greater than 5% and 5 miles long would require two passing areas.

Wally Burchak
Vice President
KBC Transport LLC

brakes: shorter stopping distances, again

Phase Two of the '121' standard's more stringent requirements is coming, but you might not notice it until a panic stop's needed.

Coming up: another "non-event" for brakes? That's what Phase Two of new federal stopping-distance requirements will be for truck operators, according to people we talked with. Stronger, higher-performance brakes on certain vehicles won't even cost much more in most cases. But like Phase One two years ago, which was hardly noticed by truckers, Phase Two represents a lot of work for brake makers and truck builders.

Effective Aug. 1, tandem-rear-axle road tractors with gross weight ratings over 59,600 pounds and all single-rear-axle tractors will have to stop quicker than they do now. The heavier tractor's maximum stopping distance from 60 mph will be 250 or 310 feet, depending on gross weight and number of axles (see chart above). All two-axle tractors will have to stop in 250 feet. The current limit for these tractors is 355 feet when loaded.

Phase One, which went into effect in 2011, affected road tractors grossing up to 59,600 pounds. They make up the great majority of those on the road, and are the ones usually involved in accidents. Thus they were chosen for the first round of performance improvements. When loaded they must stop within 250 feet from 60 mph.

These requirements are in updates to Federal Motor Vehicle Safety Standard 121, published in 2009 by the National Highway Traffic Safety Administration. FMVSS 121 goes back many years and governs design and performance of air-braked vehicles. Over the years it has been modified to mandate better performance in commercial trucks and trailers. Anti-lock braking systems for heavy trucks, first in 1975 and then finally in the mid-1990s, are part of FMVSS 121.

Reduced stopping distances are the latest effort to make heavy combination vehicles more compatible with autos and light trucks on our increasingly crowded highways, NHTSA says. Trailers are not affected because regulators assume that their brakes do their fair share of stopping. In panic situations, which the 60-mph requirements simulate, vehicle weight shifts forward, putting more load on tractor brakes.

Implementation Date	Tractor Configuration (Number of Axles)	Tractor GVWR (lbs)	60 MPH Stopping Distances (Feet)			
			Unloaded		Loaded	
			Current	New	Current	New
August 1, 2011	Three	0 to 59,600	335	235	355	250
August 1, 2013	Three	59,600 to 70,000				250
	Three	Above 70,000				310
	Two	All				250
	Four or more	0 to 85,000				250
	Four or more	Above 85,000				310

Heavy straight trucks also are not covered in the new requirements, because they generally run at lower speeds and have powerful enough brakes to be safe.

Won't be noticed

"It'll be another non-event," says Darry Stuart, a contract fleet manager and consultant, of next

Tom Berg • Senior Editor

James Robinson/PennLive.com via AP

Vehicles pile up at the site of a fatal crash near Fredericksburg, Pa., Saturday. The pileup left tractor-trailers, box trucks and cars tangled together across several lanes of traffic and into the snow-covered median. Three people were killed and scores others injured in the wreck.

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May 24, 2016

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Re: ITD Over Legal Permitting; Safety Requirements Rulemaking

Dear Messrs. Bywater and Hobdey-Sanchez:

The law firm of Givens Pursley LLP represents KBC Transport LLC ("KBC" or "Client") in the Idaho Transportation Department's ("ITD") negotiated rulemaking process. Please accept this correspondence as a supplement to our Client's April 29, 2016 submissions.

We have reviewed the submissions from the Idaho State Police ("ISP"). As the lead agency for commercial vehicle safety, we find some of ISP's concerns worth emphasizing in this process. Indeed, as ISP has recognized, "roads in much of northern Idaho are far different than southern Idaho. Many of the roads are narrower, steeper, make repeated switchbacks, and many have no truck escape ramps." *Email from William Reese to Idaho Senate Transportation Committee*, February 12, 2016.

Perhaps for northern Idaho, the most important safety point ISP raised in this rulemaking proceeding is that 87% of commercial vehicle crashes are caused by driver error. The propensity of driver error is compounded considering the "narrower, steeper" and other characteristics that roads in northern Idaho have. This statistic is precisely the reason KBC encourages ITD to focus on: (1) sight distance on roads; (2) shoulder width; (3) passing lanes; and (4) proper brakes for heavy trucks.

Sight distance requirements concern reaction times of the driver. Our Client, who is in the heavy truck industry, and ITD engineers alike have agreed that the minimum stopping distance is

approximately 400 feet for 60 mph and 200 feet for 30 mph. If those numbers provide a consensus for stopping distances, it follows that sight distance should also be commensurate to the above. In October 2010, the National Highway Traffic Safety Administration ("NHTSA") completed a study of enhanced braking systems for heavy trucks. *See* attached NHTSA Report. The study utilized the National Advanced Driving Simulator, which is a simulator used to study driver behavior including driver-vehicle reaction time and responses. A simulation was conducted on 18-wheel tractor trailer configurations weighing 73,100 pounds. One of the braking events studied was a "stopped vehicle," which was developed to show driver reactions to an obscured stopped vehicle on the highway. This would be identical to an unforseen obstacle in the roadway beyond a driver's line of sight.

The NHTSA study found that average reaction time in a "stopped event" to be two seconds, and the minimum braking distance for an enhanced S-Cam brake system (larger brake shoes and drums required by FMVSS 121 for all trucks manufactured after August 1, 2013) to be 256 feet at 60 mph. Based on this information, the minimum stopping distance at 60 mph would be 432 feet (braking distance of 256 feet plus two-second reaction time at 88 feet per second). The NHTSA study performed the "stopped event" at 70 mph, and the total stopping distance ranged from 496 feet to 724 feet depending on the braking system used. The enhanced S-Cam brake system average stopping distance for a "stopped event" was 571 feet at 70 mph. The NHTSA study was based on dry pavement conditions. Adverse weather conditions would significantly increase the total stopping distance.

Likewise, shoulder width is equally important when discussing driver error, because it allows drivers to compensate and avoid road hazards and unintentional drifting from drivers not paying attention. Currently there is no standard for minimum width for shoulders. Shoulder width reverts back to sight lines and stopping distance. A disabled vehicle cannot move off the roadway when shoulders are one foot wide or less. Trucks that cannot see far enough ahead to stop in time have no way to avoid disabled vehicles or obstacles in the roadway.

Passing lanes are also key in the reduction of driver error-related accidents. There is no dispute that 129,000 trucks pull grades slower. Impatient drivers will try to pass slower moving trucks in unsafe areas. One example is the Harpster Grade on Highway 13. The Harpster Grade is a winding, 5.0-5.5% grade with no passing lanes, no emergency truck ramps, and limited chain-up locations. Even the trucks that currently travel up this Grade—smaller than the proposed 129,000-pound trucks—move very slowly, resulting in excessive congestion, driver frustration, and complaints to ITD. Indeed, during an ITD engineer's review of Highway 13 in a KBC truck, a passenger vehicle passed on a no passing, double yellow stretch of the road. Larger trucks will move even more slowly, exacerbating the already problematic status quo and increasing the likelihood that frustrated drivers will attempt to pass in unsafe areas. Longer, heavier trucks will also have difficulty climbing the steep grade on slick roads. With narrow shoulders, no passing lanes, and a steep drop-off to the river canyon, there is no room to maneuver around a jackknifed truck in the roadway.

Finally, it is worth noting that the NHTSA study highlights the importance that braking systems have on stopping distances. The NHTSA report found that enhanced S-Cam braking systems required by FMVSS121 reduced stopping distances by 17% compared to standard S-Cam

braking systems and should be required as a minimum on all 129,000 configurations. The study performed by the Commercial Vehicle Safety Alliance ("CVSA") included in ISP comments further highlights braking issues. The study tested the effects on stopping distance if brakes were degraded by 20% on tractor and 20% on trailer. That study shows that a 20% reduction in tractor brakes more than doubles the stopping distance versus a 20% reduction in trailer brakes (110-foot tractor 20% reduction versus 50-foot trailer 20% reduction on 132GVW load). This study proves the effects of inertia in a panic stop event. The mass of load pushes forward, resulting in the tractor braking system being more important than the trailer braking system in reducing stopping distance. Based on the studies, a four-axle tractor configuration hauling 105,000 is safer than the current proposed permit application for 129,000 loads, which utilize three-axle tractor configurations. A four-axle tractor configuration has 33% more axles providing braking and reduces stopping distance. KBC also operates eight axles on tractor and lead trailer configurations. 129,000 applicants plan to utilize six-axle tractor and lead trailer configurations with four axles on pup trailers. The CVSA study proves that braking capacity of following trailers are less effective than having braking power forward on tractor trailer configurations.

The current ITD standard states that ITD must utilize "criteria established by the board based upon road and bridge structural integrity engineering standards, as well as public safety engineering standards." I.C. § 49-1004A. At this point, there are no "established" criteria. The current ITD regulations also fail to provide any concrete standards for safety. *See* Idaho Admin. Code 39.03.22.200.04.b (noting that the "analysis will be completed for engineering and safety" criteria); *id.* ("Additional consideration will be given to traffic volumes and other safety factors."). As a consequence, what constitutes safety is subject to dispute and confusion as reasonable minds can differ.

We are hopeful that the establishment of concrete safety standards incorporating the above comments will not only create a level of certainty and consensus among the engineering community, but also save lives in the process.

Sincerely,

Jeremy C. Chou

JCC/SW
Enclosure
cc: Client
9445394_1 [5195-41]

U.S. Department
of Transportation
**National Highway
Traffic Safety
Administration**

NHTSA
www.nhtsa.gov

DOT HS 811 367

October 2010

Study of Heavy Truck S-Cam, Enhanced S-Cam, and Air Disc Brake Models Using NADS

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Technical Report Documentation Page

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9. Performing Organization Name and Address National Highway Traffic Safety Administration Vehicle Research and Test Center P.O. Box B37 East Liberty, OH 43319		10. Work Unit No. (TRAIS) 11. Contract or Grant No.
12. Sponsoring Agency Name and Address National Highway Traffic Safety Administration 1200 New Jersey Ave, SE Washington, DC 20590		13. Type of Report and Period Covered July 2006 – October 2008 14. Sponsoring Agency Code
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Abstract:

In crashes between heavy trucks and light vehicles, most of the fatalities are the occupants of the light vehicle. A reduction in heavy truck stopping distance should lead to a reduction in the number of crashes, the severity of crashes, and consequently the numbers of fatalities and injuries.

This study makes use of the National Advanced Driving Simulator (NADS). NADS is a full immersion driving simulator used to study driver behavior as well as driver-vehicle reactions and responses. The vehicle dynamics model of the existing heavy truck on NADS has been modified with the creation of two additional brake models. The three braking systems used in this study are the standard S-cam, the enhanced S-cam (larger drums and shoes), and the air-actuated disc brake system. A sample of 108 CDL-licensed drivers was split evenly among the simulations using each of the three braking systems. The drivers were presented with four different emergency stopping situations. The effectiveness of each braking system was evaluated by first noting if a collision was avoided and, if not, the speed of the truck at the time of collision. In the noncollision runs additional performance measures were also evaluated, including stopping distances, braking distances, brake pedal forces and decelerations.

The results of this study show that the drivers who used either the air disc brakes or the enhanced S-cam brakes had fewer collisions in the emergency scenarios than those drivers using standard S-cam brakes. The fundamental result this research validated is that reducing heavy truck stopping distance has strong potential to decrease the number and severity of crashes in situations requiring emergency braking.

17. Key Words Heavy Truck Brakes, Air Disc Brakes , Driving Simulators		18. Distribution Statement Document is available to the public from the National Technical Information Service www.ntis.gov	
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METRIC CONVERSION FACTORS

Approximate Conversions to Metric Measures					Approximate Conversions to English Measures				
Symbol	When You Know	Multiply by	To Find	Symbol	Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH					LENGTH		
in	inches	25.4	millimeters	mm	mm	millimeters	0.04	inches	in
in	inches	2.54	centimeters	cm	cm	centimeters	0.39	inches	in
ft	feet	30.48	centimeters	cm	m	meters	3.3	feet	ft
mi		1.61	kilometers	km	km	kilometers	0.62	miles	mi
		AREA					AREA		
miles									
in^2	square inches	6.45	square centimeters	cm^2	cm^2	square centimeters	0.16	square inches	in^2
ft^2	square feet	0.09	square meters	m^2	m^2	square meters	10.76	square feet	ft^2
mi^2	square miles	2.59	square kilometers	km^2	km^2	square kilometers	0.39	square miles	mi^2
		MASS (weight)					MASS (weight)		
	ounces	28.35	grams	g	g	grams	0.035	ounces	oz
oz lb	pounds	0.45	kilograms	kg	kg	kilograms	2.2	pounds	lb
		PRESSURE					PRESSURE		
psi	pounds per $inch^2$	0.07	bar	bar	bar	bar	14.50	pounds per $inch^2$	psi
psi	pounds per $inch^2$	6.89	kilopascals	kPa	kPa	kilopascals	0.145	pounds per $inch^2$	psi
		VELOCITY					VELOCITY		
mph	miles per hour	1.61	kilometers per hour	km/h	km/h	kilometers per hour	0.62	miles per hour	mph
		ACCELERATION					ACCELERATION		
ft/s^2	feet per $second^2$	0.30	meters per $second^2$	m/s^2	m/s^2	meters per $second^2$	3.28	feet per $second^2$	ft/s^2
		TEMPERATURE (exact)					TEMPERATURE (exact)		
°F	Fahrenheit	5/9 (°F - 32)	Celsius	°C	°C	Celsius	9/5 (°C) + 32°F	Fahrenheit	°F

NOTE

REGARDING COMPLIANCE WITH

AMERICANS WITH DISABILITIES ACT SECTION 508

For the convenience of visually impaired readers of this report using text-to-speech software, additional descriptive text has been provided within the body of the report for graphical images to satisfy Section 508 of the Americans with Disabilities Act (ADA).

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EXECUTIVE SUMMARY

In crashes between heavy trucks and light vehicles, most of the fatalities are the occupants of the light vehicle. A reduction in heavy truck stopping distance should lead to a reduction in the number of crashes, the severity of crashes, and consequently the numbers of fatalities and injuries.

Based on kinematics, it is reasonable to assume that if a truck can stop in a shorter distance it is more probable that the truck will avoid colliding with an object or it will at least collide with a reduced velocity. This theory holds true given that the operators' reaction times, control behavior, and their perceptions of available stopping distance remain constant. This report validates this assumption through the use of the National Advanced Driving Simulator (NADS).

NADS is a full immersion driving simulator used to study driver behavior as well as driver-vehicle reactions and responses. The vehicle dynamics model of the existing heavy truck on NADS has been modified with the creation of two additional brake models. The three braking systems used in this study are the standard S-cam (existing brake model), the enhanced S-cam (larger drums and shoes), and the air-actuated disc brake system. A sample of 108 CDL-licensed drivers was split evenly among the simulations using each of the three braking systems. The drivers were presented with four different emergency stopping situations. The effectiveness of each braking system was evaluated by first noting if a collision was avoided and, if not, the speed of the truck and the speed of the struck vehicle at the time of collision were recorded. From these two numbers, the effective speed of collision (delta-v) was calculated.

The four stopping emergency events were right incursion, left incursion, stopped vehicle, and stopping vehicle. These events were on a dry surface and the truck drivers were restricted from steering away from the obstacles by using concrete barriers on the shoulder, parked vehicles, and moving traffic in adjacent lanes. The events timings were designed such that in the case of the S-cam brake system the driver should bring the truck to a safe stop if he/she pushes the brake pedal to its maximum travel at the time when the incursion vehicle is first perceived. This concept provided the ability to test stopping brake effectiveness during emergency situations.

Based on the results presented in this report, the type of braking system had no statistical effect on driver behavior prior to braking. Driver behavior was assessed by studying reaction time to obstacle perception and brake pedal force.

The experiment used a validated virtual environment with high fidelity and showed systematically that professional drivers using either enhanced S-cam or air disc brake systems were better able to avoid collisions than those drivers using standard S-cam brakes. Also, drivers using air disc brakes avoided collisions more often and, in those cases where a collision occurred, had lower collision speeds than those using the enhanced or the standard S-cam brake systems.

1.0 INTRODUCTION

When heavy trucks are involved in crashes with light vehicles, it is the occupants of the light vehicle who are most often killed or seriously injured. Reducing the stopping distance of commercial vehicles should result in a decrease of both crashes and their severity. This study set up a driving simulator experiment which demonstrated that drivers of heavy trucks used more effective brakes to either avoid a collision or to collide with a significantly lower speed than they would with standard brakes.

1.1 BACKGROUND

According to the Federal Motor Carrier Safety Administration as edited by the National Highway Safety Administration (NHTSA) [1], in 2002 there were approximately 434,000 heavy trucks involved in police reported crashes; 4,542 of them resulted in fatalities. Seventy-nine percent of the fatalities were occupants of other vehicles.

NHTSA believes that reducing the FMVSS 121 (49 CFR Part 571) minimum stopping distance by twenty to thirty percent will result in saving a significant number of lives [1]. In generating benefit analyses for estimating the safety effects of improved truck brakes, assumptions have to be made. It has been assumed that if a tractor-trailer can stop in a shorter distance, then fewer crashes will result. Based on kinematics, it is reasonable to assume that if you can stop in a shorter distance it is more probable that a truck will avoid colliding with an object or it will at least collide with a reduced velocity. This theory holds true given that the operators' reaction times, control behavior, and their perceptions of available stopping distance remain constant.

Commercial truck drivers understand the braking ability of tractor-trailers and under most conditions drive accordingly. However, in the real world, truck drivers are faced with many adverse conditions in numerous scenarios brought about by other vehicles (light vehicles cutting in-lane, vehicles pulling out unexpectedly, etc.). When a crash-imminent situation occurs, the truck driver must decide to brake, brake and steer, steer, accelerate, or accelerate and steer. Depending on the control behavior adopted by the driver, there could be situations where improved brakes may have little or no effect on avoiding a collision or reducing the delta speed of a crash.

The primary objective of this study was to provide test data that demonstrates the effectiveness of improved brakes on heavy trucks. This test addressed whether shorter stopping distances reduce the number and severity of certain types of heavy truck crashes.

1.2 APPROACH

The effectiveness of improved brakes on heavy trucks is examined using three different brake system conditions and four simulator scenarios. The three different brake configurations were:

- Standard truck where S-cam brakes were used on all wheels
- Enhanced S-cam truck where only the steer axle was equipped with a higher capacity version of an S-cam brake
- Air disc truck where all the wheels of the tractor were equipped with air disc brakes.

The simulator scenarios were primarily based on those used in previous NHTSA Electronic Stability Control (ESC) research [2]. All simulated roads were built with a shoulder whose traction, vibration, and audio characteristics are different than the on-road pavement. This is to realistically simulate the environment that occurs when some of a vehicle's tires depart the roadway. The lanes were 12 feet (3.7 m) wide, there were 1.9 feet (0.58 m) of road between the white line (designating the outboard edge of the lane) and the shoulder, and the shoulder was 11.5 feet (3.51 m) wide. Beyond the shoulder, there was an additional 75 feet (23 m) of drivable terrain (see Figure 1.1). The scenarios took place on dry pavement. The virtual environment reflected conditions consistent with the pavement. In particular, the scene was clear and the pavement appeared dry.

The study used the NADS heavy truck cab and dynamics model [3, 4]. A typical 18-wheel tractor-trailer combination was selected with a gross weight of 73,100 pounds (33,200 kg). Stopping distance was reduced by 17% and 30% when the standard S-cam brake system was replaced by the enhanced S-cam and disc systems respectively.

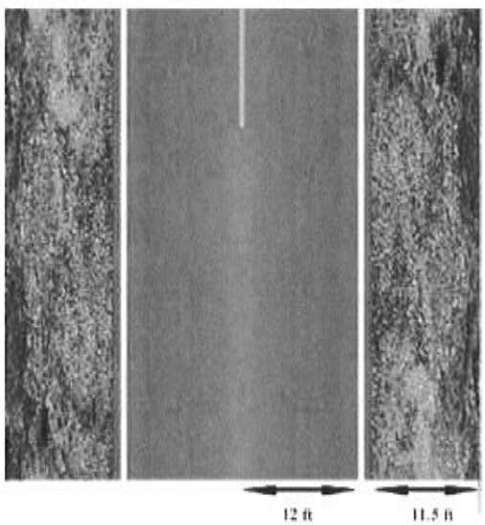

Figure 1.1 - Road Geometry

Truck drivers were recruited from local Iowa trucking companies as well as through radio and newspapers ads targeted at all truck drivers in the area. Participants consisted of drivers who held a valid Commercial Driver's License (CDL) and were between the ages of 22 and 55 (current statistics show that approximately 75% of all drivers involved in heavy truck crashes are between the ages of 22 and 55 and drove on average 2000 miles during the last 3 months). This ensured that participants were actively driving heavy trucks. The population of commercial vehicle drivers is comprised of mostly males, but no attempt was made to balance by gender. Participant pay in this experiment was comparable with a professional truck driver's hourly wage of $30 per hour plus incentive pay.

A repeated measures experiment design in which participants experienced multiple scenarios was used. Independent variables included brake system (3 levels: standard S-cam, enhanced S-cam, and air disc brakes) and event order (4 events were used, but only 3 events were fully

randomized, giving 6 levels; the fourth event was always last). A single age group was used (22-55). This design resulted in 18 experimental cells. To allow 6 repetitions of each event order per brake condition, 108 participants who would successfully complete all 4 events were needed. This recruiting goal was met. The principal measure for this study was whether the driver crashed or not. Secondary measures consisted of collision speed, stopping distance, reaction time to event start, and average deceleration. Other behaviors were tabulated such as if the driver braked, steered, and/or accelerated.

1.3 SCENARIO DESIGN

To understand the effectiveness of heavy truck improved brakes, scenarios were designed to emulate real world situations where heavy truck crashes are occurring. Dry asphalt pavement conditions were simulated. A total of four scenarios containing situations conducive to emergency braking were used. Events were presented to each participant as individual drives. Each participant drove all the scenarios. Each scenario was approximately five minutes in length and ended immediately after presentation of a conflict event. The scenarios were designed to have consistent entry speed (maintained through monetary incentives) for all participants and no downshifting during the event itself. They were also designed such that the driver could stop without hitting the target vehicle, if the brakes were applied immediately. The scenarios conflict events were:

1.3.1 Right Incursion

The goal of this event was to force the driver to apply brakes to avoid colliding with oncoming traffic. A vehicle that pulls out of a hidden driveway attached to a roadside farmhouse combined with carefully timed oncoming traffic created the conditions for such a maneuver (Figure 1.2). The driver approached a driveway that can hide a vehicle. The driver was motivated via monetary incentives to maintain the speed limit of 55 mph (89 kph). Parked vehicles on both shoulders prevented the driver from steering to avoid the oncoming traffic. When the driver was four seconds from arriving at the driveway location, the hidden parked vehicle pulled out from the right and stopped, blocking the right lane. Drivers who could not stop within the available distance would collide with the white incursion vehicle, the green oncoming car, the gray oncoming car, or the parked truck on the left shoulder.

1.3.2 Left Incursion

The goal of this event was to force the driver to react to an incursion from the left and to brake suddenly while traveling at highway speed. The driver was on a two-lane rural highway crossing a heavily wooded area with frequent oncoming traffic (Figure 1.3). The posted speed limit was 55 mph (89 kph) and the driver was motivated via monetary incentives to maintain speed. There were several parked vehicles on both shoulders. As the driver approached the location of the event, one of the oncoming vehicles was tasked to arrive at the event location at a fixed relative position to the driver. Oncoming traffic approached a parked vehicle on the shoulder opposite to the driver's side. That parked vehicle began moving and cut off the oncoming traffic which was then forced to steer into the driver's lane. The oncoming traffic would enter the driver's lane at a fixed time-distance, 8 seconds away from the driver. Concrete barriers were placed on the right

side so that the driver would not steer to the shoulder. If the driver could not stop within the available distance, the driver would collide with the oncoming red SUV, oncoming traffic in the left lane, or the concrete barriers.

1.3.3 Stopped Vehicle

The goal of this event was to force the driver to react to an obscured stopped vehicle on the highway. The driver was on a 4-lane rural highway traveling at the posted speed limit of 70 mph (110 kph) (Figure 1.4). There was a steady stream of traffic in the adjacent lane as well in the oncoming lanes. Once the driver achieved the posted speed limit, a delivery truck sped past, made a right lane change into the driver's lane, and became the lead vehicle as well as the obscuring vehicle. The lead vehicle maintained a distance of 400 ft (122 m) in front of the driver. When the participant was 610 ft (186 m) from a stopped vehicle, the lead vehicle made a lane change into the stream of traffic in the adjacent lane revealing the stopped vehicle. The driver could collide with the stopped vehicle, traffic traveling in the same direction in the adjacent lane, or oncoming traffic in the far lanes. Because this was the most severe stop, it was always the last scenario for each driver.

1.3.4 Stopping Vehicle

The goal of this event was to force the driver to react to an abruptly stopping lead vehicle while traveling at 55 mph (89 kph). There was a continuous flow of oncoming traffic throughout the event and there were barricades and construction vehicles parked along the right side of the road. These barricades and parked vehicles constrained the driver from steering off-road during the braking event (Figure 1.5). The driver was on a two-lane rural highway crossing a heavily wooded area with frequent oncoming traffic. The posted speed limit was 55 mph. As the driver was moving along, a vehicle approached the truck from behind. As the driver cruised along, the following vehicle made a lane change and overtook the truck. It entered the driver's lane and maintained a distance of 132 ft (40 m) for approximately 2100 ft (640 m) before it decelerated at the rate of 0.75 g to a complete stop. The driver was precluded from steering via construction barriers on the edge of driver's lane and oncoming traffic in the adjacent lane. A collision could happen with the stopping green lead vehicle, oncoming traffic, or the concrete barriers.

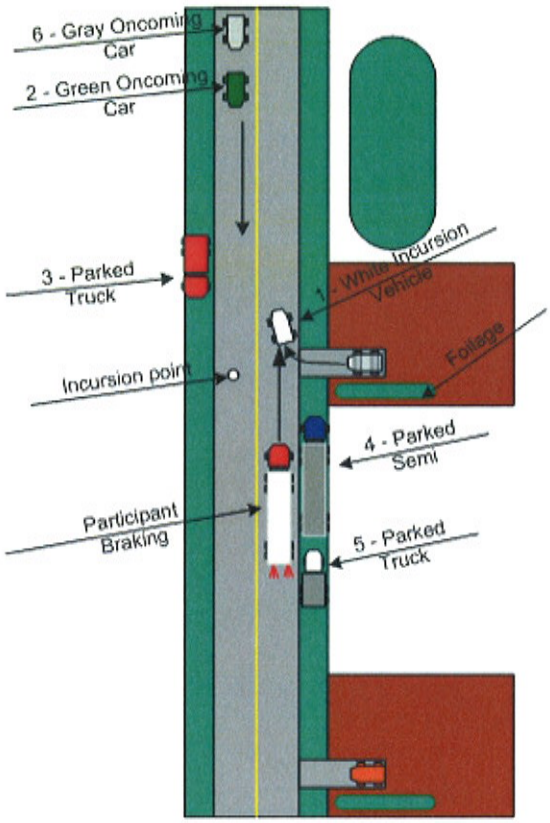

Figure 1.2 - Right incursion

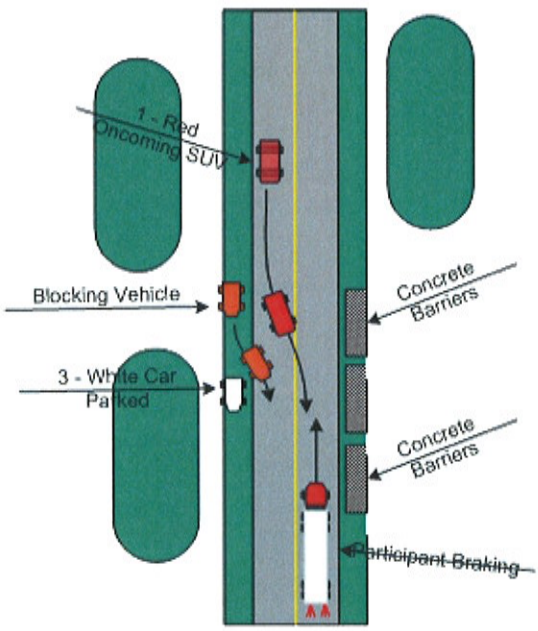

Figure 1.3 - Left incursion

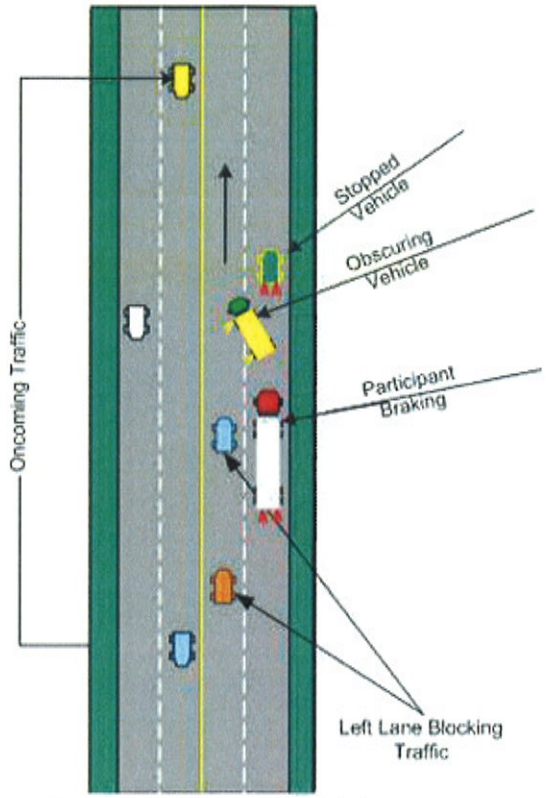

Figure 1.4 - Stopped vehicle

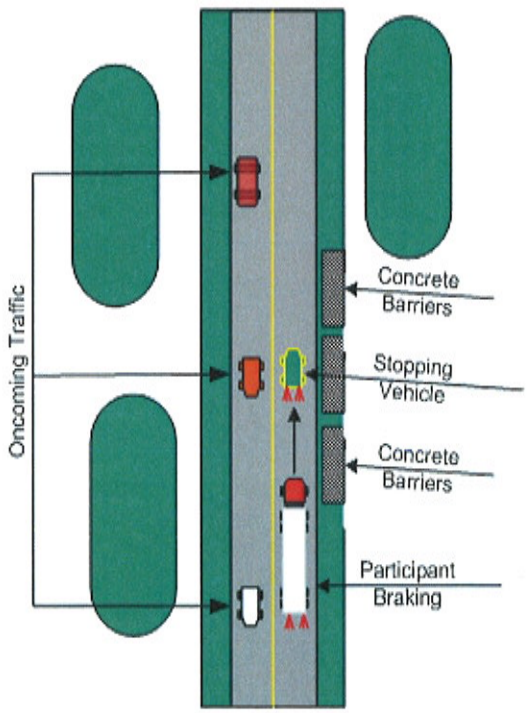

Figure 1.5 - Stopping vehicle

2.0 APPARATUS

The experiment was performed at the NADS facility, located at the University of Iowa's Oakdale Research Park in Coralville. The simulator hardware is described below. Modifications were required to be made to the vehicle dynamics software, in particular to the braking subsystem.

2.1 SIMULATOR

NADS consists of a large dome in which an entire vehicle cab (e.g., cars, trucks, and buses) can be mounted. The dome is mounted on a 6-degree-of-freedom hexapod, which is mounted on a motion system, which provides 65 feet (20 meters) of both lateral and longitudinal travel. There is a yaw degree of freedom between the hexapod and the dome, which allows 330 degrees of yaw rotation. The NADS motion system has a total of 9 degrees of freedom as shown in Figure 2.1. To simulate high frequency road disturbances and high frequency loads through the tires and suspension, NADS contains four vibration actuators, mounted at points of suspension-chassis interaction. These vibration actuators are mounted between the floor of the dome and vehicle, and they act only in the bounce direction of the chassis. The vehicle driven controls and displays inside the cabs are electronically and mechanically active (Figure 2.2). The driver is immersed in sight, sound, and movement so real that impending crash scenarios can be convincingly presented with no danger to the driver (Figure 2.3). The NADS capabilities were evaluated by independent simulation experts [5], and the truck system was evaluated by professional drivers [6]. This independent professional assessment of the system provides confidence on the level of realism that can be concluded from the simulator research results.

The Visual System provides the driver with a realistic 360-degree field-of-view, including the rearview mirror images. The driving scene is 3-dimensional, photo-realistic, and correlated with other sensory stimuli. The image generator is capable of rendering 10,740,736 pixels at a frequency of 60 Hz. The Visual System database includes representations of highway traffic control devices (signs, signals, and delineation), 3-dimensional objects that vehicles encounter (potholes, concrete joints, pillars, etc.), common intersection types (including railroad crossings, overpasses, bridge structures, tunnels, etc.), and various weather conditions. In addition, high density, multiple-lane traffic can be made to interact with the driver's vehicle. The visual display timing is real time. The time delay between the driver input and the visual display is less than 50 milliseconds. This eliminates driver overshoot reactions and possible instability as a result of time delay within a closed-loop environment. An advanced compensator was developed and installed into NADS to keep the visuals and drivers input in phase [7]. The compensator is similar in capabilities to what is used by NASA at their simulator research facilities [8]. The heavy truck visuals are different from those of passenger vehicles due to the inclusion of the trailer visual display. The truck driver is able to see the trailer from the driver's side mirror, which accurately reflects the rear view of the truck. This is made possible by adjusting the rear image channel to compensate for the curvature of the dome and the offset placement of the mirror. This capability is unique to the NADS due to its 360-degree horizontal field of view capacity.

The Control Feel System (CFS) for steering, brakes, clutch, transmissions, and throttle realistically controls reactions in response to driver inputs, vehicle motions, and road/tire interactions over the vehicle maneuvering and operating ranges. The CFS is capable of

representing automatic and manual control characteristics such as power steering, existing and experimental drivetrains, antilock brake systems (ABS), and cruise control. The control feel cuing feedback has high bandwidth and no discernible delay or distortion associated with driver control actions or vehicle dynamics.

The Motion System provides a combination of translational and angular motion that duplicates scaled vehicle motion kinematics and dynamics with nine degrees of freedom. The Motion System is coordinated with the CFS to provide the driver with realistic motion and haptic cuing during normal driving and pre-crash scenarios. The motion system is configured and sized to correctly represent the specific forces and angular rates associated with vehicle motions for the full range of driving maneuvers. The washout algorithm that is used to generate dynamic specific forces (acceleration at the driver's head with gravity effect) and cab orientation rates is tuned using high sensitivity cuing with a washout scaling of forty-five percent.

In addition, four actuators located at each wheel of the vehicle provide vertical vibrations that simulate the feel of a real road (Figure 2.4). NHTSA's Vehicle Research and Test Center (VRTC) measured cab vibrations of a GM-Volvo tractor owned by NHTSA. The vibrations were measured at different engine speeds. Four accelerometers with a maximum capacity of ±4 g were mounted vertically on the truck floor, dashboard, driver seat (actually beneath the seat), and steering handwheel. These measurements provided information regarding the location of the fundamental frequencies and the magnitude associated with the vibration feel inside the cab. Harmonic functions that closely replicate the frequencies and magnitude levels (vibration energy) were derived and used to drive the vertical actuators. This method allowed the vertical vibrations to be reproduced with great fidelity inside the cab. The frequency content of these vibrations extended higher than the bandwidth of the hexapod and dome longitudinal and lateral motions. The intensity of these modes at different speeds were measured at VRTC, and in NADS the vibration cues that best represented the speed of the scenarios have been implemented. Figure 2.5 shows the power spectrum of the truck cab vibration felt at the NADS dome. The 2-Hz frequency is related to truck bounce mode, the 5-8 Hz frequencies are related to axle mode, 10-12 Hz frequencies are related to cab modes, and the 17-25 Hz frequencies are related to engine and power train modes.

A manual transmission with low and high gear range selection was used for this study (Figure 2.6). Before drivers were engaged in the scenarios, they were given ample time (about twenty minutes) to drive and get familiar with the transmission system. Drivers demonstrated different skill levels; however, none of the scenarios involved in this study required transmission shifting during the braking event.

The cab steering system was calibrated and the controls were tuned to provide a close steering feel for both on-center and turning maneuvers. VRTC measurements provided the torque-steer curve and the amount of freeplay currently existing in the GM-Volvo truck.

The NADS truck cab system is equipped with a pneumatic brake hardware system. VRTC measured actual brake feel from the GM-Volvo truck and calibrated the NADS cab to reflect accurate brake pedal feel.

The Auditory System provides motion-correlated, three dimensional, realistic sound sources that are coordinated with the full ranges of the other sensory systems' databases. The Auditory System also generates vibrations to simulate vehicle-roadway interaction. The auditory database includes sounds emanating from current and newly designed highway surfaces, from contact with three-dimensional objects that vehicles encounter (potholes, concrete-tar joints, etc.), from other traffic, and from the vehicle during operation, as well as sounds that reflect roadway changes due to changing weather conditions. VRTC measured the engine sound of the GM-Volvo truck at different engine speeds and provided the data to NADS to be displayed in real time and coordinated with the engine speed.

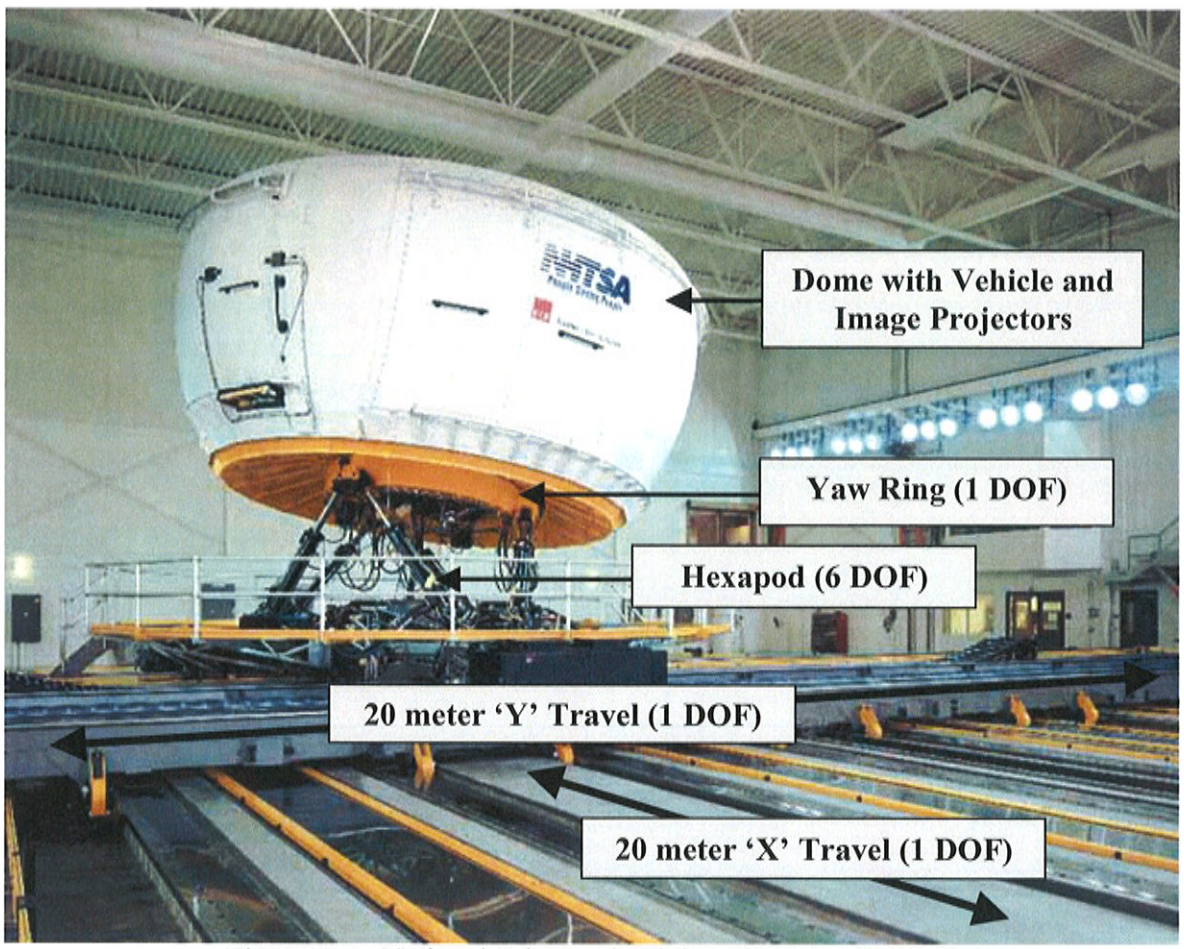

Figure 2.1 - National Advanced Driving Simulator (NADS)

Figure 2.2 - Freightliner cab interior

Figure 2.3 - Truck cab in the NADS dome

Figure 2.4 - Truck cab showing vertical actuator for vibration cues

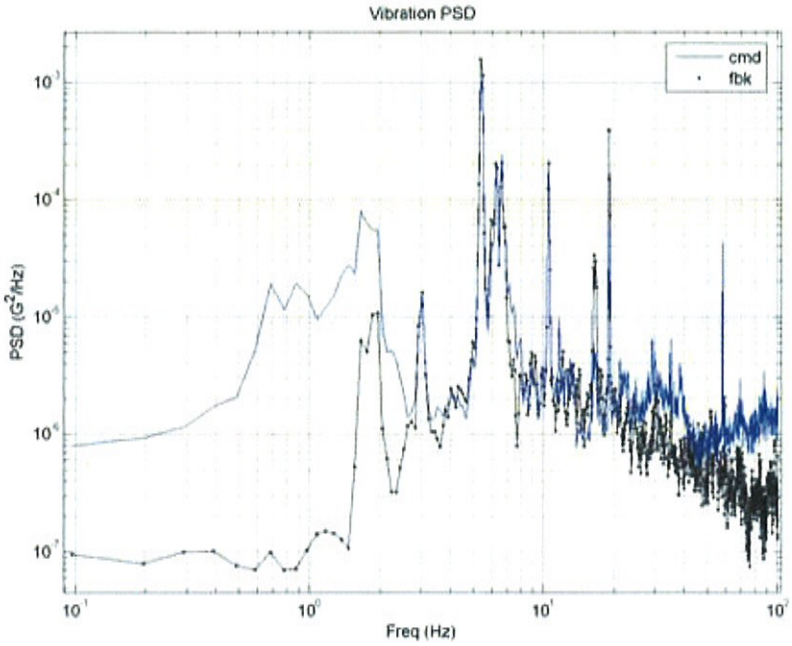

Figure 2.5 - Vibration power spectrum measured on the NADS cab (commanded and measured)

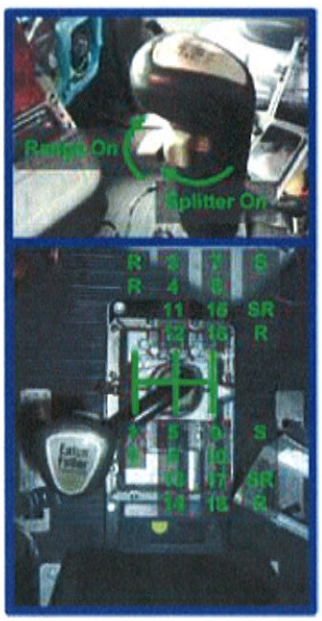

Figure 2.6 - Truck cab shifting

2.2 VEHICLE DYNAMICS AND BRAKE SYSTEM MODELS

The NADS vehicle dynamics computer simulation (NADSdyna) determined vehicle motions and control feel conditions in response to driver control actions, road surface conditions, and aerodynamic disturbances. Vehicle responses were computed for commanding the Visual, Motion, Control Feel, and Auditory Systems.

The vehicle dynamics model used in this project was developed by VRTC for the 1992-GMC truck manufactured by Volvo GM Heavy Truck, model WIA64T and a 1992 Fruehauf trailer model FB-19.5NF2-53 [3, 4]. Appendix C contains additional information on the S-cam, enhanced S-Cam, and air disc brake models developed for this study. Appendix D contains additional information regarding the measurement and modeling of the cab vibrations.

The torque characteristics of commercial vehicle brakes have been studied by numerous investigators. A brake model formulation based on fundamental understanding of the development of the instantaneous brake torque as influenced by pressure, temperature, sliding velocity, work history, temperature gradients, and other factors has not yet been achieved. Recent research has modeled brake effectiveness as empirical functions. The brake models used in NADS are primarily empirical, based on fitting experimental data obtained from brake dynamometer and field test data (Figure 2.7).

The objective of this research was to study the functional effects of three different brake configurations. The brake parameters were set such that severe braking from 60 mph (97 kph) provides a stopping distance of 307 ft (93.6 m) for standard S-cam brakes, 256 ft (78.0 m) for enhanced S-cam brakes, and 215 ft (65.5 m) for air disc brakes (as shown in Figure 2.8). This is a reduction of stopping distance of 17% and 30% if the standard S-cam brake system is replaced with the enhanced S-cam and disc systems respectively. In this study all these systems were integrated into the same tractor-trailer model [9].

Information on the NADS data and video collected during this study are contained in Appendix E. Appendix F contains a report of a consultants' visit to NADS prior to this study. This report contains a review of NADS subsystems with particular emphasis on the NADS control feel steering and braking systems (CFS).

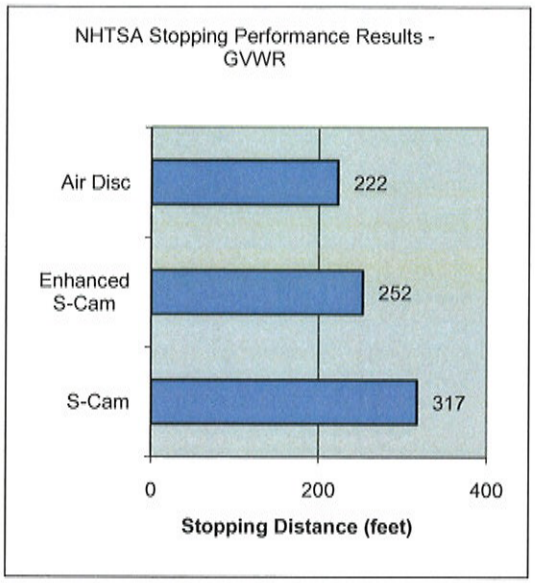

Figure 2.7 - Brake performance measured by VRTC for a typical tractor-trailer with different brakes

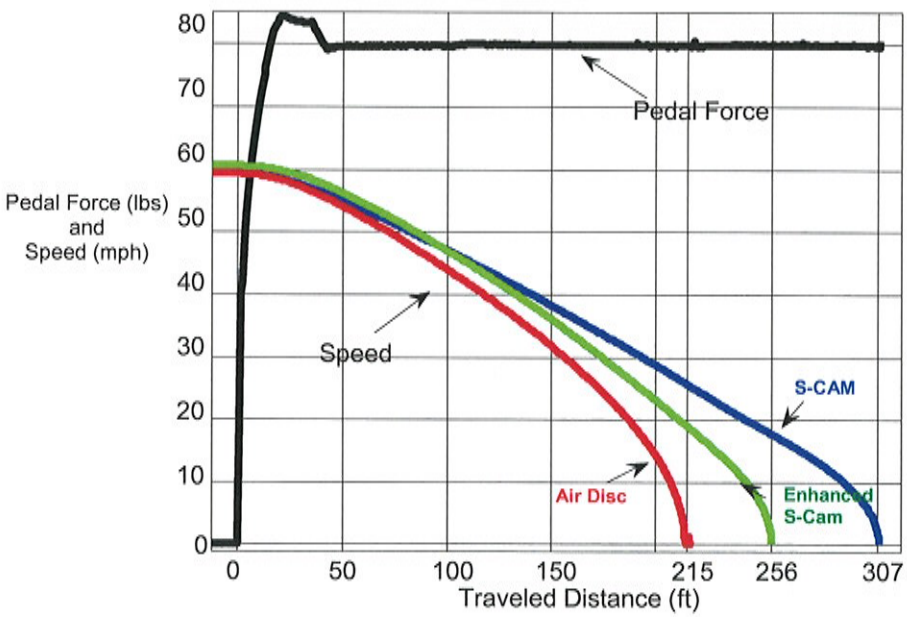

Figure 2.8 - Brake performances on NADS

3.0 PROCEDURE

The total number of participants in this study was 108. Upon arrival at the NADS facility, participants were given a verbal overview of the Informed Consent Document and were then asked to read and sign the document. Next, the participants completed the NADS Driving Survey and were given instructions on the monetary incentive scheme. Participants were assigned a single brake system condition for their participation. The order of scenario presentation was varied systematically across participants.

Appendix B contains a more detailed description of the simulator study protocol. This protocol contains an overview description of each of the three brake systems used in this study.

Prior to beginning treatment drives, participants received a familiarization practice drive. This drive provided them experience with the vehicle's brake system's capabilities, and also familiarity with shifting the transmission.

After each scenario drive, participants were told the amount of incentive they earned and the amount was recorded on a data sheet. After all driving was completed, participants completed the simulator sickness questionnaire. After the simulator was docked, the participant was escorted to the participant prep area, offered a snack or beverage, and given an opportunity to ask questions. Participants completed a realism survey and a post-drive questionnaire.

Finally, the participant was paid an amount consisting of the sum of the base pay plus incentive pay. The participant signed the payment voucher, describing how compensation was related to driving performance. The participant was then escorted to the exit.

Drivers were given incentives to maintain a constant velocity within ± 3 mph (5 kph) of the target speed. A driver could earn a total $3.00 per drive based on the percentage of time that his or her speed remained within the specified range. Generally, a short period immediately after the scenario start and the event itself were excluded from this calculation.

4.0 DATA REDUCTION

Each event was divided into six segments using seven different time points. These time points were T0 (trigger activated) through T6 (event completion), and they are defined in Table 4.1. T1 was defined differently for each event (see Table 4.2). Event completion at T6 was determined by evaluating several conditions, described in Table 4.3. The condition that was met first was used to set T6. This condition was called endCond.

Table 4.1 Definition of event time points

Time	Description
T0	T0 was when the subject activated the event trigger
T1	T1 was when the driver can first perceive the beginning of the event (see Table 4.2)
T2	T2 was the initiation of accelerator pedal release (when the current accelerator pedal position is less than 90% of the mean pedal position over the last 1 second)
T3	T3 was the completion of accelerator pedal release (when accelerator pedal position dropped below 5% of the full pedal position range)
T4	T4 was the initiation of brake pedal depression (when brake pedal force exceeded 2.0 pounds)
T5	T5 was the application of maximum brake pedal force
T6	T6 was the completion of the braking event
endCond	Condition used to determine T6 (see Table 4.3)

Table 4.2 Definition of T1 for each event

Event	Definition
Right	When the corner of the incursion vehicle first becomes visible from behind the occlusion vehicle
Left	When the oncoming vehicle began its lane change into the subject's lane
Stopped	When the lead vehicle begins the lane change that reveals the stopped vehicle
Stopping	When the lead vehicle begins to decelerate

Table 4.3 Conditions which defined the end of the event

endCond	Definition
1	Subject stopped (velocity is < 0.1 ft/s)
2	Subject acceleration averaged over 1 sec was greater than -0.5 ft/s^2 after braking response began
3	Right incursion vehicle stopped (The stopping of the incursion vehicle after it had entered the driving lane occurred instantaneously so the end of the event is defined immediately before this occurred)
4	None of the other conditions met; use the end of the data file

The following variables were collected:

- longitudinal distance between each event,
- velocity and acceleration at each event,
- gear shift position,
- accelerator pedal position,
- brake pedal force,
- steering wheel angle at each Ti,
- reaction time between events,
- braking distance from T4 to T6,
- total stopping distance from Tl to T6,
- maximum brake pedal force (brake pedal force at T5),
- mean and median brake pedal force from T4 to T6,
- mean deceleration rate,
- maximum deceleration rate,
- time from T1 to maximum deceleration,
- maximum absolute value of steering wheel angle from Tl to T6,
- time to collision at Tl (assuming driver's speed does not change before collision occurrence),
- distance to collision object at Tl,
- final distance to collision object at T6,
- collision (1 = yes, 0 = no),
- collision object name,
- collision velocity (relative velocity at time of collision),
- heading angle of tractor at each Ti,
- articulation angle at each Ti,
- maximum articulation angle,
- time of maximum articulation angle from T1,
- tractor accelerations in x, y, and z directions at each Ti,
- trailer accelerations in x, y, and z directions at each Ti,
- tractor yaw rate at each Ti,
- and trailer yaw rate at each Ti.

Collisions with other vehicles were enumerated for each scenario. Collisions could occur with a single oncoming vehicle or with vehicles parked alongside the road. To provide better discrimination as to the meaning of collisions, the reduced data contained individual indicators of collision with each vehicle in each scenario.

5.0 RESULTS

One of the main performance measures for the testing was the number of crashes (collisions) that occurred for each brake type and scenario. For those simulator runs that resulted in crashes, the truck collision speed in the crash was also evaluated as a performance measure of crash severity. In addition to crash occurrences and crash severity, each event was analyzed separately using a similar statistical approach based on comparing drivers' reaction times, speeds at the onset of the braking, stopping distances, braking distances, mean and maximum brake pedal forces, and mean and maximum decelerations.

The hypothesis of this experiment was that there were more collisions (and with higher collision speed) with the S-cam brakes than with the other two systems. Truck collision speed is an indication of the collision severity; higher speeds indicate higher kinetic energy and consequently, higher severity collisions. Collision delta speed that is usually used in analyzing crash severity is the truck collision speed minus the speed of the vehicle (or obstacle and in this case is zero). The higher the truck collision speed the higher the delta speed.

After the experiment was completed, a problem with trigger event was discovered in the stopped event scenario. In 14 of these runs, the trigger was delayed such that the driver was too close to the leading vehicle to have enough time to brake effectively to avoid a collision. These runs were eliminated from the analysis leaving 94 runs for the stopped event scenario.

Table 5.1 summarizes the number of collisions that occurred with the incursion vehicles during each scenario for each brake type. There were 108 subjects in this study, which were divided into 3 groups of 36 subjects, each group assigned to a different brake type. Each subject drove all 4 scenarios. Table 5.1 includes the number of collisions that occurred for each scenario and for each brake type. The right incursion scenario resulted in only 3 collisions, the left incursion resulted in 28 collisions, the stopped event resulted in 37 collisions, and the stopping event resulted in 43 collisions. Clearly the right incursion scenario is less likely to result in a collision and the stopped and stopping scenarios are most likely to result in a collision. Comparing these numbers to real world data [10], the right incursion event occurred in 0.5% of all heavy truck multivehicle crashes, the left incursion 4.5%, the stopped event 4.2%, and the stopping event 2.9%. Table 5.1 indicates that more collisions with the incursion vehicles occurred with the S-cam brakes (51 collisions) than the other brake types. The total number of collisions for the enhanced S-cam brakes (31 collisions) is greater than those for the air disc brakes (29 collisions).

Table 5.1 Summary of number of collisions with incursion vehicles

	S-Cam	Enhanced S-Cam	Air Disc	Total Collisions per Scenario
Right Incursion	2	1	0	3
Left Incursion	13	4	11	28
Stopped Event	14	17	6	37
Stopping Event	22	9	12	43
Total Collisions per Brake Type	51	31	29	111

Table 5.2 contains a summary of the collisions by percentage of the total number of runs for each condition. The 108 drivers each drove 4 scenarios resulting in a total of 418 runs (after eliminating the 14 problem runs from the stopped event). Therefore, the 111 collisions represent 26.6% of the total number of runs.

Table 5.2 Summary of collisions by percentage of total runs

	S-Cam	Enhanced S-Cam	Air Disc	Total Collisions per Scenario
Right Incursion	5.6%	2.8%	0.0%	2.8%
Left Incursion	36.1%	11.1%	30.6%	25.9%
Stopped Event	43.8%	56.7%	18.8%	39.4%
Stopping Event	61.1%	25.0%	33.3%	39.8%
Total Collisions per Brake Type	36.4%	22.5%	20.7%	26.6%

Figures 5.1 and 5.2 show bar graphs representing the total number of collisions per brake type and for each brake type and scenario, respectively. These are graphical representations of the data provided in Tables 5.1 and 5.2.

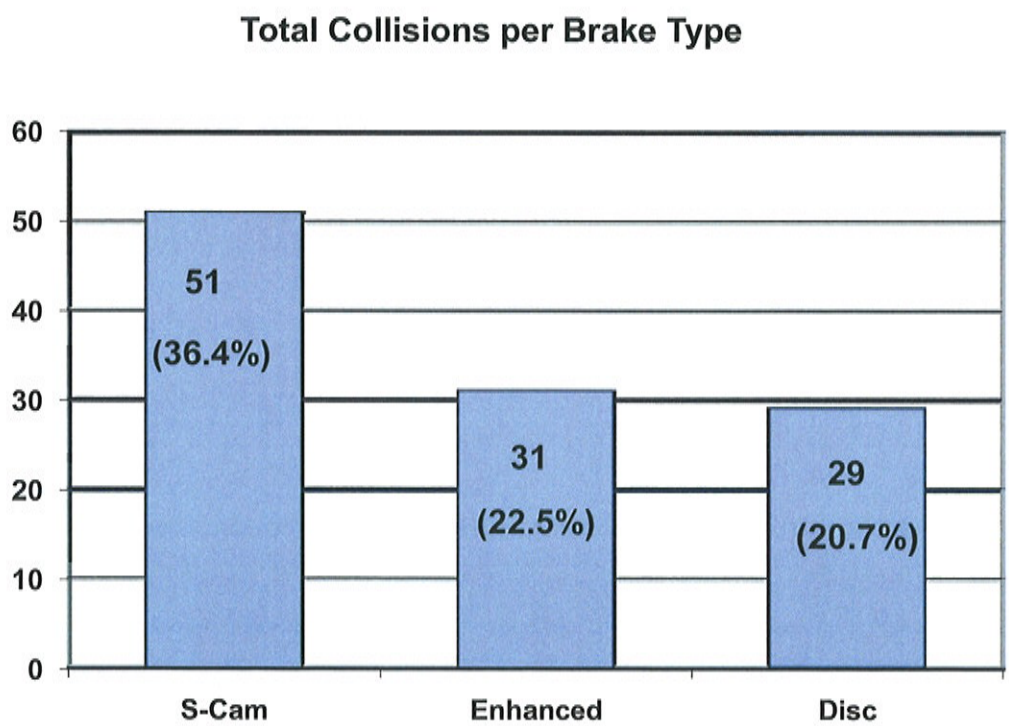

Figure 5.1 - Total number of collisions per brake type

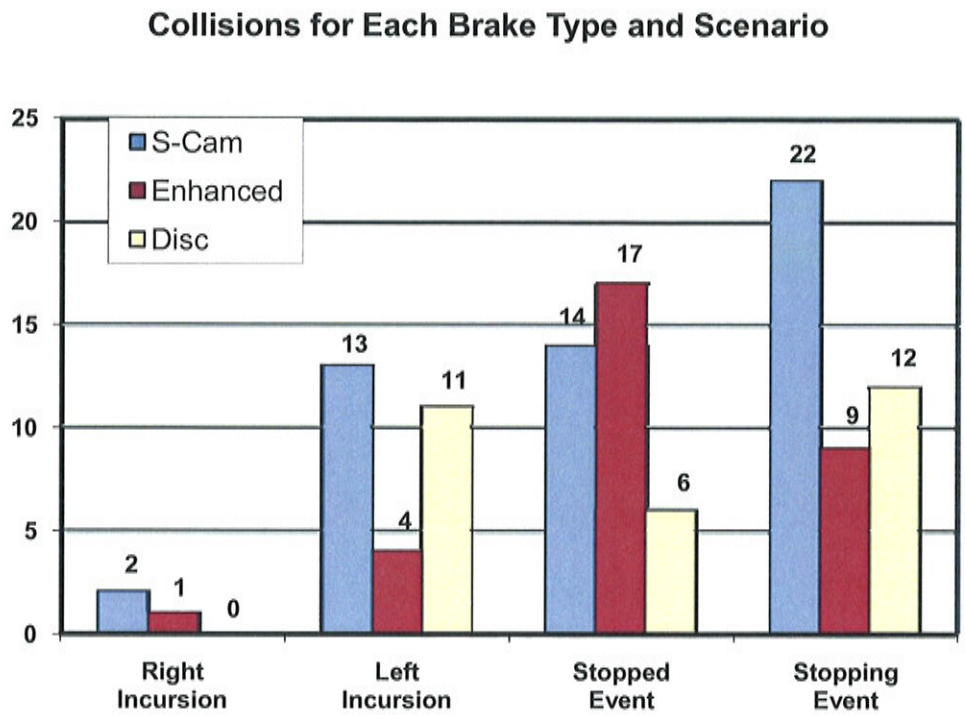

Figure 5.2 - Total number of collisions for each brake type and scenario

Table 5.3 contains mean collision speeds and the difference in vehicle speeds between the striking vehicle and the struck vehicle (delta-v) for all three brake types that occurred during the left incursion, stopped event, and stopping event, whereas Figure 5.3 is a bar graph representation of this data. Delta-v can be used to determine the severity of injury for occupants in the struck vehicle. The right incursion mean collision speed data are not included in this table and graph, as there were only three collisions during the right incursion so a comparison of the mean collision speeds for this case would be meaningless. The left incursion results in a head-on collision; that is why delta-v is larger than the collision speed. In the last two scenarios, the struck vehicle was either stopped or moving in the same direction as the truck. The rightmost column of Table 5.3 contains the p-value determined from the multi-factor analysis of variance (ANOVA) used to compare the means of the observations. P is the probability that the type of brake system has no effect on the variable. A p-value near zero suggests that at least one sample mean is significantly different from the other sample means. Specifically, a p-value less than or equal to 0.05 indicates a statistically significant difference attributed to the type of brakes.

Table 5.3 Mean collision speed and mean delta-v for collisions with struck vehicles (mph)

	S-Cam	Enhanced S-Cam	Air Disc	P
Left Incursion	24.2 (38.7)	23.3 (37.6)	17.2 (31.4)	0.27
Stopped Event	32.0 (32.0)	25.4 (25.4)	23.4 (23.4)	0.02
Stopping Event	23.0 (23.0)	18.9 (18.9)	15.7 (15.6)	0.07

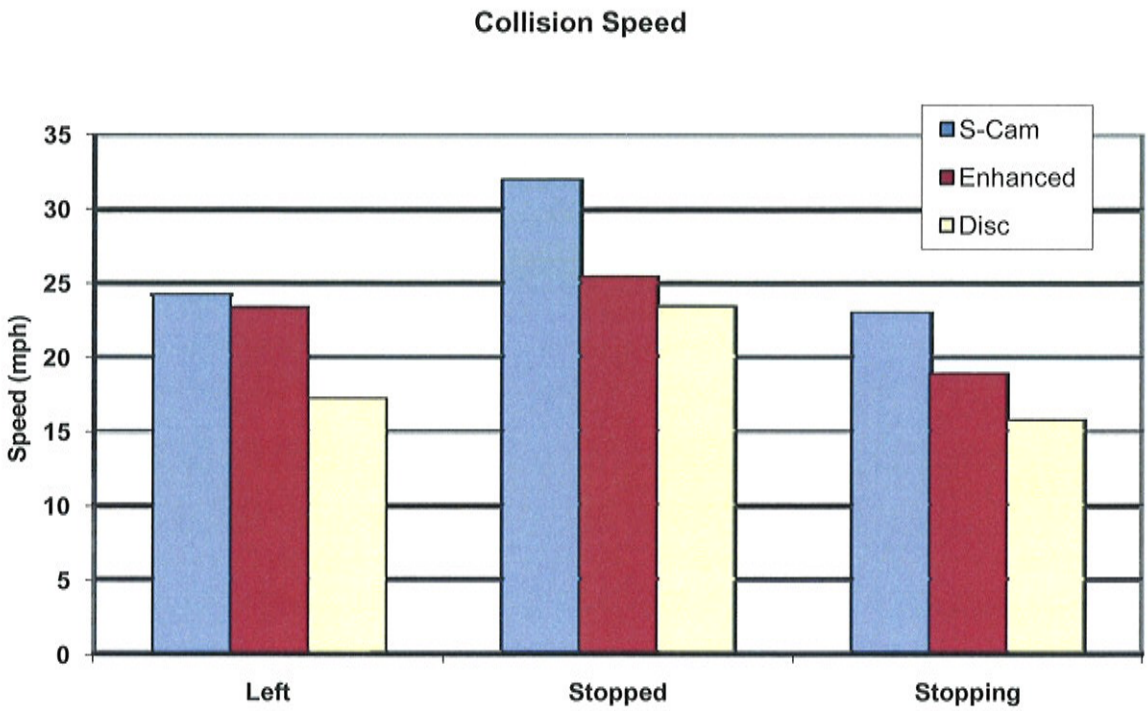

Figure 5.3 - Mean collision speed

The mean collision speeds and the mean delta-v are highest with the S-cam brakes. For the left incursion and the stopping event, the mean collision speed of the three different brake types is not significantly different (at 95-percent confidence), although the trend shows a reduction in collision velocity from S-cam to enhanced S-cam to air disc brakes. For the stopped scenario, there is a statistically significant difference in the mean collision speeds.

Figures 5.4, 5.5, and 5.6 contain comparison graphs showing the mean values and 95% confidence intervals on the mean values for each brake type mean collision speed for the left incursion, stopped event, and stopping event, respectively. Confidence intervals were calculated using the Tukey-Kramer multiple comparison method on the previously calculated ANOVA results. In these mean comparison graphs, if the confidence intervals on a pair of mean values do not overlap, there is 95% confidence that the mean values are different. For the stopped (Figure 5.5) scenario, the bands of the S-cam and enhanced S-cam brakes do not overlap. This implies that the difference in collision velocity is statistically significant. For both the stopped (Figure 5.5) and the stopping (Figure 5.6) scenario, the confidence band for the standard S-cam and the air disc brakes just barely overlap. Whereas this implies that the mean collision speeds do not differ significantly (at 95% confidence), an increase in the number of samples would likely make this difference between the two brake types significant.

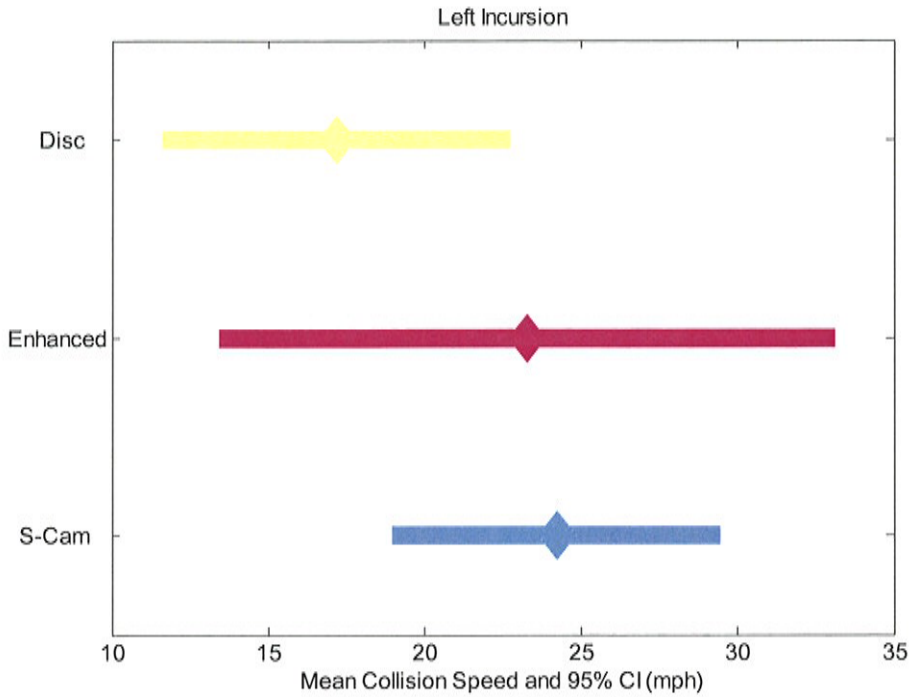

Figure 5.4 - Left incursion mean collision speed

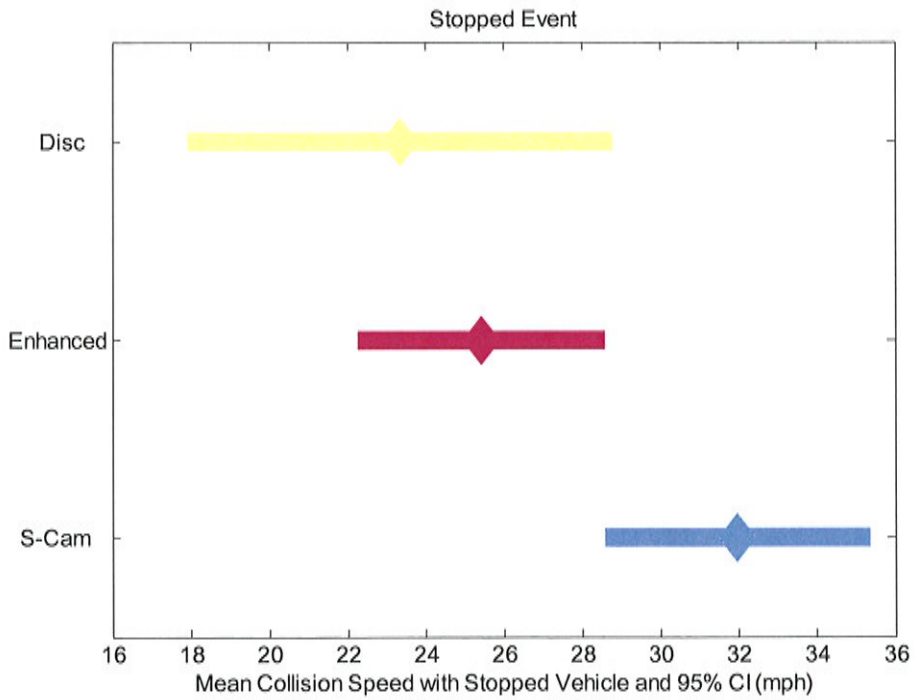

Figure 5.5 - Stopped event mean collision speed

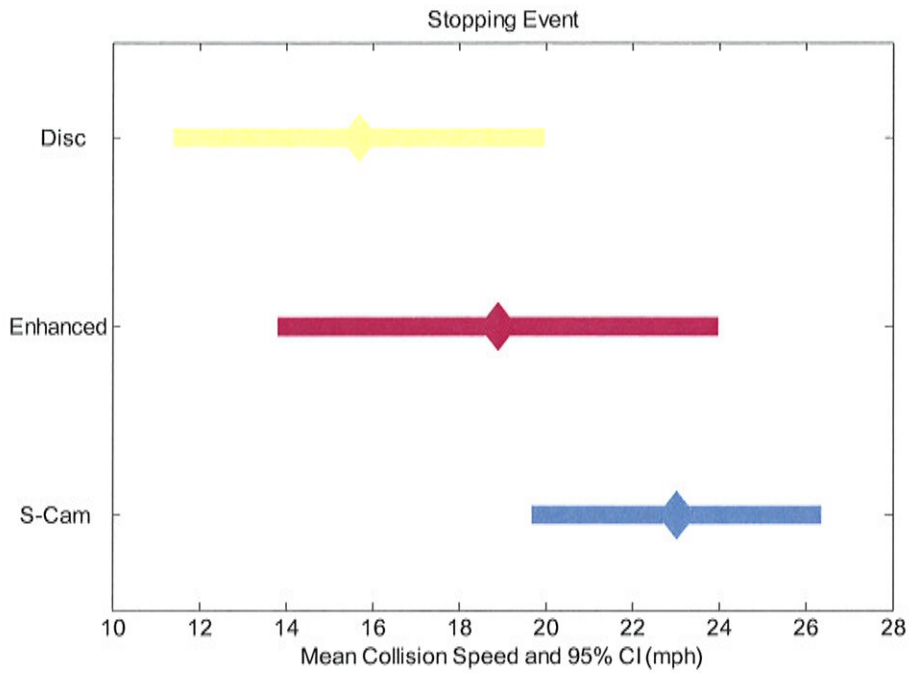

Figure 5.6 - Stopping event mean collision speed

Table 5.4 summarizes the number of non-collision events analyzed for each brake type and scenario. Except for the stopped event, the number of non-collisions per scenario is equal to the total number of runs for each scenario (108) less the number of collisions with the incursion vehicles. During the stopped event scenario, a total of 5 collisions (1 with S-cam brakes, 1 with enhanced S-cam brakes, and 3 with air disc brakes) occurred with objects other than the incursion vehicle. As explained above, only 94 runs were analyzed for this scenario.

The second row of Table 5.4 contains the number of runs during each scenario that were excluded from the analyses because the speed at the onset of the event was not within 10 mph of the target speed (nominal entry speed). Because braking and stopping distances are directly related to vehicle speed, runs in which the speed at the onset of braking differ greatly from the target speed were eliminated to avoid biasing the data. The range of 10 mph was chosen to keep the onset speeds clustered without eliminating too many of the runs, which would weaken the statistical analysis of the results. A total of 5 non-collision runs were excluded from the analyses as a result of being speed outliers.

In an effort to generate meaningful performance measures, it was necessary to analyze results from comparable simulator runs. Table 4.3 lists the end conditions that were used to define the end of the scenario events. To meaningfully analyze braking and stopping distances, brake pedal forces, and decelerations it was necessary to consider runs that stopped under the same end condition. Only runs that were terminated by end condition (endCond) 1 (vehicle was braked to a stop) were included in the non-collision analyses. The last three rows of Table 5.4 indicate the

number of S-cam, enhanced S-cam, and air disc brake runs that were included in the analyses for each scenario.

Table 5.4 Summary of non-collision runs used in non-collision analyses

	Right Incursion	Left Incursion	Stopped Event	Stopping Event
Number of Non-Collisions	105	80	52	65
Number of Speed Outliers (Not Within 10 mph of Target Speed)	3	1	0	1
Number of Non-Collisions with Speed OK	102	79	52	64
Number of Non-Collisions with Speed OK and with endCond = 1	49	56	32	48
Number of S-Cam Included in Analyses	14	16	9	9
Number of Enhanced S-Cam Included in Analyses	21	23	9	21
Number of Air Disc Included in Analyses	14	17	14	18

To reliably compare the three brake systems for each braking event scenario, it is necessary to evaluate driver performance characteristics to make sure that the drivers performed similarly in the scenarios regardless of which brake type they were using. Driver reaction time and vehicle speed at braking onset were the performance characteristics evaluated. Driver reaction time is defined here as the time from event onset (T1) to the time when braking started (T4).

Figures 5.7-5.10 contain box plot graphs of the driver reaction times for each scenario, whereas Figures 5.11-5.14 contain box plot graphs of vehicle speed at braking onset for each scenario. For each box plot graph, the results for the individual brake types are displayed using box and whisker plots. The lower and upper lines of each "box" are the 25th and 75th percentiles of the sample. The distance between the top and bottom of the box is the inter-quartile range. The line in the middle of the box is the sample median. If the median is not centered in the box, this is an indication of skewness in the data sample.

The "whiskers" are lines extending above and below the box. They show the extent of the rest of the sample (unless there are outliers). If there are no outliers, the maximum of the sample is the top of the upper whisker. The minimum of the sample is the bottom of the lower whisker. By default, an outlier is a value that is more than one and a half times the inter-quartile range away from the top or bottom of the box. Outliers are indicated by a "+" symbol. Outlier points are results of variations in driver perception and/or reactions and responses.

The notches in the box are a robust graphic confidence interval about the median of a sample. A side-by-side comparison of two notched box plots provides a graphical way to determine which groups have significantly different medians. For boxes whose notches do not overlap, one can

conclude, with 95% confidence, that the true medians do differ. This is similar to a one-way analysis of variance, except that the latter compares means.

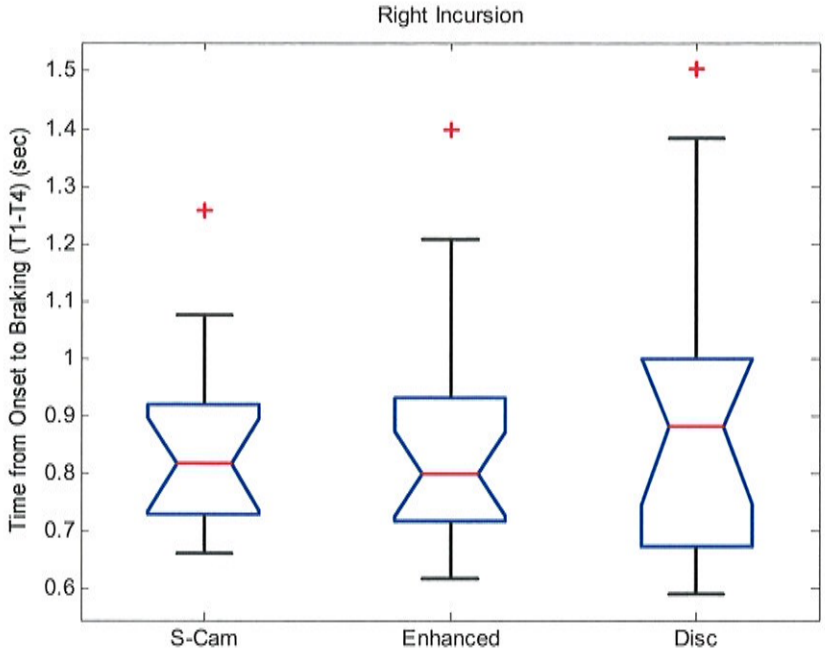

Figure 5.7 - Reaction times during right incursion scenarios

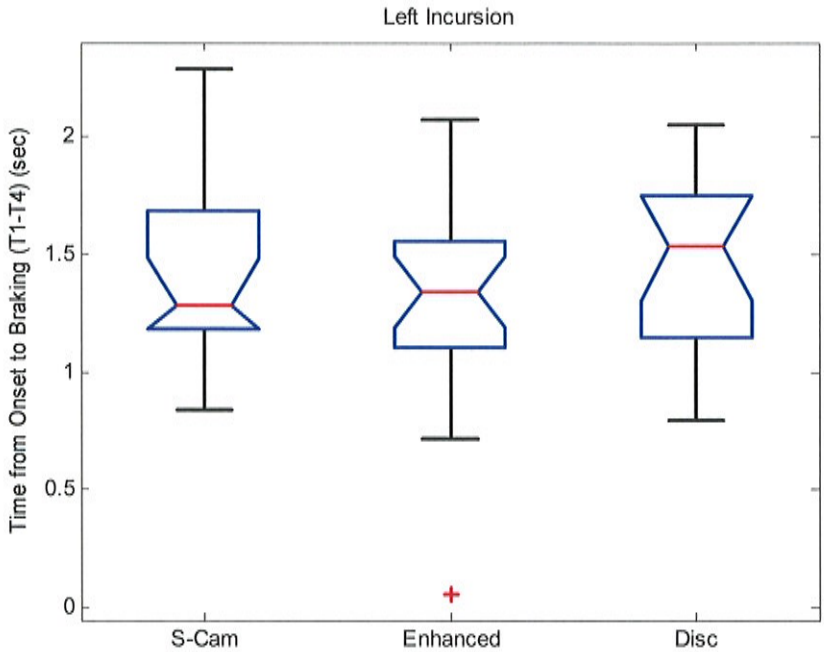

Figure 5.8 - Reaction times during left incursion scenarios

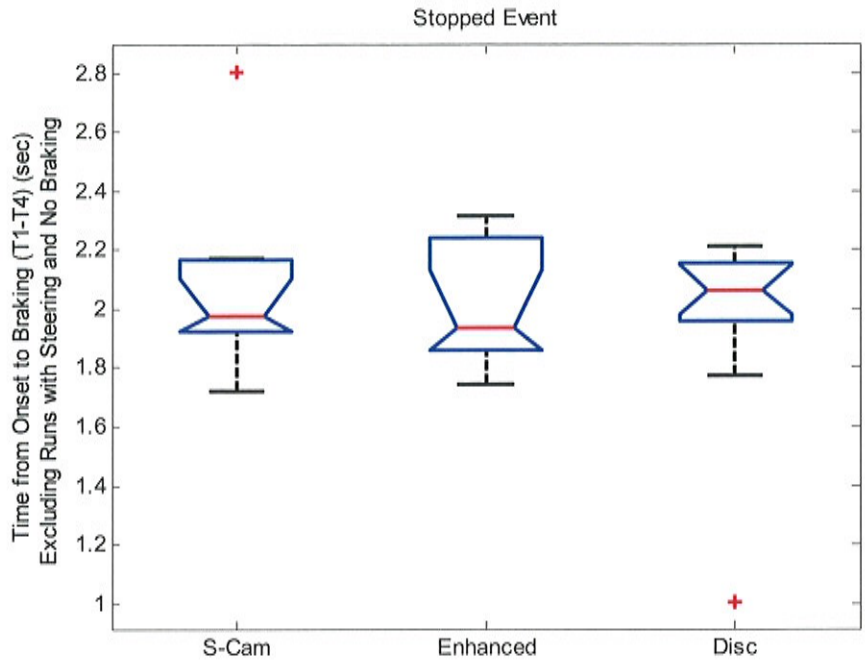

Figure 5.9 - Reaction times during stopped event scenarios

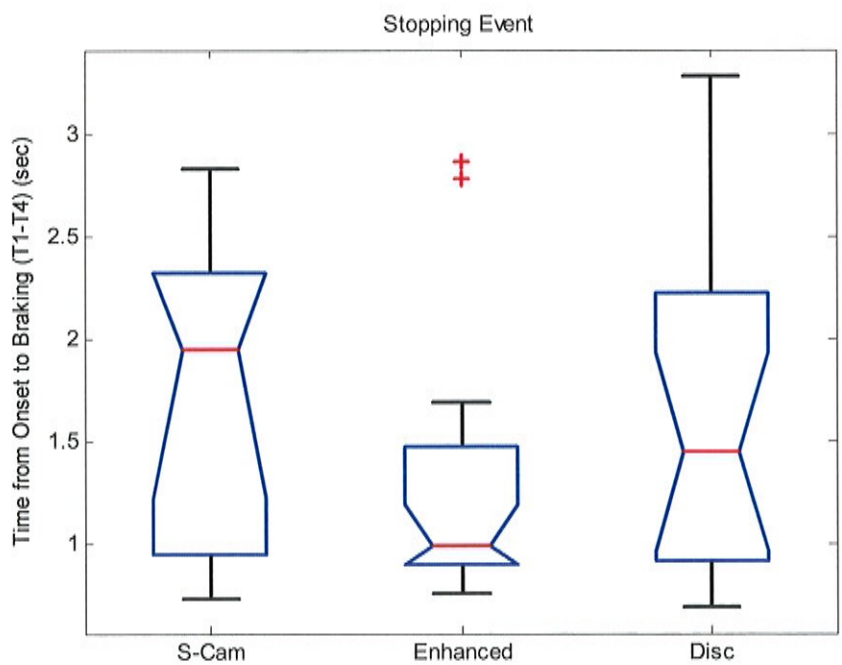

Figure 5.10 - Reaction times during stopping event scenarios

Figures 5.7, 5.8, and 5.9 indicate that the reaction time median values do not differ significantly. The notches in the boxes overlap for the three scenarios. Figure 5.10 shows a significant difference in the median reaction times between the S-cam and the enhanced S-cam brakes for the stopping event scenario. The authors do not have an explanation of why this would be the case, other than the fact that the reaction time for the enhanced S-cam brake system is very skewed (as shown by the median value very close to the bottom (lower quartile) of the box plot). The analysis of the mean value of reaction time (discussed below) shows no statistical difference in reaction times among drivers of the three systems. There is not a significant difference in median reaction times between the enhanced S-cam and the air disc brakes or between the air disc and the standard S-cam brakes.

Table 5.5 contains mean time from event onset to braking (reaction times) for all three brake types that occurred during the left and right incursion, stopping event, and stopped event. The P-values in the last column show no statistical difference between brake types. Figure 5.11 is a graphical representation of this data set.

Table 5.5 Mean time (sec) and number of tests from event onset to braking (Time from T1 to T4)

	S-Cam	Enhanced S-Cam	Air Disc	P
Right Incursion	0.85 (14)	0.86 (21)	0.90 (14)	0.81
Left Incursion	1.40 (16)	1.29 (23)	1.50 (17)	0.29
Stopped Event	2.08 (9)	2.01 (9)	1.98 (14)	0.73
Stopping Event	1.72 (9)	1.27 (21)	1.62 (18)	0.19

The p-values shown on Table 5.5 and Figure 5.11 suggest that the driver reaction time mean values for each scenario are statistically similar and the drivers' perceptions of the events happened around the same time from event initiations. This is the same thing that box plots showed for the median values. The average reaction times for the drivers are statistically similar across the brake types for all four scenarios. That is, drivers for the S-cam, enhanced S-cam, and air disc brakes perceived the obstacles with no significant variations.

Figures 5.12-5.15 indicate that the vehicle speed at braking onset median values do not differ significantly for the right incursion, left incursion, and stopped event. In the case of the stopped event shown in Figure 5.14, it appears that the box notches for the S-cam and air disk brake types do not overlap. This indicates that there is 95% confidence that the true medians for these cases do differ. However, Table 5.6 indicates that the mean values for all three brake types do not differ. In the case of the stopping event shown in Figure 5.15, the box notches for the S-cam and enhanced S-cam brake types do not overlap. Again, this indicates that the there is 95% confidence that the true medians for these cases do differ. Table 5.6 indicates that this is also

true for the mean values. The authors have no explanation for this, but the fact that these two medians differ appears to have no impact on the performance measures analyzed and presented later in this report. In fact, if the S-cam group had lower speeds at braking onset, this would reduce the group's stopping distance. This is shown not to be true later in this chapter. Table 5.6 and Figure 5.16 contain results for mean speed at braking onset.

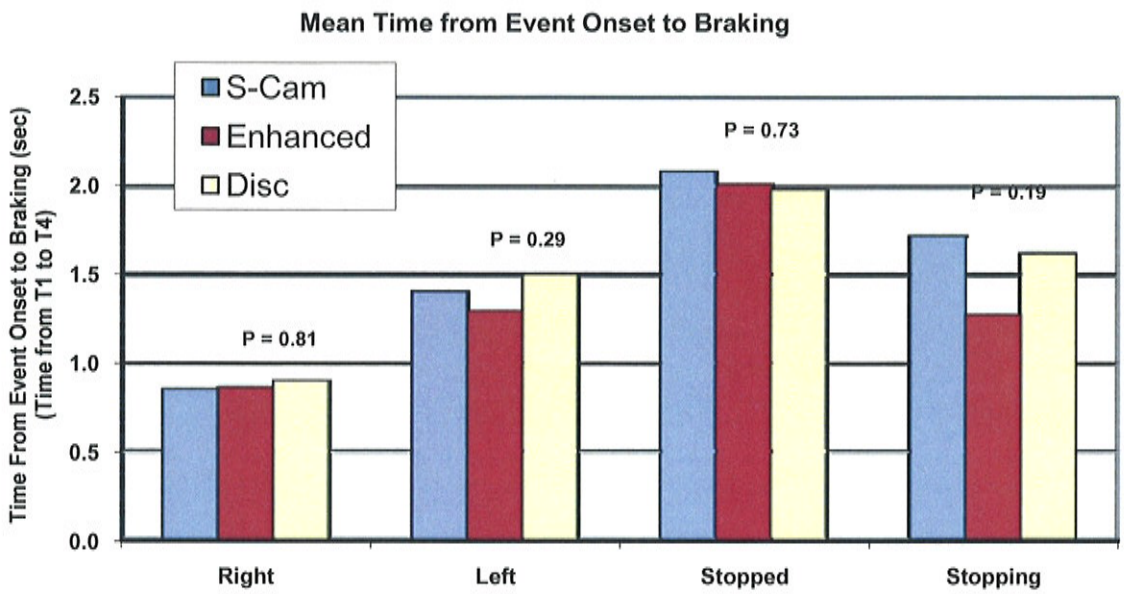

Figure 5.11 - Mean time from event onset to braking (reaction time)

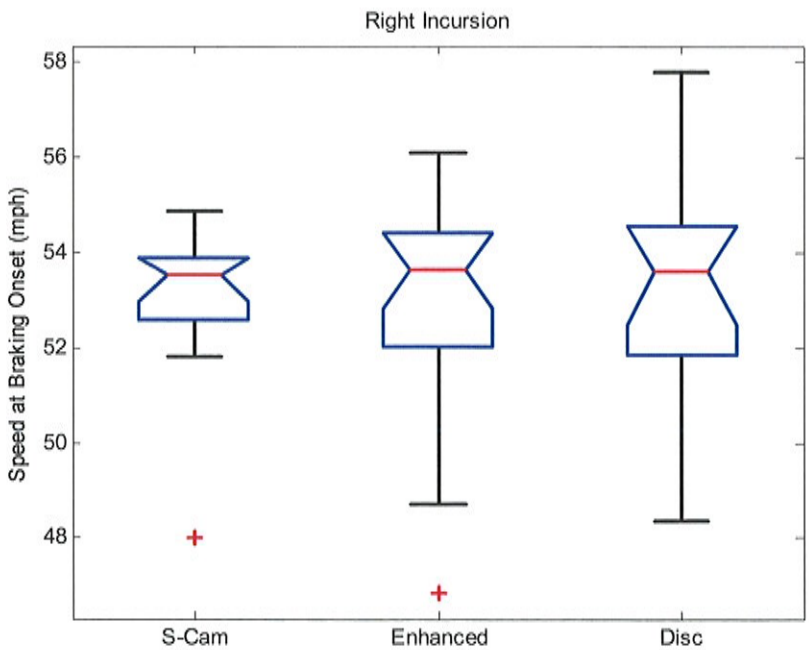

Figure 5.12 - Speeds at braking onset during right incursion scenarios

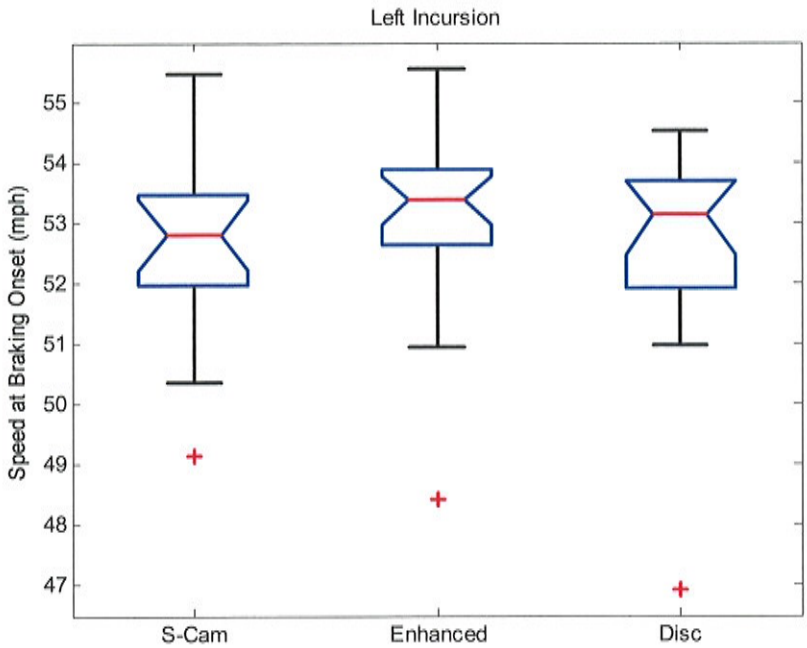

Figure 5.13 - Speeds at braking onset during left incursion scenarios

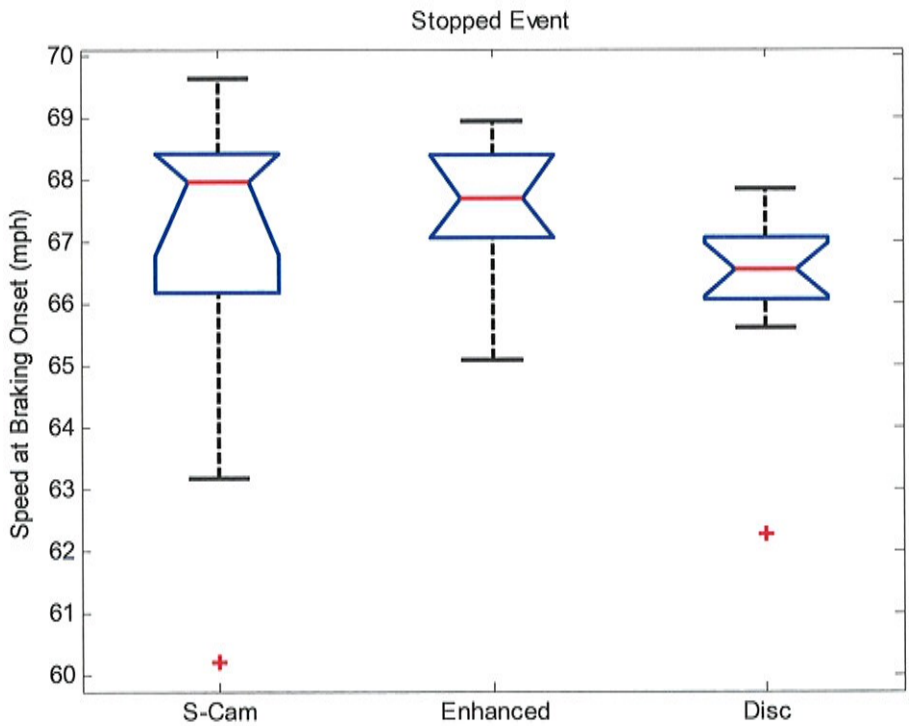

Figure 5.14 - Speeds at braking onset during stopped event scenarios

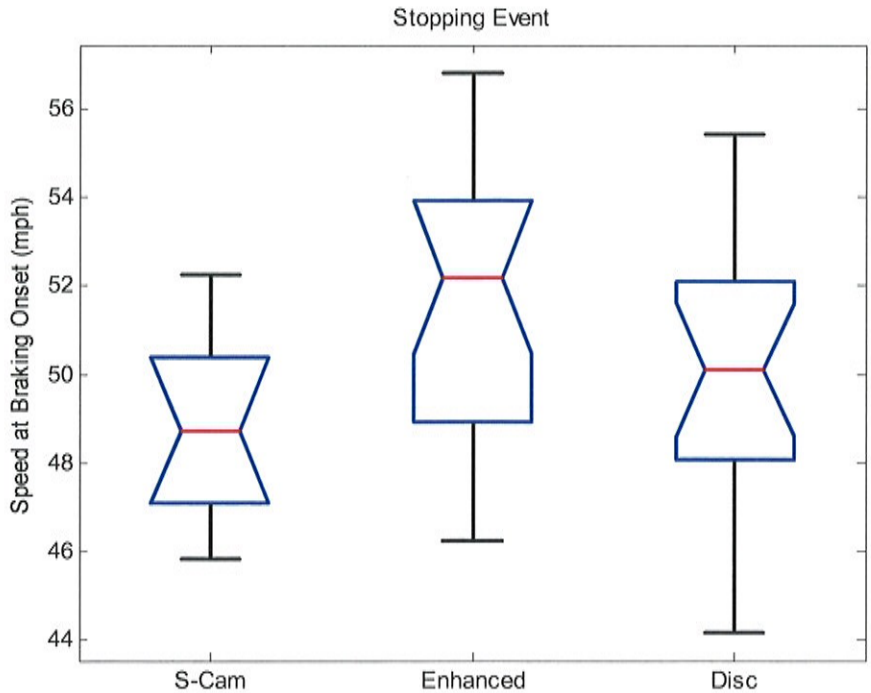

Figure 5.15 - Speeds at braking onset during stopping event scenarios

The p-values shown of Table 5.6 and Figure 5.16 suggest that the speed at braking onset mean values are not significantly different for the right incursion, left incursion, and stopped event; but are significantly different for the stopping event. This too is the same thing that box plots showed for the median values. Post hoc analysis revealed that the mean speed at braking onset was statistically significantly lower in the scenarios using standard S-cam brakes than those using enhanced S-cam brakes. As stated earlier, this difference did not affect the braking distance results.

Table 5.6 Mean speed (mph/kph) and number of tests at braking onset

	S-Cam	Enhanced S-Cam	Air Disc	P
Right Incursion	53.1 / 85.4 (14)	52.9 / 85.2 (21)	53.4 / 85.9 (14)	0.84
Left Incursion	52.6 / 84.6 (16)	53.1 / 85.4 (23)	52.6 / 84.7 (17)	0.54
Stopped Event	66.8 / 107 (9)	67.5 / 109 (9)	66.4 / 107 (14)	0.43
Stopping Event	48.9 / 78.6 (9)	51.8 / 83.4 (21)	50.0 / 80.5 (18)	0.01

Tables 5.7 and 5.8 show mean values and p-values for stopping distance and braking distance, respectively, for each scenario and brake type. Figures 5.17 and 5.18 contain bar graphs of

stopping distance and braking distance. The stopping distance is the distance traveled from the onset of the event (at time T1) to the stopping point (at time T6). The braking distance is the distance traveled from the onset of braking (at time T2) to the stopping point (at time T6).

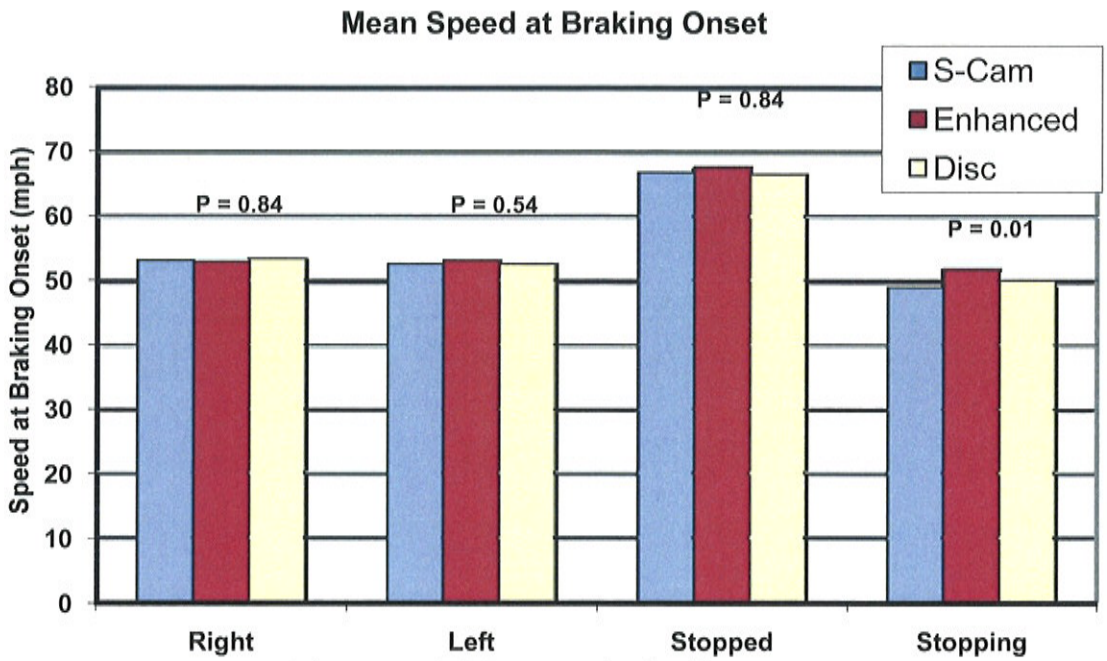

Figure 5.16 - Mean speed at braking onset

Table 5.7 Mean stopping distance (distance traveled from T1 to T6) (ft / m)

	S-Cam	Enhanced S-Cam	Air Disc	P
Right Incursion	282 / 85.9.0	249 / 75.8	251 / 76.6	0.01
Left Incursion	334 / 102	303 / 92.4	317 / 96.5	0.11
Stopped Event	724 / 221	571 / 174	496 / 151	< 0.01
Stopping Event	319 / 97.3	279 / 85.0	287 / 87.5	0.09

Table 5.8 Mean braking distance (distance traveled from T4 to T6) (ft / m)

	S-Cam	Enhanced S-Cam	Air Disc	P
Right Incursion	216 / 66.0	183 / 55.7	181 / 55.3	< 0.01
Left Incursion	227 / 69.2	203 / 61.8	201 / 61.3	< 0.01
Stopped Event	521 / 159	373 / 114	303 / 92.4	< 0.01
Stopping Event	198 / 60.3	185 / 56.3	172 / 52.3	0.03

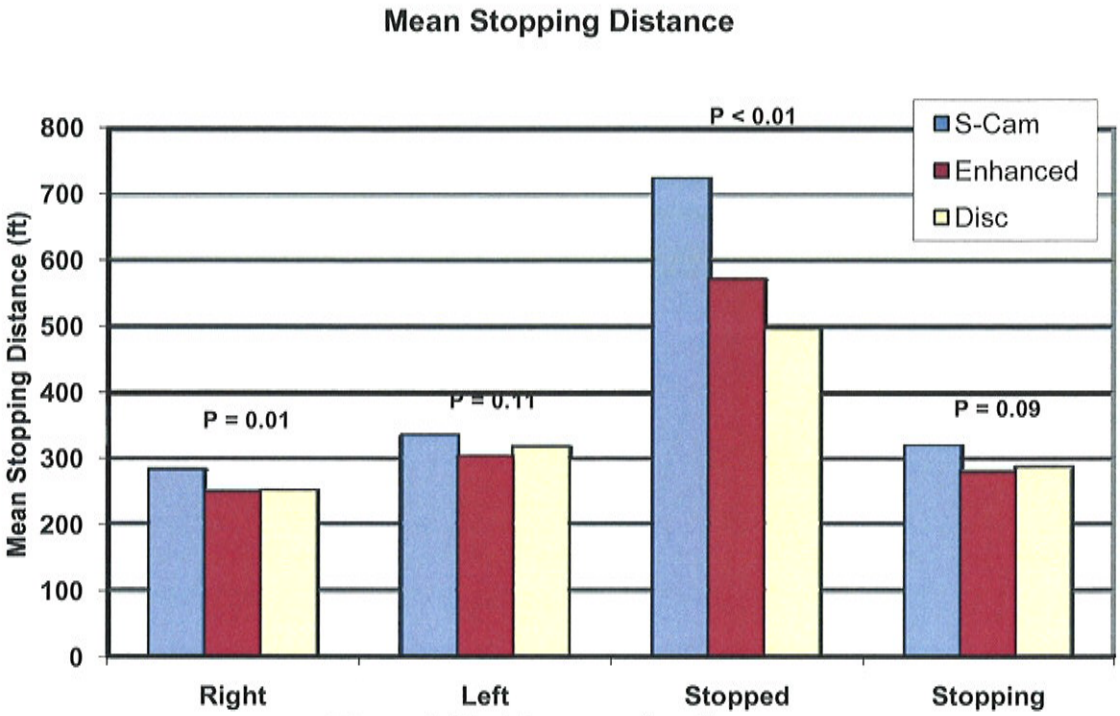

Figure 5.17 - Mean stopping distance

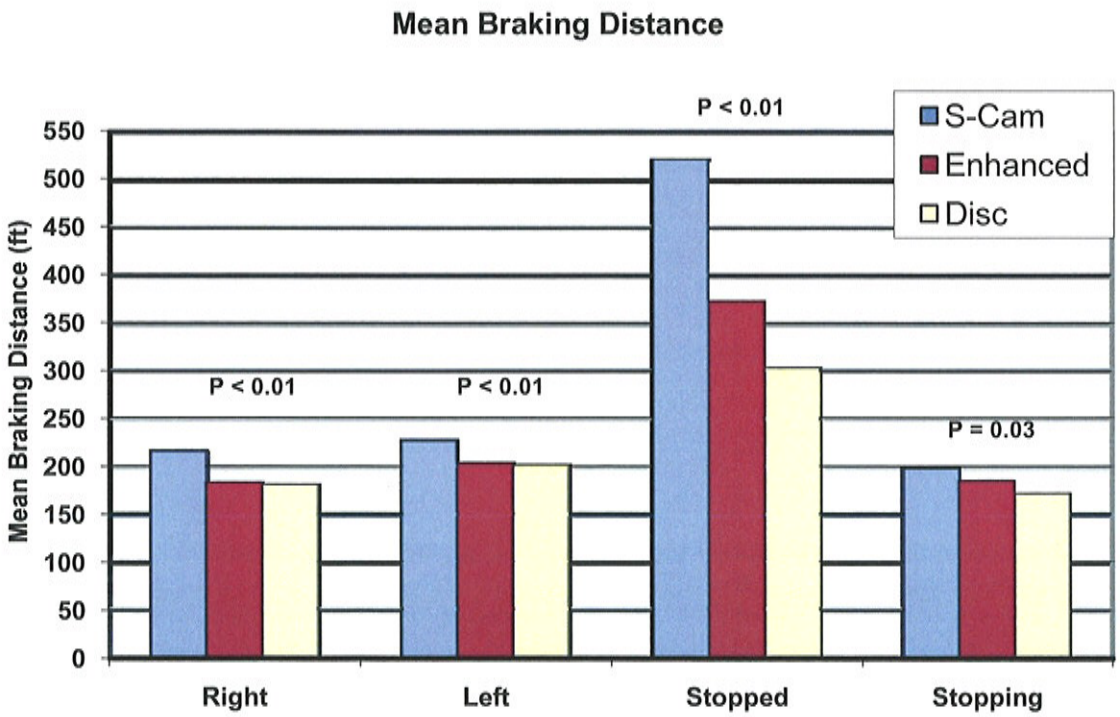

Figure 5.18 - Mean braking distance

The p-values for the stopping distances are similar to the braking distances for the right incursion and stopped event. The p-values for the left incursion and stopping events are not as low for the stopping distance as they are for braking distance. However, the trends in stopping distance are similar to the trends in braking distance.

The p-values for the braking distances indicate that the mean braking distance of at least one brake type differ significantly from the other brake types. The mean braking distance for the S-cam brakes is greater than for the other two brake types (Figure 5.18). The box plots for these tests (see Appendix A) show that the braking distance of the S-cam is statistically significantly longer than those of the enhanced S-cam and air disc brake types, except in the stopping vehicle scenario, where the braking distance of the S-cam brake was statistically significantly longer than only that of the air disc brake (confirmed by 95% confidence intervals). The braking distances for the enhanced brakes are similar to the braking distances for the air disc brakes except for the most severe scenario; the stopped event (in which case the air disc brakes had both a shorter stopping and braking distance).

Appendix A contains box plot graphs of stopping distance and braking distance, as well as the other performance measures of mean brake pedal force, maximum brake pedal force, mean deceleration, and maximum deceleration.

The drivers' braking efforts were compared for the three brake types in order to confirm that reductions in collisions were the result of better stopping performance rather than a reduction of driver braking effort (pedal force) when driving a truck with the standard S-cam system. The mean values and p-values of the mean brake pedal force (Table 5.9 and Figure 5.19) and maximum brake pedal force (Table 5.10 and Figure 5.20) were evaluated. In the cases of the left incursion and the stopping events, there was a statistically significant difference in mean brake pedal force. For the left incursion scenario, the mean brake pedal force was statistically significantly lower for the air disc brake than for the standard S-cam. For the stopping event scenario, the mean brake pedal force was statistically significantly lower for the air disc brake than for the enhanced S-cam. The authors believe this is due to the drivers with disc brakes easing off the brake pedal when they realized that a collision was no longer a threat. There was no statistical difference in maximum brake pedal force.

Table 5.9 Mean of mean brake pedal force (Mean Force from T4 to T6) (lb / N)

	S-Cam	Enhanced S-Cam	Air Disc	P
Right Incursion	75.4 / 335	70.8 / 315	67.0 / 298	0.11
Left Incursion	71.4 / 317	66.1 / 294	60.8 / 270	0.02
Stopped Event	74.5 / 331	77.0 / 343	70.9 / 315	0.27
Stopping Event	70.3 / 313	71.5 / 318	62.0 / 276	0.03

The mean values and p-values of the mean deceleration (Table 5.11 and Figure 5.21) and maximum deceleration (Table 5.12 and Figure 5.22) indicate that one of the means for mean deceleration and maximum deceleration was significantly different than at least one of the other

two brake types. Examination of the box plots for these variables (Appendix A) reveals that S-cam value is statistically significantly lower than that of the other two brake types. The trends in the mean and maximum deceleration results are similar. The disc brakes provided the highest decelerations in all cases; even though the mean and maximum brake pedal forces were lower in nearly all cases. As a result of braking capability, drivers with air disc brakes experienced the fewest number of collisions, the lowest collision speeds, and the shortest mean braking distance.

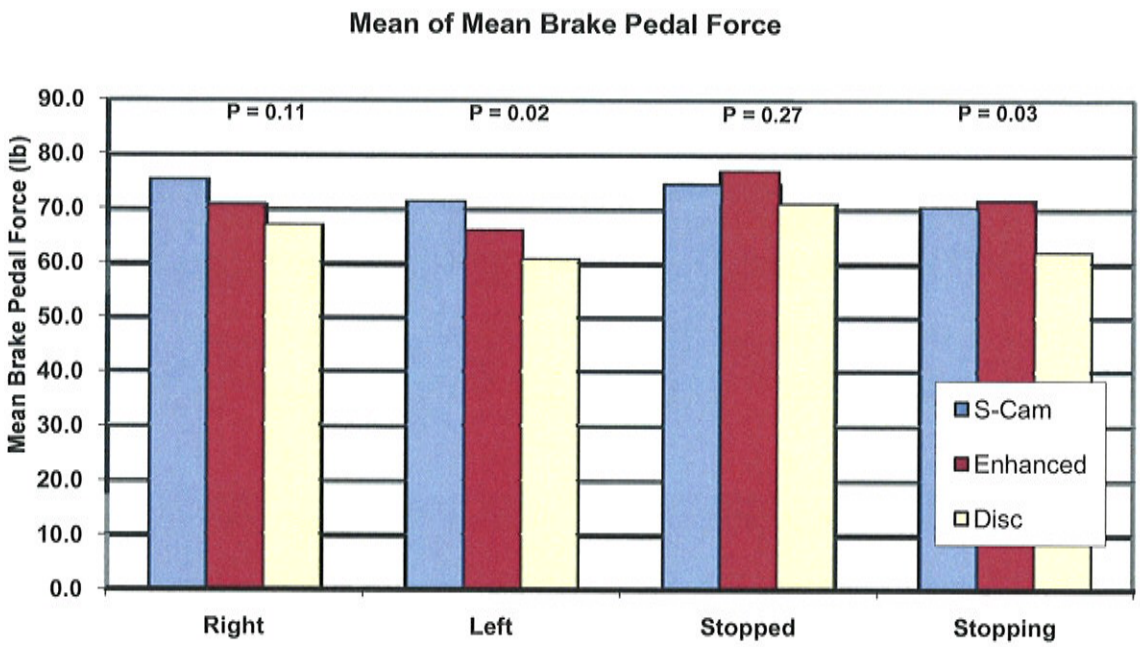

Figure 5.19 - Mean of mean brake pedal force

Table 5.10 Mean of maximum brake pedal force (lb / N)

	S-Cam	Enhanced S-Cam	Air Disc	P
Right Incursion	82.4 / 366	81.7 / 363	82.1 / 365	0.48
Left Incursion	81.5 / 363	82.0 / 365	78.8 / 350	0.07
Stopped Event	82.7 / 364	82.5 / 367	81.1 / 361	0.14
Stopping Event	83.3 / 370	81.2 / 361	79.5 / 354	0.24

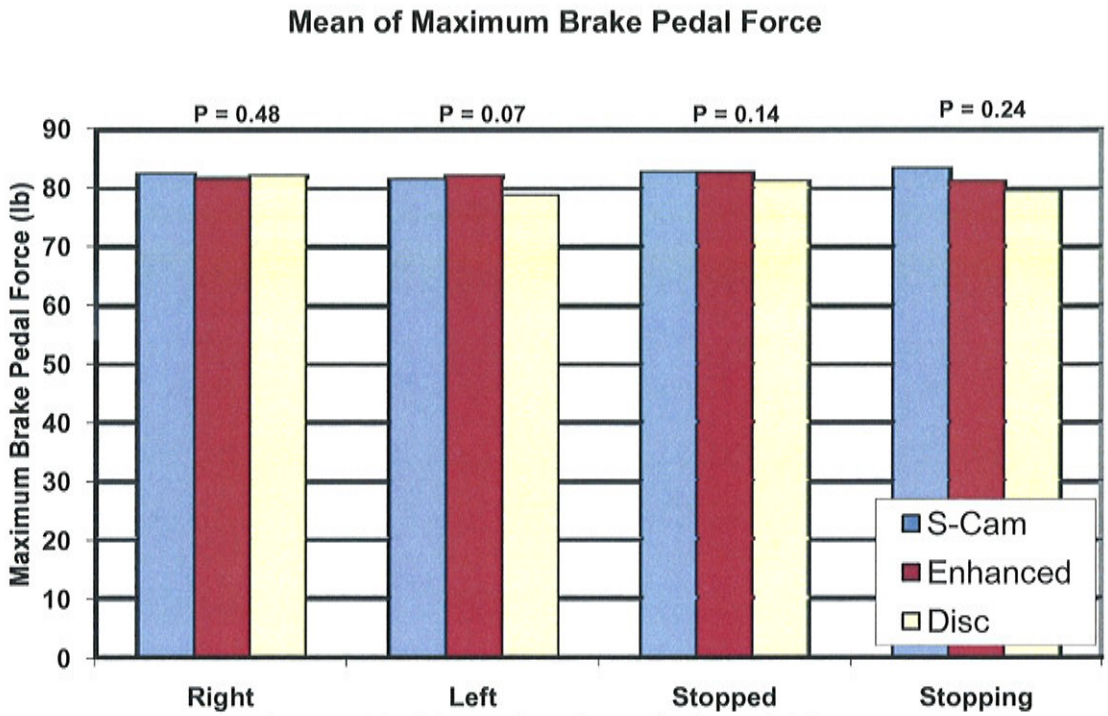

Figure 5.20 - Mean of maximum brake pedal force

Table 5.11 Mean of mean deceleration (g)

	S-Cam	Enhanced S-Cam	Air Disc	P
Right Incursion	-0.42	-0.51	-0.53	< 0.01
Left Incursion	-0.41	-0.48	-0.50	< 0.01
Stopped Event	-0.24	-0.34	-0.45	< 0.01
Stopping Event	-0.41	-0.51	-0.52	< 0.01

Table 5.12 Mean of maximum deceleration (g)

	S-Cam	Enhanced S-Cam	Air Disc	P
Right Incursion	-0.52	-0.66	-0.67	< 0.01
Left Incursion	-0.51	-0.63	-0.65	< 0.01
Stopped Event	-0.51	-0.63	-0.65	< 0.01
Stopping Event	-0.52	-0.65	-0.66	< 0.01

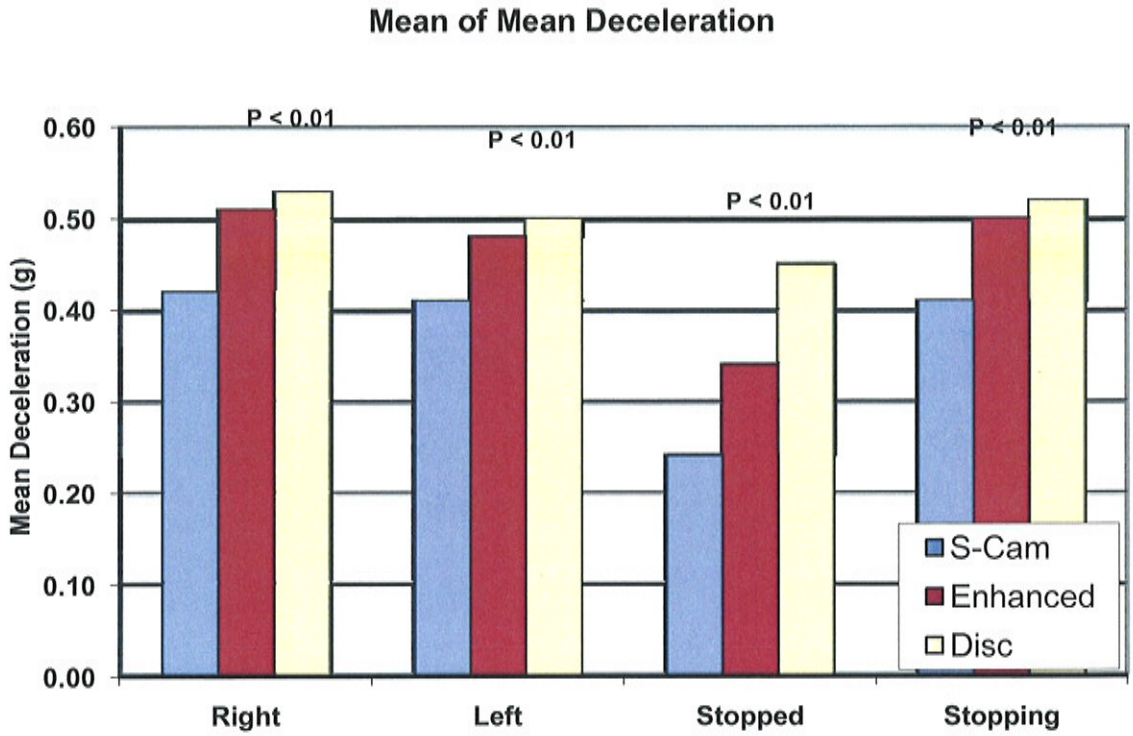

Figure 5.21 - Mean of mean deceleration

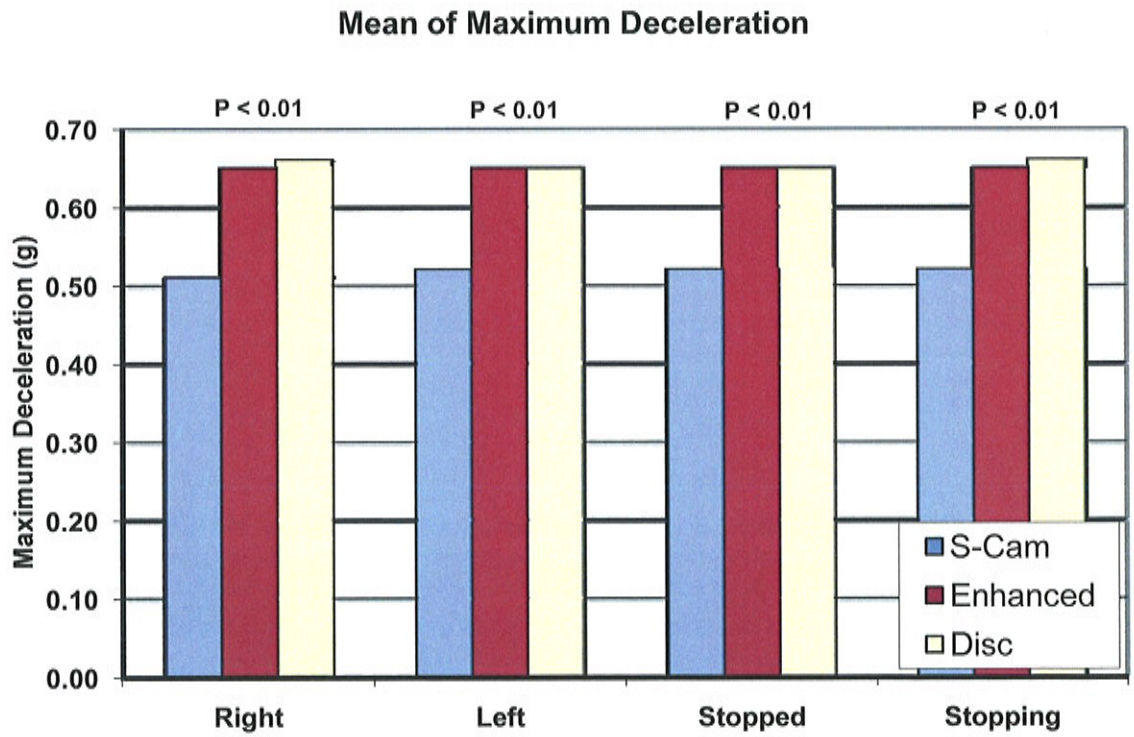

Figure 5.22 - Mean of maximum deceleration

6.0 CONCLUSIONS

Based on the results presented here, the hypothesis that a brake system that provides a shorter stopping distance in an emergency braking event would reduce crashes and crash severity is valid.

Except for the speed at braking onset during the stopping event scenario, the type of braking system had no statistically significant effect on driver behavior prior to braking. Drivers' braking efforts measured through brake pedal forces, truck speeds at the onset of braking during three of four events, and reaction times of scenario perceptions were statistically similar; and revealed that the type of braking system had no statistically significant effect on driver behavior prior to braking. A comparison of mean values of these three variables suggested with high confidence (95%) that the reduction in collisions were the result of better stopping performance rather than drivers' braking behavior.

The experiment showed that professional drivers using either the enhanced S-cam or air disc brake systems were better able to avoid collisions than those drivers using the standard S-cam brakes. Although there were not enough samples to provide statistical significance, the trend in the data indicates that those drivers using the enhanced S-cam and air disc brakes had fewer collisions than those using the standard S-cam brakes. The data showed that the ratio of collisions to total number of drives for the standard S-cam system is 36%, 23% for the enhanced S-cam, and 21% for the air disc brake. For the most severe event (the stopped event at 70 mph), the ratio of collision to the total number of runs for the air disc system is 19%, whereas it is 44% and 57% for the standard S-cam and enhanced S-cam systems respectively. Also, drivers using air disc brakes in this same event had reduced collision speeds compared with those using the enhanced S-cam brake system. The mean collisions speeds were 23.0 mph, 28.5 mph, and 32.0 mph for the air disc, enhanced S-cam, and standard S-cam brake systems, respectively. Collision speed is a major determinant of crash severity, and the air disc brake system lowered collision speed most effectively.

The data showed that there were more collisions with vehicles equipped with brake systems characterized by longer stopping distances, and that more crashes occurred with the standard S-cam brakes than with the other two brake types. In the case of emergency events at high speed, the disc brake system provided the safest solution.

In the cases where the driver was able to stop before crashing into the other vehicle, analysis showed that the braking distance of the standard S-cam brake was statistically significantly longer than that of the air disc brake in all four scenarios, and it was statistically significantly longer than that of the enhanced S-cam brakes in three of the scenarios. In terms of mean and maximum deceleration, in all four scenarios, the vehicle with the standard S-cam brakes did not decelerate as well as the vehicles with enhanced S-cam or air disc brakes (statistically significant in all cases).

7.0 REFERENCES

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8.0 APPENDICES

8.1 APPENDIX A: Box Plot Graphs of Performance Measures

Stopping Distance, Braking Distance, Mean Brake Pedal Force, Maximum Brake Pedal Force, Mean Deceleration, and Maximum Deceleration.

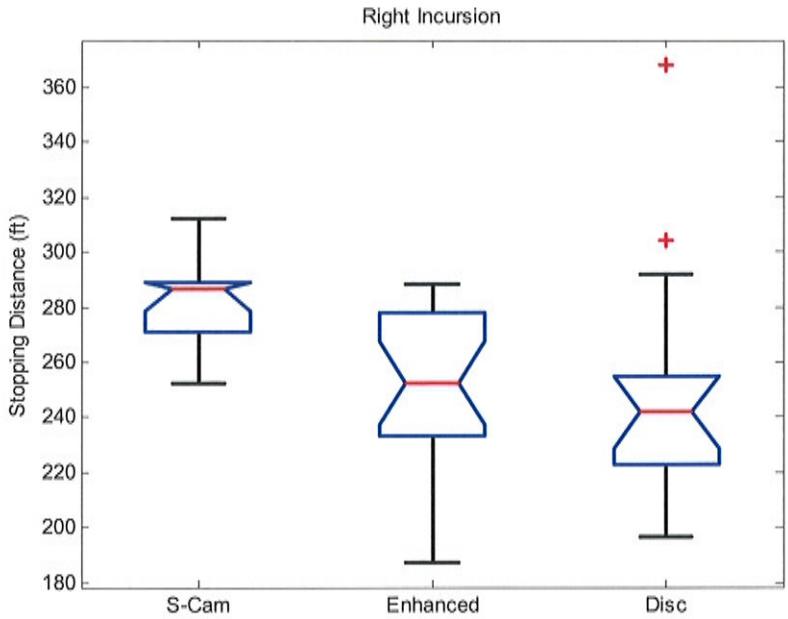


Figure A1 - Right incursion stopping distance

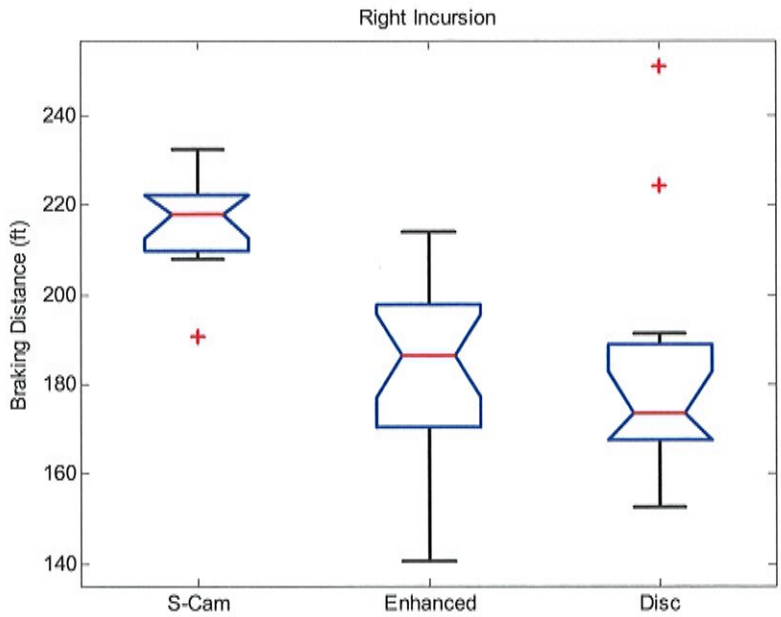


Figure A2 - Right incursion braking distance

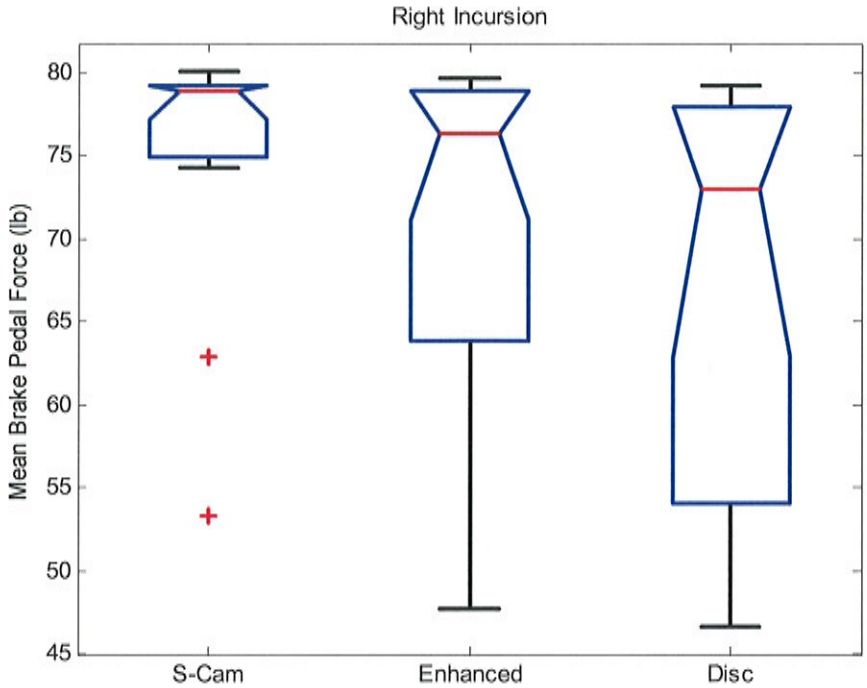


Figure A3 - Right incursion mean brake pedal force

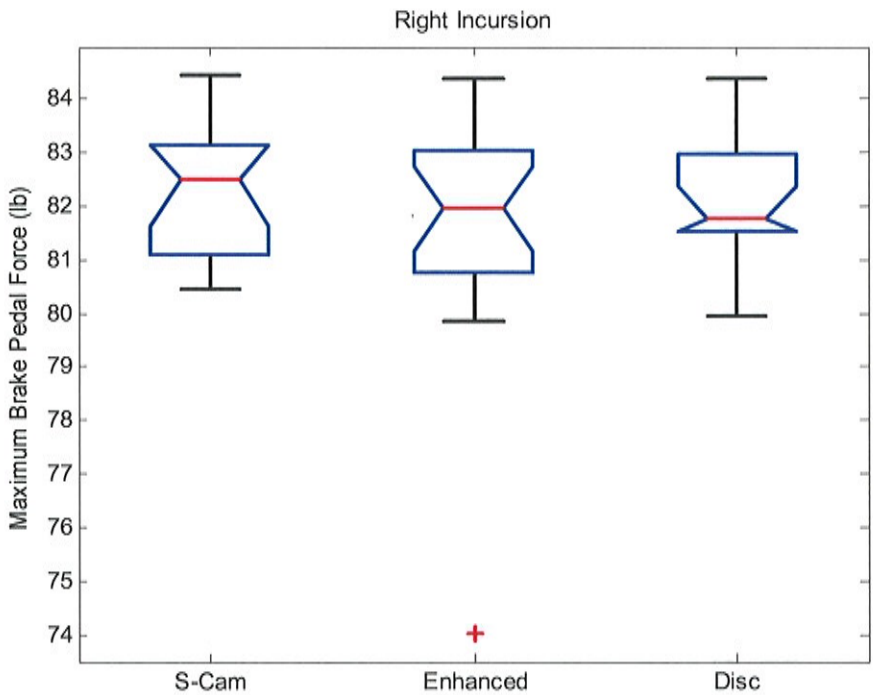


Figure A4 - Right incursion maximum brake pedal

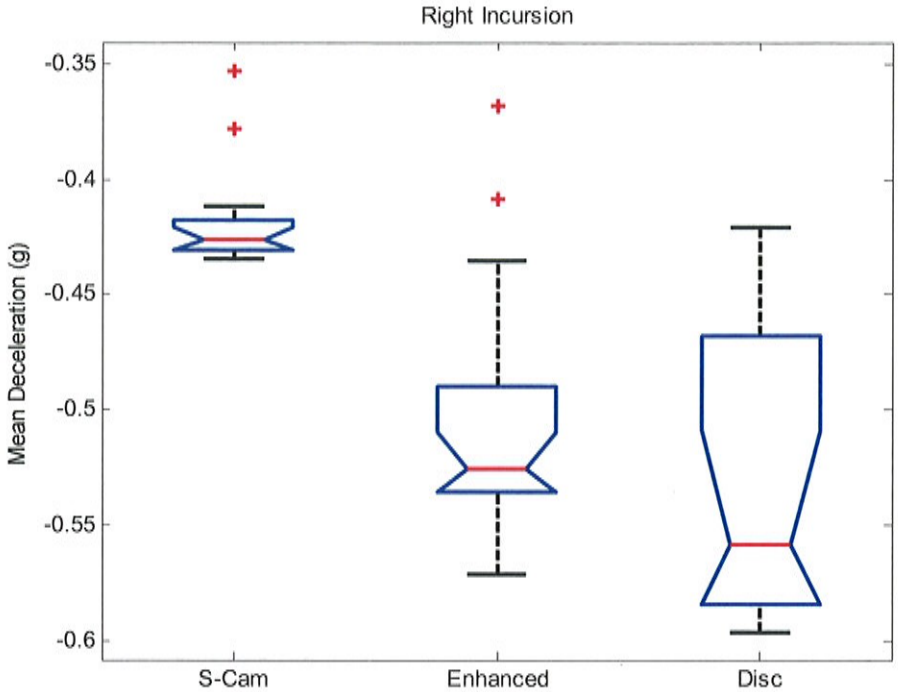


Figure A5 - Right incursion mean deceleration

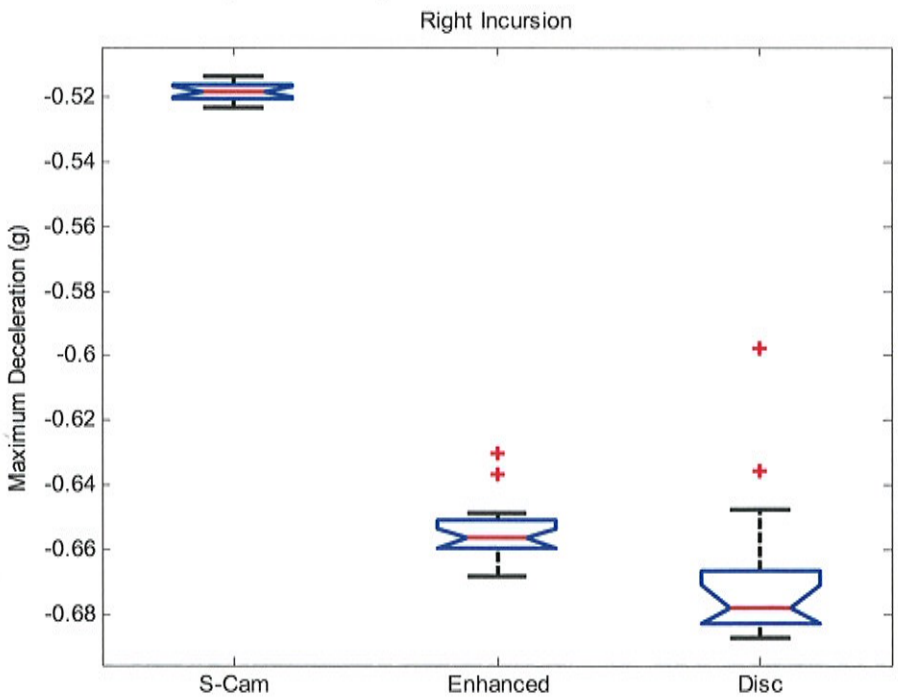


Figure A6 - Right incursion maximum deceleration

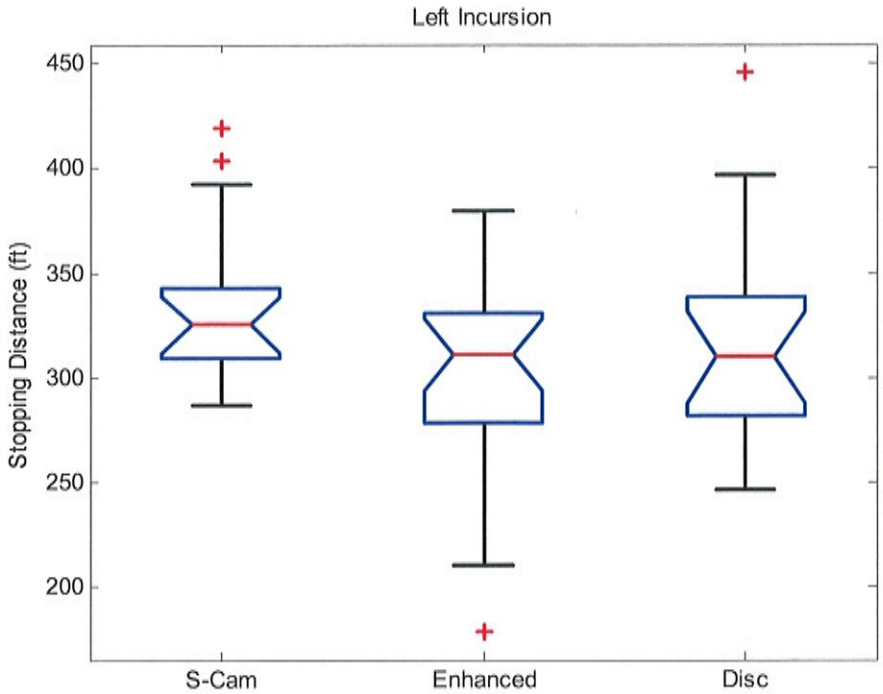


Figure A7 - Left incursion stopping distance

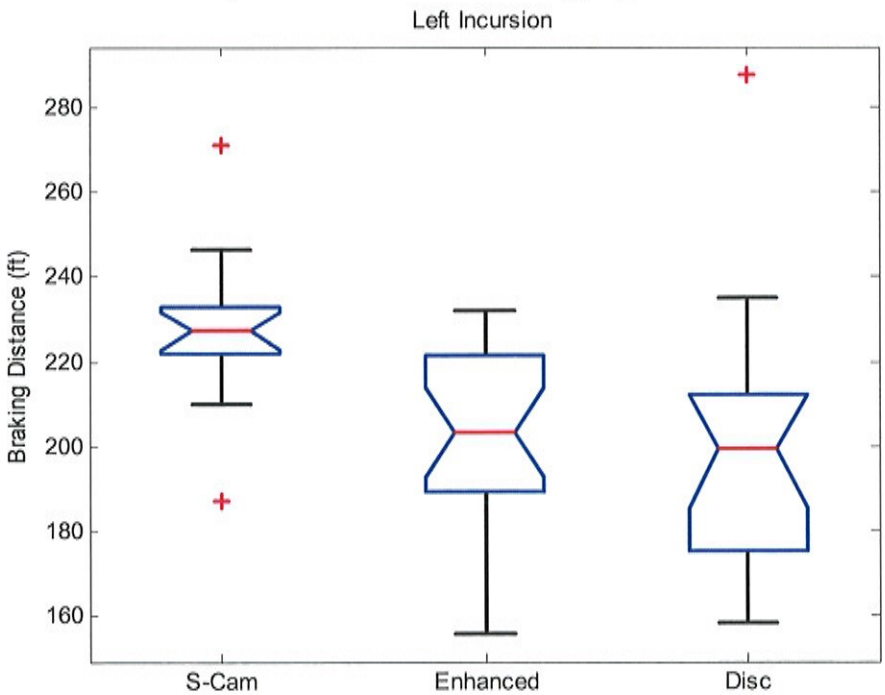


Figure A8 - Left incursion braking distance

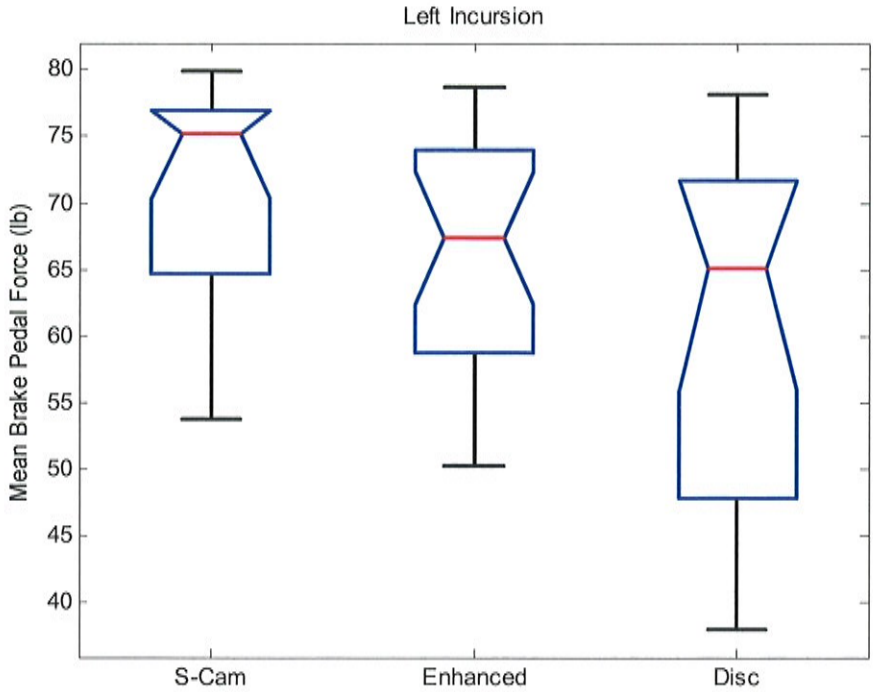


Figure A9 - Left incursion mean brake pedal force

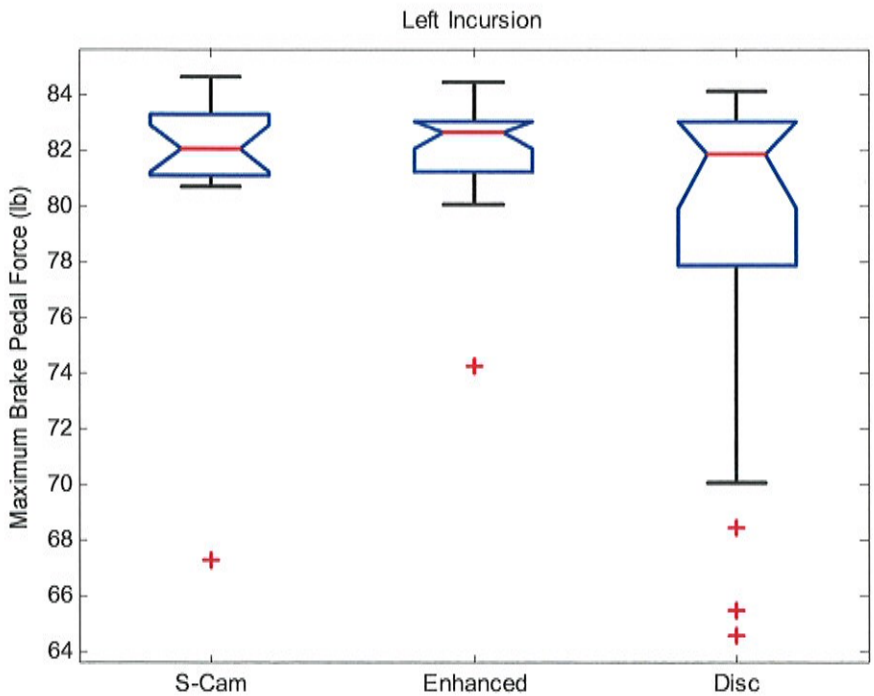


Figure A10 - Left incursion maximum brake pedal force

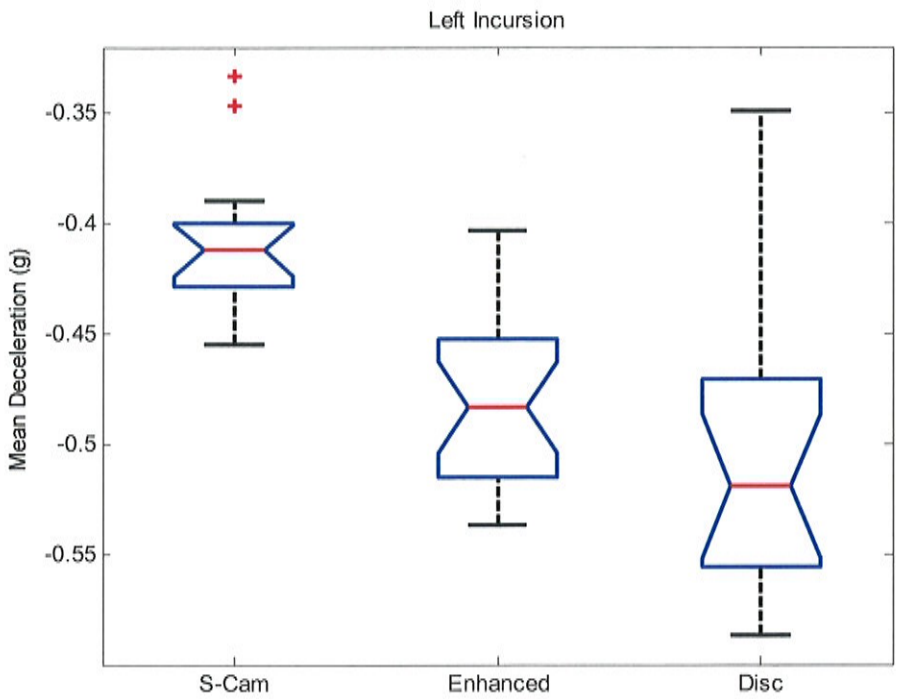


Figure A11 - Left incursion mean deceleration

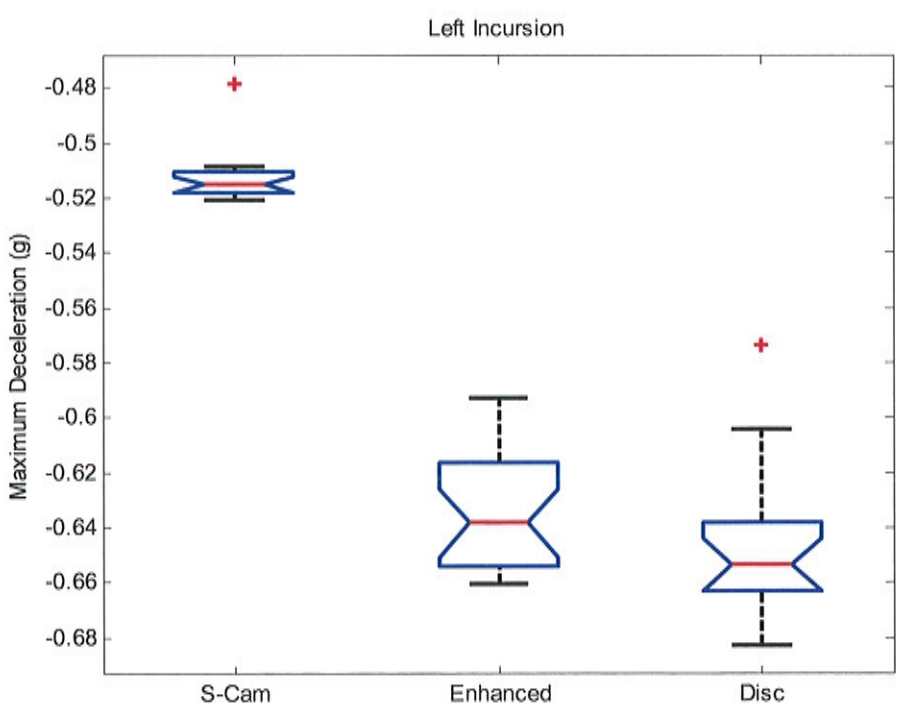


Figure A12 Left incursion maximum deceleration

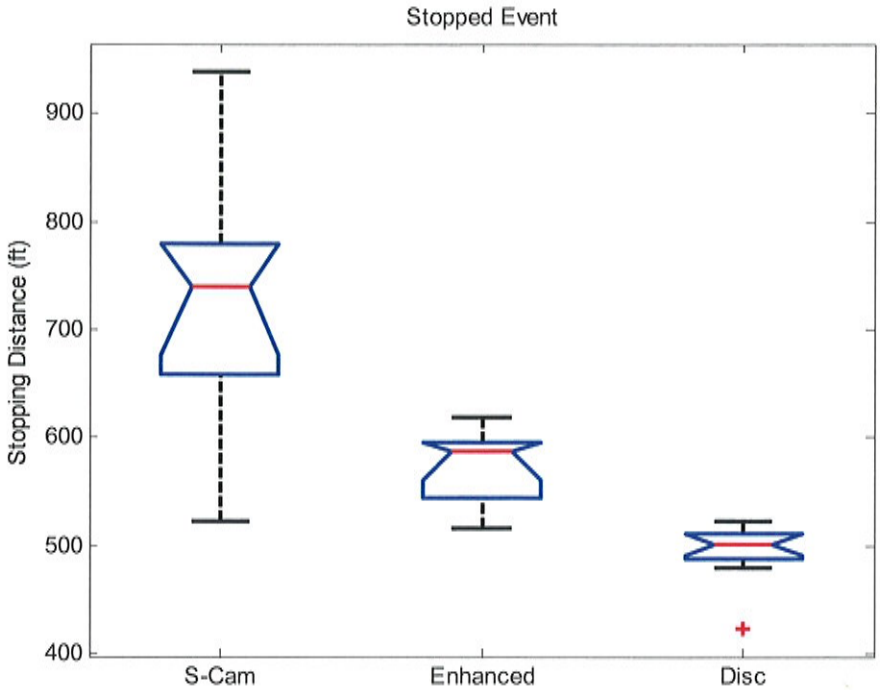


Figure A13 - Stopped event stopping distance

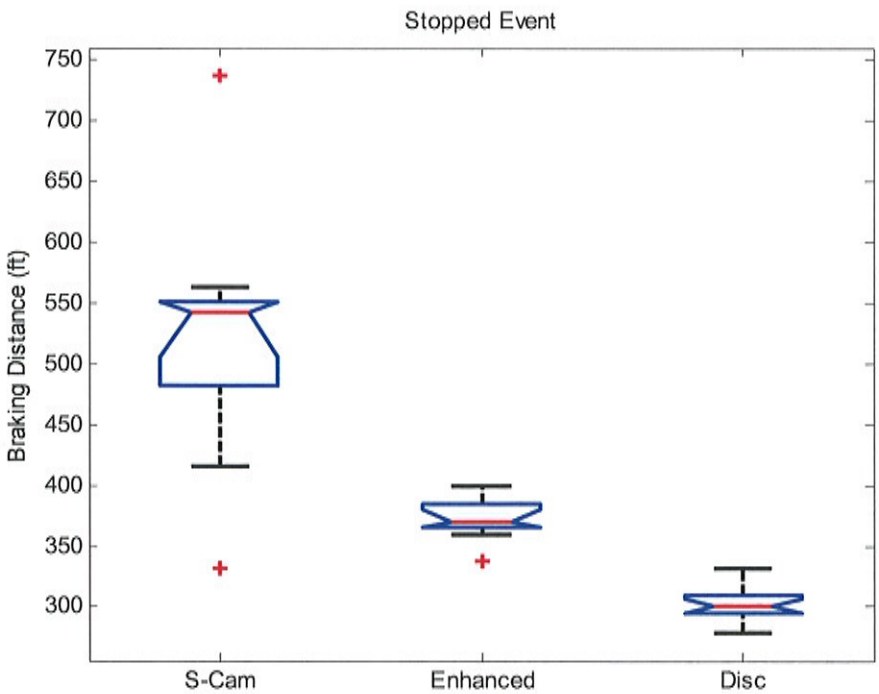


Figure A14 - Stopped event braking distance

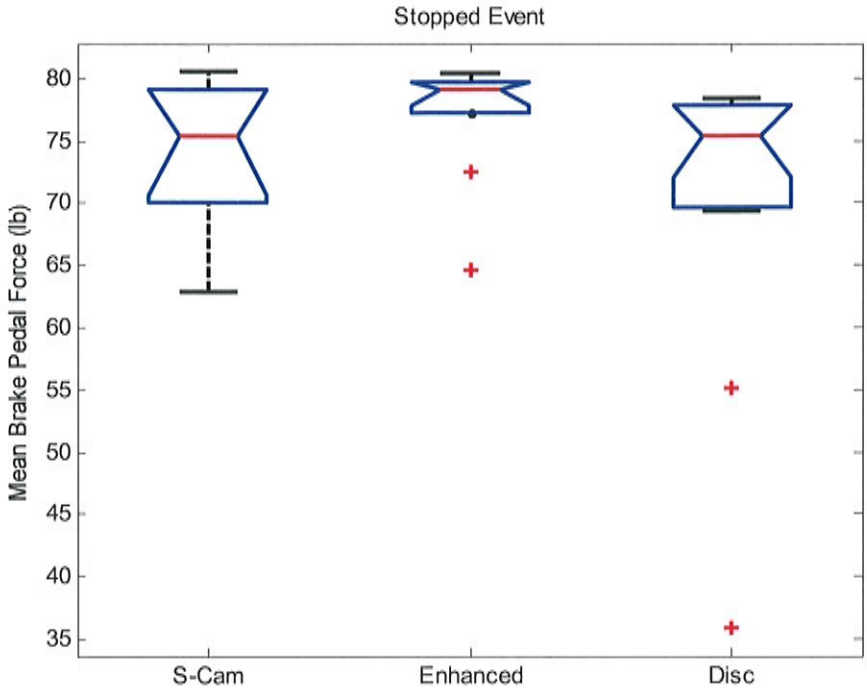


Figure A15 - Stopped event mean brake pedal force

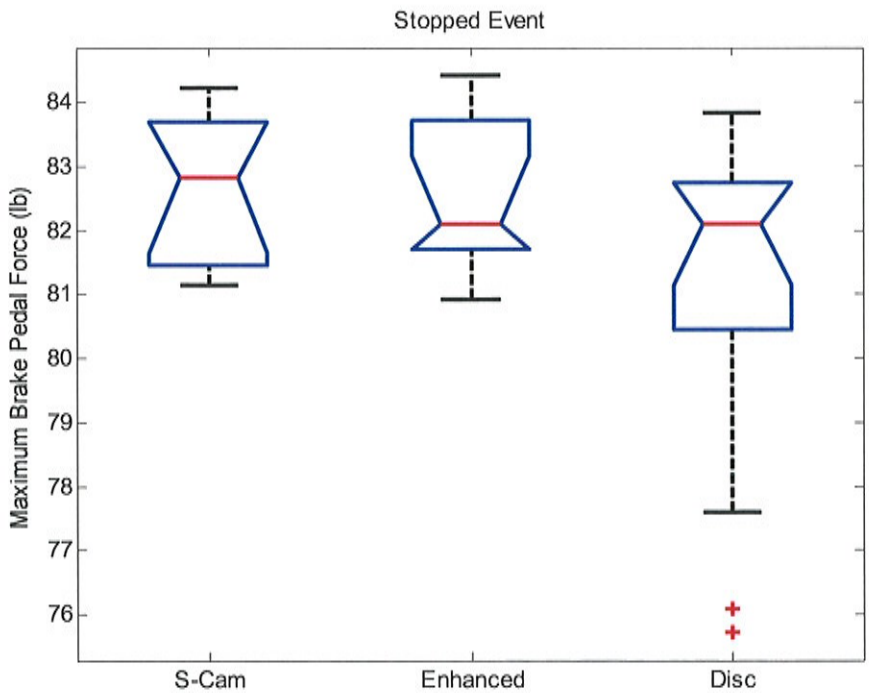


Figure A16 - Stopped event maximum brake pedal force

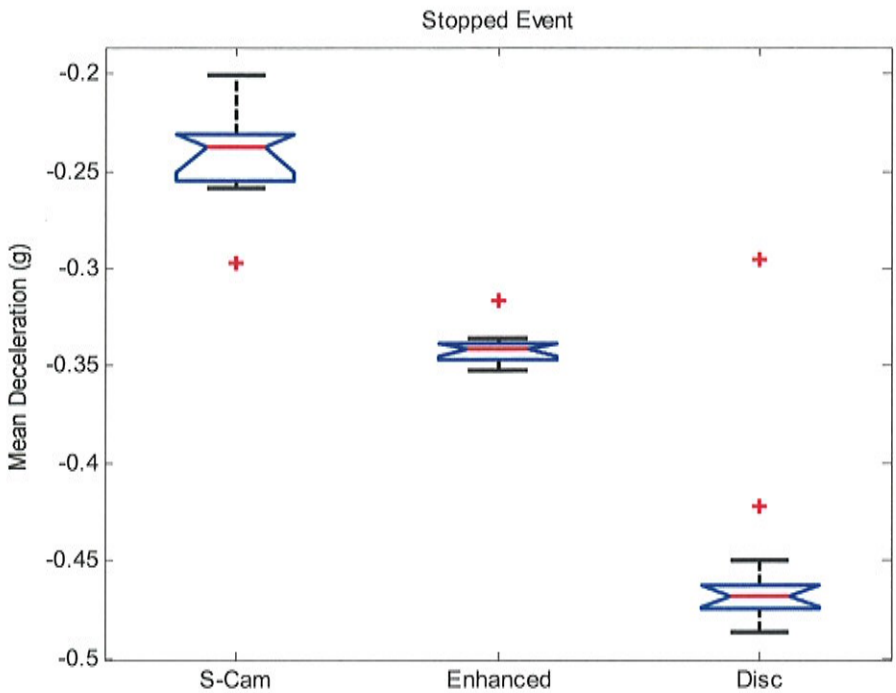


Figure A17 - Stopped event mean deceleration

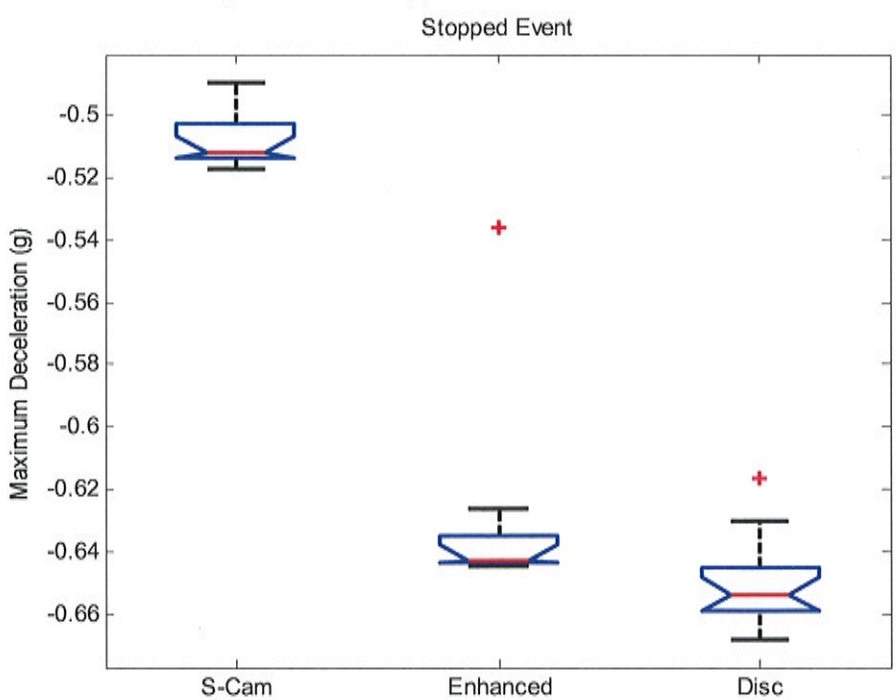


Figure A18 - Stopped event maximum deceleration

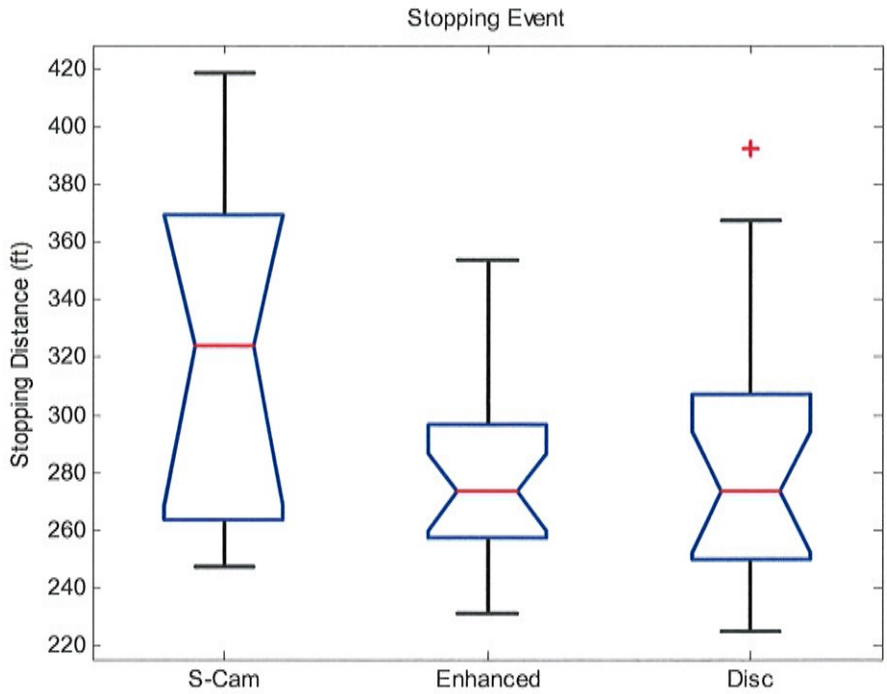


Figure A19 - Stopping event stopping distance

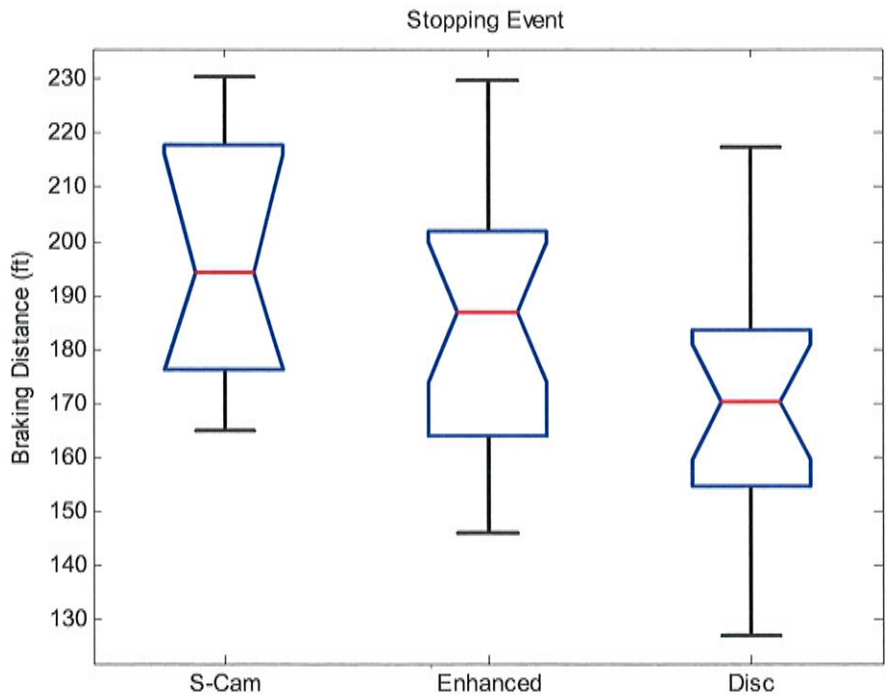


Figure A20 - Stopping event braking distance

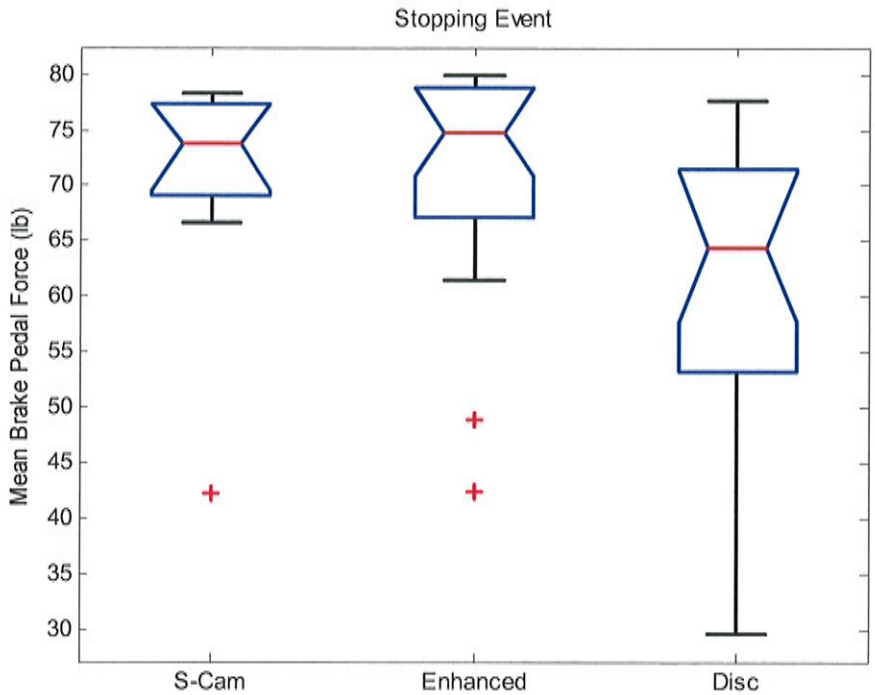


Figure A21 - Stopping event mean brake pedal force

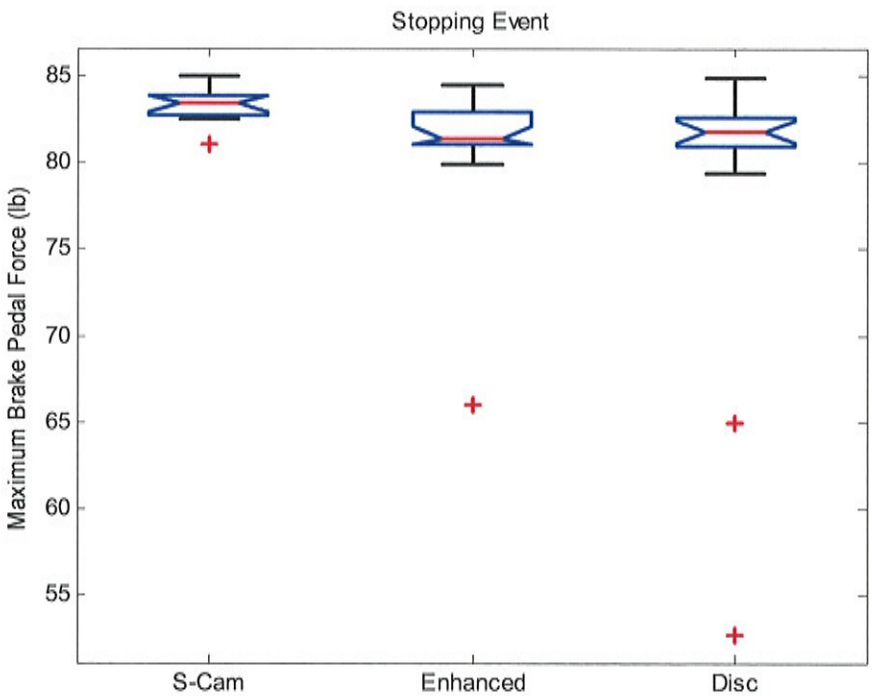


Figure A22 - Stopping event maximum brake pedal force

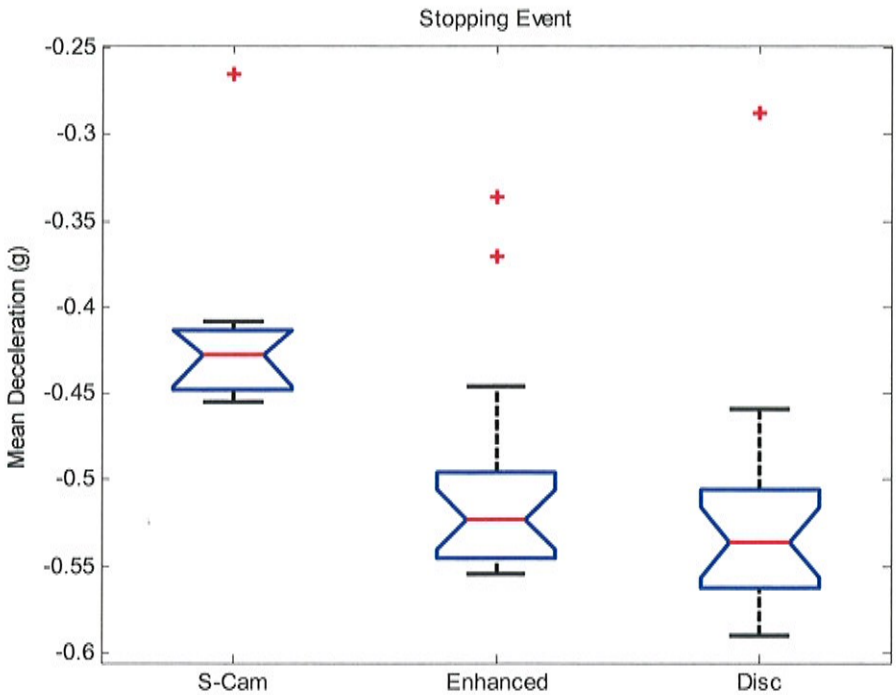


Figure A23 - Stopping event mean deceleration

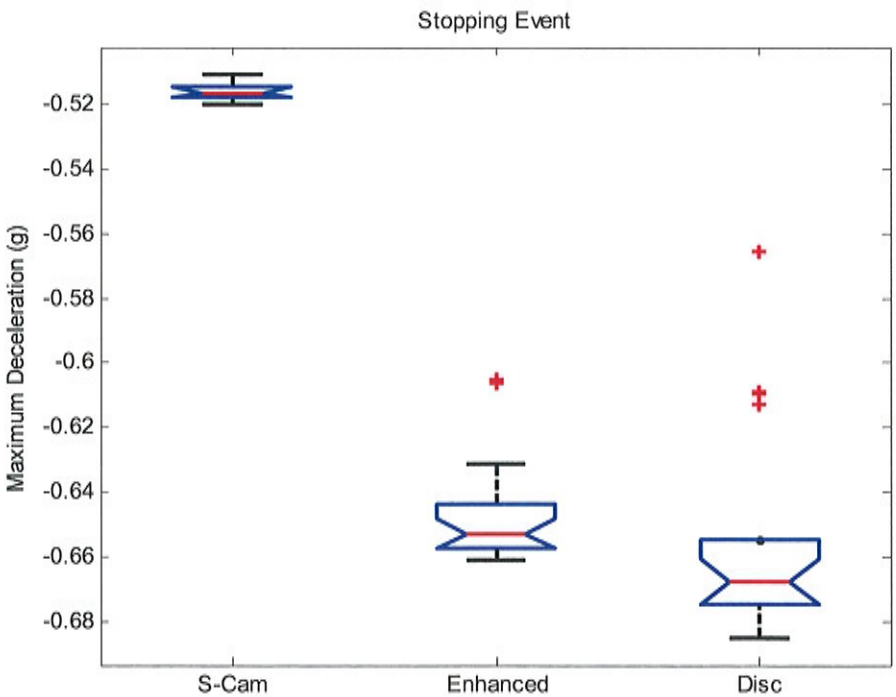


Figure A24 - Stopping event maximum deceleration

8.2 Appendix B: Simulator Study Protocol

Heavy Truck-Air Disc Brake Informed Consent Summary

Introduction

I am going to give you an overview of the research study you will be participating in today, and then I will ask you to read the Informed consent document which describes the study in detail. This document provides important information about what you will be asked to do during your visit, the risks and benefits of the study, and your rights as a research participant.

After your study visit, you will receive a copy of the Informed Consent Document for your records.

Purpose

You have been invited to participate in this study because you have:

- a valid, unrestricted, Class A Commercial Drivers License (CDL-A),
- 6 months experience,
- average at least 2000 miles per month over the last 6 months
- are in good general health, and
- are between the ages 25-55.

During your visit you will participate in a study examining the effectiveness of air disc brakes on heavy trucks.

Approximately 118 people will take part in this study.

Time Commitment

If you agree to take part in this study, your involvement will last approximately 2 hours.

What Will Happen During the Study?

Once you have completed the informed consent, we will have you complete a questionnaire regarding your driving history, demographic information, and general health status. In order to receive payment for your participation, you will complete a payment voucher. We will need to record your Social Security Number in order to process your voucher through the University.

Next you will be given eye exams that test your color vision, contrast sensitivity, and visual acuity.

Then you'll be given a brief description of brake systems that will be used in this study. You have the opportunity to earn incentive pay based on your driving performance. Research staff will explain the incentive system before you enter the simulator.

You then will be escorted to the simulator, where you will be briefed on the simulator cab, and on the drives you'll complete as part of this study. An experimenter sits in the back seat of the cab to ensure your safety while driving and exiting the simulator.

You will be asked to complete a practice drive and four study drives. Your drive time in the simulator will last approximately 1 hour. Afterward, you will be asked to complete additional questionnaires about your experience in the simulator.

"Tell me what we are asking you to do today?" Clarify misunderstandings the participant may have regarding their participation in the study.

While you drive, researchers collect 2 types of data:
Engineering data is collected from sensors that measure vehicle operation, motion, and driver actions.
Video data is collected using small cameras inside and outside the cab. This helps us understand your driving performance. (For example if the engineering data documents that a steering maneuver was performed, the video recording data will show what conditions led to that maneuver)

Views recorded include: your face and hands on the steering wheel, the road scene, the foot pedals, and a view from outside the cab (show still picture). Data is recorded onto storage media for analysis by research staff.

We will keep your name and information about you on file. This is primarily for recruitment purposes, but occasionally we contact participants in order to follow-up on data collected during their original study visit.

Agreeing to participate in this study does not obligate you to participate in future studies.

Risks
The risks involved in participating in this study are minimal.

You may experience discomfort associated with simulator disorientation. This is very rare and we do not expect this to happen to you today. You may quit driving at any time if you experience any discomfort.

In the rare event that the simulator's normal exiting procedure is not available, you will be assisted down a small ladder and escorted to a participant waiting room.

For more details about these risks, please refer to your Informed Consent Document.

Benefits
You may not benefit personally from being in this study. However, we hope that other people might benefit from this study by gaining useful information regarding braking technologies that reduce the number and severity of certain types of heavy truck crashes.

Additionally, many participants find driving in a simulator of this type to be an exciting and unique experience.

Costs
There is no cost to you for enrolling in this study. You will be compensated a base pay of $30 per hour of participation which is expected to take approximately 2 hours. In addition to your base pay, you will have the opportunity to earn an additional $12 incentive pay based on your driving performance. Most drivers earn some amount of incentive pay, but it is not expected that you will earn the full amount.

Funding
The National Highway Traffic Safety Administration (NHTSA) is funding this study. The University of Iowa is receiving payments from them to support the activities that are required to conduct the study.

Confidentiality
We will keep your participation in this research study confidential. We take several steps to protect your identity. You are assigned a research number that our staff uses during data collection, analysis, and reporting. If we write a report or article about this study, we typically describe the study results in a summarized manner.

Video image data and associated audio data may be publicly released, either separately or with the appropriate engineering data. This is typically done for scientific, educational, outreach, legislative, or research purposes. Examples include use of data:

- in a presentation of study findings at a professional conference,
- in a production for local media,
- in an interactive display on driver safety at a local mall, or
- in support of proposed legislation.

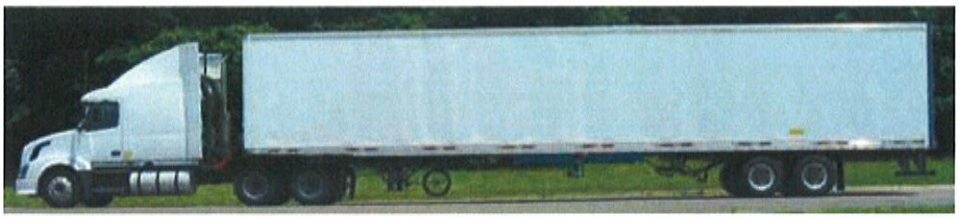
Video is usually presented in short clips to illustrate study findings. Often video used in TV segments are of NADS staff rather than study participants, in order to not disrupt data collection.

Voluntary
Your participation is voluntary. You may choose not to take part at all, or if you decide to be in this study, you may stop participating at any time. Under certain circumstances, your participation may end without your consent.

Video Data Release Statement
In the Informed Consent Document, you will be asked to grant permission to release your video data.

Questions
The research team is here to address your concerns and answer questions during your visit.

Do you have any questions?



The truck you will be driving today has an 18-speed transmission without electronic engine control. A liberal amount of slipping the clutch is required to get the truck moving and up to speed. The trailer will be fully loaded. This document describes the three braking systems used in this study (one of which will be used on the truck you drive today) as well as the shifting pattern for an 18-speed transmission.

Vented Air Disc Brakes

Vented air disc brakes are newly developed for the North American market; they are found on some emergency or specialty heavy trucks and are optional on over-the-road trucks. Disc brakes supply mechanical force to the brake via a pneumatic chamber that converts the air pressure into a linear force. Brake output can be "tuned" by using brake chambers of various sizes.

Steer and Drive Axle:

The following foundation brake configurations are used for vented air disc brakes:

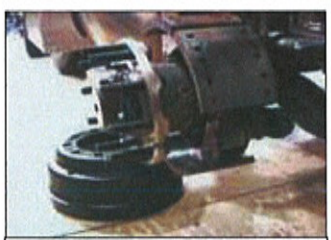
Steer axle: 16.9" diameter. Ventilated air disc rotor, sealed caliper, typically a 20-sq.-in. chamber, no slack adjuster

Drive axle: 16.9" diameter. Ventilated air disc rotor, sealed caliper, typically a 24-sq.-in. chamber, no slack adjuster

Stopping Distance at 75 mph: 371 ft.

S-Cam Drum Brakes

S-cam drum brakes have been used in North America for several decades and currently make up over 90% of the heavy vehicle brakes in the fleet. S-cam drum brakes supply mechanical force to the brake via a pneumatic chamber that converts the air pressure into a linear force. Brake output can be "tuned" by using brake chambers of various sizes.



Steer and Drive Axle:

The following foundation brake configurations are used for S-cam drum brakes:

Steer axle: 15" diameter x 4" wide S-cam drum brake with a 20-sq.-in. air chamber, 5.5" slack adjuster (lever arm)

Drive axle: 16.5" diameter x 7" wide S-cam drum brake with a 30-sq.-in. air chamber (larger chamber = higher air pressure-to-torque "gain"), 5.5" slack adjuster

Stopping Distance at 75 mph: 618 ft.

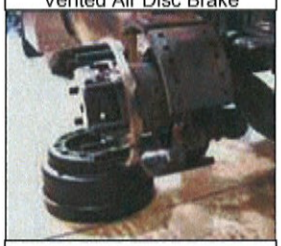
Enhanced S-Cam Brakes
Enhanced S-cam brakes, also known as hybrid disc brakes, employ significantly higher-output discs on the steer axle to supplement standard S-cam drums on the drive axle.

The following foundation brake configurations are used for enhanced S-cam brakes:

Steer axle (Same as vented air disc brakes): 16.9" diameter. Ventilated air disc rotor, sealed caliper, typically a 20-sq.-in. chamber, no slack adjuster
Drive Axle (Same as standard S-cam drum brakes): 16.5" diameter x 7" wide S-cam drum brake with 30-sq.-in. air chamber (larger chamber = higher air pressure-to-torque "gain"), 5.5" slack adjuster

Stopping Distance at 75 mph: 553 ft.

Steer Axle:
Vented Air Disc Brake



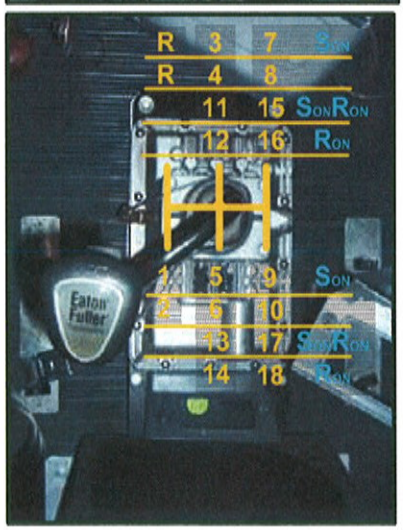
Drive Axle: Standard S-Cam Drum Brake

Shifting pattern for an 18-speed transmission

Flip grey toggle button (SON) clockwise to turn splitter on.

Flip black switch (RON) up to turn the range on.

Follow this pattern for an 18-gear transmission.



8.3 Appendix C: S-cam, Enhanced S-Cam, and Air Disc Brake Models

The S-cam and disc brake characteristics were measured at the brake-dynamometer at VRTC. The brake torque (T_b) is fitted using polynomial functions. The models were adopted from the work of Al Dunn[1]. The brake torque formulation is provided by equation (C1) and plotted at different speeds versus chamber brake pressure, Figure C1.

$$T_b = \begin{cases} 0 & 0 \le P_c \le P_{p0} \\ \sum_{i=0}^{2} C_i (P_0)^i \frac{P_c}{P_0} & P_{p0} \le P_c \le P_0 \\ \sum_{i=0}^{2}\left(\sum_{j=0}^{2} c_{ij} V_{hub}^j\right)(P_c)^i & P_0 \le P_c \le P_{res} \end{cases} \qquad \text{(C1)}$$

Where P_{p0} is the break pressure when the system does not activate, P_0 is the brake pressure where the speed effect is negligible, P_c is the acting pressure, V_{hub} is the hub speed, and C_i's are polynomial coefficients.

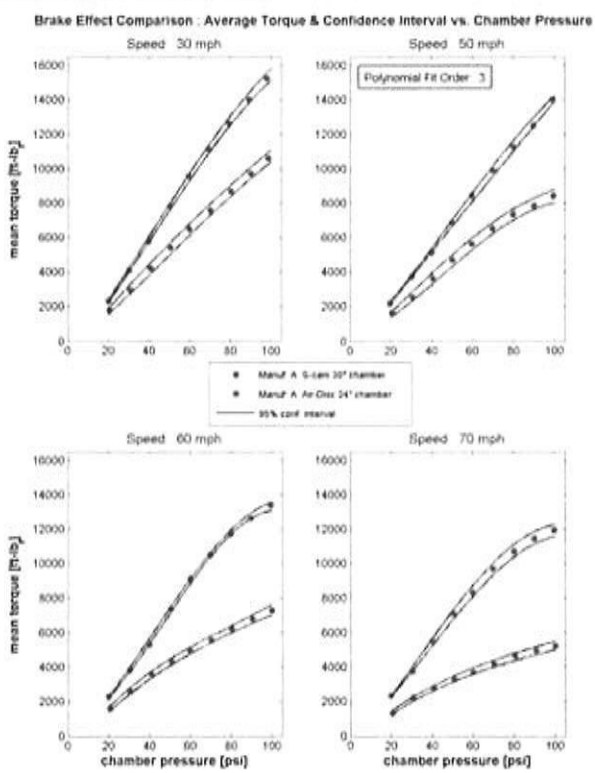


Figure C1. - Brake torque versus chamber pressure for air disc and S-cam brakes

[1] Ashley Dunn, *Jackknife Stability of Articulated Tractor Semitrailer Vehicles with High-output Brakes and Jackknife Detection on Low Coefficient Surfaces*, Ph.D. Dissertation, The Ohio Sate University, 2003

Brake line pressure buildup is modeled as a first-order differential equation with time constants determinant from effective heat coefficients. Brake torque-line pressure hysteresis characteristics are frequently encountered in heavy truck air brake systems, but may not be of significance under low level or normal braking conditions. Large hysteresis can be important under emergency braking conditions where ABS cycling is involved; it can lead to significant reduction in braking performance[2]. Disc brakes exhibit significantly lower hysteresis levels than S-cam brakes as shown by VRTC measurements.

During braking, the kinetic and potential energies of a moving vehicle are converted into thermal energy through friction in the brakes. For a tractor-trailer driving downhill, the driver may need to apply continuous braking in order to maintain a constant speed. If the brakes of a heavy truck are applied for a long time down a steep slope, the brakes loose effectiveness due to excessive temperature. This phenomenon is called brake fade. The NADS heavy truck brake system uses the following generic fade model[3] based on an energy balance at the brakes:

$$T(t+\Delta t)=\left(T(t)-T_{\infty}-\frac{4.628T_{rq}\omega}{hA_r}\right)\exp\left(\frac{-hA_r}{3600m_c}\Delta t\right)+T_{\infty}+\frac{4.628T_{rq}\omega}{hA_r} \qquad \text{(C2)}$$

Where,

$T(t)$	: brake temperature *(°F)*
T_{∞}	: temperature of the environment *(°F)*
T_{rq}	: brake torque *(ft-lb)*
ω	: wheel rotational speed *(rad/sec)*
hA_r	: equivalent heat transfer coefficient *(BTU/(h °F))*
mc	: effective brake mass specific heat *(lb BTU/°F)*
t	: time *(sec)*
Δt	: time step *(sec)*

Textbooks on heat transfer provide a large number of empirical equations for the convective heat transfer coefficients for a variety of test conditions and geometries. These conditions usually apply to discs or drums not disturbed by tires and other wheel components. Road test data obtained from testing heavy vehicles equipped with drum brakes indicate that the convective heat transfer coefficient may be expressed by a functional relationship as follows:

$$hA_r = k_0 + k_1 u \qquad \text{(C3)}$$

Where u is vehicle speed in ft/sec and k_0 and k_1 are coefficients that can be estimated experimentally. These coefficients for tractor-trailer S-cam brakes were estimated to be:

$$k_0 = 50 \ \ BTU/(h\,°F)$$

[2] Johnson, L.K., Fancher, P.S., and Gillespie, T.D. , "An Empirical Model for the Prediction of the Torque Output of Commercial Vehicle Air Brakes." Highway Safety Research Institute, University of Michigan, Report No> UM-HSRI-78-53, 1978

[3] Rudolf Limpert, *Brake Design and Safety*, Society of Automotive Engineers, Inc., ISBN 1-56091-261-8, 1992

$$k_1 = 1.5 \ BTU\ sec/(h\ ^oF\ ft)$$
$$m_c = 0.813 \ BTU/^oF$$

The time constant for the heating/convective-cooling effect is:

$$\tau = \frac{3600 m_c}{h A_r} = \frac{3600 m_c}{k_0 + k_1 u} \ \text{(sec)} \qquad \text{(C4)}$$

The effective brake torque is obtained from reducing the applied brake due to heat effects as follows:

$$Brake_effective = Brake_applied \times \left(1 - F\left(T(t) - T_\infty\right)\right) \qquad \text{(C5)}$$

In equation C5 $F(\ )$ is a function that relates brake torque reduction to temperature increase. This function is defined using cubic spline interpolation of a lookup table of brake effectiveness versus temperature reading. The curve is estimated from dynamometer measurements at VRTC. We should note also that brake fades are not large during emergency stopping on straight roads, and the disc brakes have very low fade effects when compared to S-cam brakes. For the disc brakes the fade reduction factor was decreased significantly. The brake parameters were set such that severe braking from 60 mph provides a stopping distance of 307 feet for standard S-cam brakes, 256 feet for enhanced S-cam brakes, and 215 feet for air disc brakes.

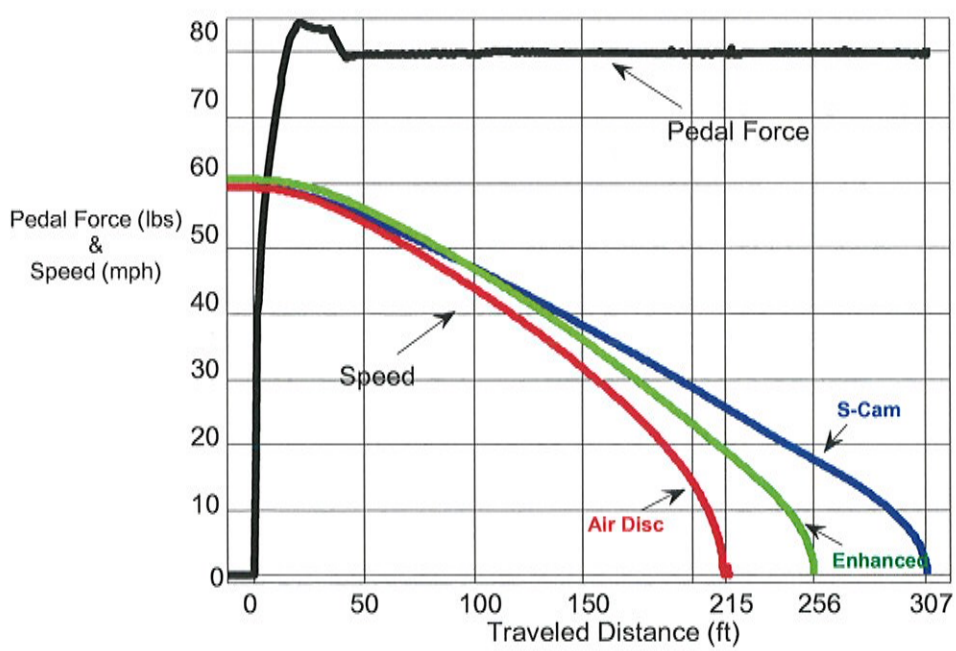


Figure C2. - Stopping distance performances

8.4 Appendix D: Heavy Truck Cab Vibration Measurements

Measurements:

The purpose for the vibration measurements is to provide information regarding the fundamental frequencies and magnitudes associated with the vibration feel inside the cab. Information from the tests was used to actuate the four vertical vibration actuators located inside the NADS simulator dome.

Measurements of vehicle speed, engine RPM, and vertical acceleration within the cab were made with a sampling frequency of 200 Hz. Four accelerometers were mounted in the cab to measure vertical accelerations on the cab floor, dashboard, beneath the driver's seat, and on the steering wheel. The data collected was analog low-pass filtered to 50 Hz. Eight data segments were collected for a 1-minute duration each, for which the test driver maintained constant engine RPM levels of 800, 1000, 1200, 1400, 1600, 1800, 2000, and maximum RPM.

Results:

The vibrations were modeled with harmonic functions to emulate the measured power spectrum. Series of harmonic functions were developed to represent different RPM levels as shown on Figure D1. The harmonic functions are formulated as follows,

$$F = mass \sum_{i=1}^{n} A_i \sin\left(2\pi f_i * time\right) \qquad \text{(D1)}$$

The mechanical range of the vibration actuators is limited to 25 Hz which is sufficient to model the most important measured fundamental frequencies. These frequency modes are at 2 Hz for tractor-trailer sprung mass/spring modes, 5-7 Hz for axle modes, 10-12 Hz for cab modes, and 17-25 Hz for engine and powertrain modes.

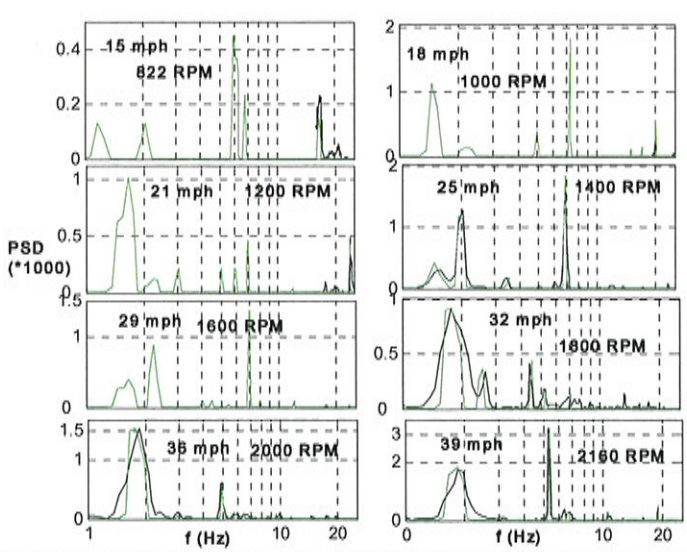


Figure D1 - Power spectrum of measured (driver seat) and modeled harmonic vibrations

8.5 Appendix E: Simulator Data

The data collection requirements for the simulator are listed in the following table.

CSSDC = Change State Signal Data Collection, and indicates that data is collected only when the state changes.

Table E1 Collected *daq* variables

Definition	NADS Variable Name	Units	Collection Freq
Accelerator pedal position	CFS_Accelerator_Pedal_Position	Normalized value between 1 and 0	240 Hz
Auto Transmission Mode *Note - The use of "CFS_Transmission_Gear" and "CFS_Auto_Transmission_Mode" are mutually exclusive for one cab.	CFS_Auto_Transmission_Mode	-2 = Park -1 = Reverse 0 = Neutral 1 = First 2 = Second 3 = Drive 4 = Overdrive	CSSDC
Brake pedal force	CFS_Brake_Pedal_Force	Pounds	240 Hz
Brake pedal position	CFS_Brake_Pedal_Position	Radians of actuator movement	240 Hz
Steering wheel angle	CFS_Steering_Wheel_Angle	Degrees	240 Hz
Steering wheel angle rate	CFS_Steering_Wheel_Angle_Rate	Degrees/sec	240 Hz
Steering wheel torque	CFS_Steering_Wheel_Torque	Foot-pounds	240 Hz
Transfer case mode	CFS_Transfer_Case_Mode	1 = 2H 2 = 4H 3 = Neutral 4 = 4L Generally defaults to 3 but hardcoded to 1 for CTB	CSSDC
Transmission Gear *Note - The use of "CFS_Transmission_Gear" and "CFS_Auto_Transmission_Mode" are mutually exclusive for one cab	CFS_Transmission_Gear	-1 = Reverse 0 = Neutral 1 = First 2 = Second 3 = Third 4 = Fourth 5 = Fifth 6 = Sixth 7 = Seventh 8 = Eighth 9 = Ninth 10 = Tenth 11 = Eleventh 12 = Twelfth 13 = Thirteenth 14 = Fourteenth 15 = Fifteenth 16 = Sixteenth 17 = Seventeenth 18 = Eighteenth 19 = Nineteenth 20 = Twentieth	CSSDC
Cruise Control state	CIS_Cruise_Control	0 – Not available 1 – off 2 – On 3 – Set/Accel 4 – Resume 5 - Coast	CSSDC
Car horn	CIS_Horn	1 – off 2 - on	CSSDC
Turn signals	CIS_Turn_Signal	1 – no turn signal on 2 – left turn signal on 3 – right turn signal on 4 – hazard signals on	CSSDC

Definition	NADS Variable Name	Units	Collection Freq
Angular velocity commanded at the head point	MIF_Head_Point_Angular_Velocities	Degrees/sec	120 Hz
Specific forces commanded at the head point	MIF_Head_Point_Specific_Forces	G's	120 Hz
Left front vibration acceleration, commanded	MIF_LF_Vibr_Accel_Zdd	G's	120 Hz
Left rear vibration acceleration, commanded	MIF_LR_Vibr_Accel_Zdd	G's	120 Hz
Right front vibration acceleration, commanded	MIF_RF_Vibr_Accel_Zdd	G's	120 Hz
Right rear vibration acceleration, commanded	MIF_RR_Vibr_Accel_Zdd	G's	120 Hz
Achieved head point angular velocity	MTS_Head_Point_Angular_Velocities	Degrees/sec	120 Hz
Achieved head point specific forces	MTS_Head_Point_Specific_Forces	G's	120 Hz
Left front vibration acceleration, Feedback	MTS_LF_Vibr_Accel_Zdd	G's	120 Hz
Left rear vibration acceleration, Feedback	MTS_LR_Vibr_Accel_Zdd	G's	120 Hz
Position Commanded – Hexapod Pitch	MTS_Pos_Cmd_Hex_Pitch	Degrees	120 Hz
Position Commanded – Hexapod Roll	MTS_Pos_Cmd_Hex_Roll	Degrees	120 Hz
Position Commanded – Hexapod X	MTS_Pos_Cmd_Hex_X	Inches	120 Hz
Position Commanded – Hexapod Y	MTS_Pos_Cmd_Hex_Y	Inches	120 Hz
Position Commanded – Hexapod Yaw	MTS_Pos_Cmd_Hex_Yaw	Degrees	120 Hz
Position Commanded – Hexapod Z	MTS_Pos_Cmd_Hex_Z	Inches	120 Hz
Position Commanded – Turntable	MTS_Pos_Cmd_TT	Degrees	120 Hz
Position Commanded – X Crossbeam	MTS_Pos_Cmd_X_Crossbeam	Inches	120 Hz
Position Commanded – Y carriage	MTS_Pos_Cmd_Y_Carriage	Inches	120 Hz
Position Feedback – Hexapod Pitch	MTS_Pos_Feedback_Hex_Pitch	Degrees	120 Hz
Position Feedback – Hexapod Roll	MTS_Pos_Feedback_Hex_Roll	Degrees	120 Hz
Position Feedback – Hexapod X	MTS_Pos_Feedback_Hex_X	Inches	120 Hz
Position Feedback – Hexapod Y	MTS_Pos_Feedback_Hex_Y	Inches	120 Hz
Position Feedback – Hexapod Yaw	MTS_Pos_Feedback_Hex_Yaw	Degrees	120 Hz
Position Feedback – Hexapod Z	MTS_Pos_Feedback_Hex_Z	Inches	120 Hz
Position Feedback – Turntable	MTS_Pos_Feedback_TT	Degrees	120 Hz
Position Feedback – X Crossbeam	MTS_Pos_Feedback_X_Crossbeam	Inches	120 Hz
Position Feedback – Y carriage	MTS_Pos_Feedback_Y_Carriage	Inches	120 Hz
Right front vibration acceleration, Feedback	MTS_RF_Vibr_Accel_Zdd	G's	120 Hz
Right rear vibration acceleration, Feedback	MTS_RR_Vibr_Accel_Zdd	G's	120 Hz
Increments every time the Audio trigger fires	SCC_Audio_Trigger	Integer, begins simulation at 0	CSSDC
Bit mask of Audio and Visual states	SCC_DynObj_AudioVisualState	2 integers	60 Hz
Scenario object's color index	SCC_DynObj_ColorIndex	Integer 1 - 5	60 Hz
Cved IDs of Scenario Objects	SCC_DynObj_CvedId	Integer ≥ 0	60 Hz
Indicates how many valid objects in SCC_DynObj Array	SCC_DynObj_DataSize	Integer	60 Hz
Scenario object's HCSM Type	SCC_DynObj_HcsmType	Integer	60 Hz
Headings of Scenario Objects	SCC_DynObj_Heading	Degrees	60 Hz
Name of scenario object	SCC_DynObj_Name	Array of char	60 Hz
Position of scenario object	SCC_DynObj_Pos	Feet	60 Hz
Roll and Pitches of Scenario Objects	SCC_DynObj_RollPitch	Degrees	60 Hz
Sol IDs of Scenario Objects	SCC_DynObj_SolId	Integer ≥ 0	60 Hz
Velocities of Scenario Objects	SCC_DynObj_Vel	Ft/s	60 Hz

Definition	NADS Variable Name	Units	Collection Freq
Lead vehicle follow data	SCC_Follow_Info	An array of 9 floats 1st - identifier of object -1 if none or error 0 if no ownvehicle 2nd - distance to lead vehicle (in feet) 3rd - bumper-to-bumper time to lead vehicle (in seconds) 4th - bumper-to-bumper distance to lead vehicle (in feet) 5th - time-to-collision (in seconds) 6th - lead vehicle velocity (ft/s) 7th – x coordinate of lead vehicle 8th – y coordinate of lead vehicle 9th – z coordinate of lead vehicle	120 Hz
Deviation from center of lane	SCC_Lane_Deviation	Feet	120 Hz
Array of 5 floats	SCC_LogStreams	1st float (Logstream1), 0 – 4, scenario specific value relating to closeness of driver to event. See section 0 for details on this LogStream. 2nd float (Logstream2), 0 or 1 0 = incentives off 1 = incentives on	60 Hz
Over speed limit accumulation	SCC_Over_Speed_Limit	Integer >= 0	60 Hz
Pitch of the driver, in scenario coordinates.	SCC_Scen_Pos_Hex_Pitch	Degrees	CSSDC
Roll of the driver, in scenario coordinates.	SCC_Scen_Pos_Hex_Roll	Degrees	CSSDC
X position of the driver, in scenario coordinates.	SCC_Scen_Pos_Hex_X	Feet	CSSDC
Y position of the driver, in scenario coordinates.	SCC_Scen_Pos_Hex_Y	Feet	CSSDC
Yaw of the driver, in scenario coordinates.	SCC_Scen_Pos_Hex_Yaw	Degrees	CSSDC
Z position of the driver, in scenario coordinates.	SCC_Scen_Pos_Hex_Z	Feet	CSSDC
Turntable position of the driver, in scenario coordinates.	SCC_Scen_Pos_TT	Degrees	CSSDC
Crossbeam position of the driver, in scenario coordinates.	SCC_Scen_Pos_X_Crossbeam	Inches	CSSDC
Cariage position of the driver, in scenario coordinates.	SCC_Scen_Pos_Y_Carriage	Inches	CSSDC
Total number of increments collected at 60 Hz	SCC_Total_Speed_Limit	Integer >= 0	60 Hz
Under speed limit accumulation	SCC_Under_Speed_Limit	Integer >= 0	60 Hz
Signal sent to mirror	SCC_Warning_Lights	0 – no warning 1 – left mirror warning 2 – right mirror warning 3 – both mirror warning	CSSDC
Within speed limit accumulation	SCC_Within_Speed_Limit	Integer >= 0	60 Hz
Type of surface the tire is upon	TPR_Surface_Tire_Friction_Ind	0 – intersections and drivable off-road 14 – road 20 - shoulder	CSSDC
	TPR_Tire_Surf_Type		240 Hz
	TPR_Tire_Surf_Obj_Type		240 Hz

Definition	NADS Variable Name	Units	Collection Freq
Flag to enable/disable ABS system	VDS_ABS_Operating_Flag	0 – ABS system disabled 1 – ABS system enabled	CSSDC
Acceleration pedal position backdrive	VDS_Acc_Pedal_Pos_Backdrive	NA	240 Hz
The type of brake currently in use by the dynamics	VDS_Brakefile_Name	Standard.inp – S-Cam brakes Enhanced.inp – Hybrid brakes Disc.inp – Air disc brakes	
Chassis CG Acceleration	VDS_Chassis_CG_Accel	Feet/sec*sec	240 Hz
Chassis CG angular velocity	VDS_Chassis_CG_Ang_Vel	Deg/sec	240 Hz
Chassis CG orientation	VDS_Chassis_CG_Orient	degrees	240 Hz
Chassis CG position	VDS_Chassis_CG_Position	feet	240 Hz
Chassis CG velocity	VDS_Chassis_CG_Vel	mph	240 Hz
Add to master table	VDS_Curr_Gear		
Output flag, indicates whether ABS is active or not.	VDS_ESP_ABS_ACTIV_FLAG	0 – Not active 1 - Active	CSSDC
Output flag, indicates whether ESC is active or not.	VDS_ESP_ACTIV_FLAG	0 – Not active 1 – Active	CSSDC
Output – Brake pedal drop flag	VDS_ESP_BRAKE_PEDAL_DROP_FLAG	0 – No action 1 – Lower brake pedal to simulation active booster	CSSDC
Output – Brake pedal vibration flag	VDS_ESP_BRAKE_PEDAL_VIB_FLAG	0 – No action 1 – Vibrate brake pedal to simulate feedback	CSSDC
Output – Fault detected flag	VDS_ESP_FAULT	0 – No fault 1 – Fault detected, system shut down	CSSDC
Inputted value, set by run's RCM file, enables/disables ESC.	VDS_ESP_Flag	0 – ESC System disabled 1 – ESC System enabled	CSSDC
Output flag, indicates whether the traction control portion of ESC is active, or not.	VDS_ESP_TRACT_CNTRL_FLAG	0 – Not active 1- Active	CSSDC
Inputted variable – type of ESC	VDS_ESP_Type	1 – Engine torque 2 – Axle torque	CSSDC
Eye point orientation in global coordinate system	VDS_Eyepoint_Orient	Degrees	240 Hz
Eye point position in global coordinate system	VDS_Eyepoint_Pos	feet	240 Hz
Angular velocity of head point	VDS_Head_Pt_Angular_Vel	Deg/sec	240 Hz
Head point specific forces	VDS_Head_Pt_Specific_Force	G's	240 Hz
Output – Light lamp on instrument panel	VDS_LAMP_FLAG	0 – System not active 1 – System active	CSSDC
Wheel torque due to external forces	VDS_Load_Torque	Foot-pounds	240 Hz
Number of grids used for each contact patch	VDS_Num_Grids	NA	CSSDC
Number of tires on vehicle	VDS_Num_Tires	0-10	240 Hz
Commanded Steering Wheel Torque	VDS_Steering_Torque_Backdrive	Foot-pounds	240 Hz
The tire/terrain contact location	VDS_Tire_Ground_Contact	ft	240 Hz
Tire rotational velocity	VDS_Tire_Rot_Vel	Degrees/sec	240 Hz
Tire slip angle	VDS_Tire_Slip_Angle	Degrees	240 Hz
Tire slip ratio	VDS_Tire_Slip_Ratio	0 – 1 norm	240 Hz
Tire weight on wheels	VDS_Tire_Weight_On_Wheels	Pound force	240 Hz
Trailer CG Acceleration	VDS_Trailer_CG_Accel	Feet/sec*sec	240 Hz
Trailer CG angular velocity	VDS_Trailer_CG_Ang_Vel	Deg/sec	240 Hz
Trailer CG orientation	VDS_Trailer_CG_Orient	Degrees	240 Hz
Trailer CG position	VDS_Trailer_CG_Position	Feet	240 Hz
Trailer CG velocity	VDS_Trailer_CG_Vel	Mph	240 Hz
Add to master doc	VDS_Veh_Dynamic_Pres		240 Hz
Engine revolutions per minute	VDS_Veh_Eng_RPM	Rpm	240 Hz
Engine torque	VDS_Veh_Eng_Torque	Foot-pounds	240 Hz
Vehicle heading	VDS_Veh_Heading	Degrees	240 Hz
Vehicle speed	VDS_Veh_Speed	Mph	240 Hz
Transmission revolutions per minute	VDS_Veh_Trans_RPM	Rpm	240 Hz
Commanded Vibration Forces	VDS_VibrForce	G's	240 Hz
Heading angle of wheel	VDS_Wheel_Center_Heading	Degrees	240 Hz
Translational velocity of wheel center	VDS_Wheel_Center_Velocity	Ft/sec	240 Hz
Wheel spin	VDS_Wheel_Spin	Rad/sec	240 Hz

Definition	NADS Variable Name	Units	Collection Freq
Rotational position of tire, in radians	VDS_Wheel_Spin_Angle	Rad	240 Hz
Road wheel angle	VDS_Wheel_Steer_Angle	Rad	240 Hz
Add to master doc	VVS_Horn_Sound		240 Hz
ESC on icon	VVS_Right_Warning_Light	1 – off, 2 - on	CSSDC
Speedometer backdrive	VVS_Speedometer_Backdrive	Mph	240 Hz
Add to master table	VVS_Starter_Sound	Na	240 Hz

Video Data

Video collection took place for the duration of each run and consists of two different video streams. Note that video collection started at the same time the NADS entered the "RUN" state, which coincided with the time that the participant was able to drive. Video collection ended 10 seconds after the operator stopped the simulator, or when an abort, emergency stop, or fire stop signal was generated by any of the NADS or NADS facility subsystems. This means that no video was collected while the simulator was transitioning to the start position or between scenarios.

Stream 1

Stream 1 consisted of the quad split. There was also a recording of it, in mpeg format, on the hard disk. For the mpeg recording, each run was recorded to a different file. There was also a recording of it to digital video tape. Figure E1 shows an example of stream 1, whereas Figure E2 shows the configuration settings for the MPEG recordings.

Figure E1 - Example of quad split

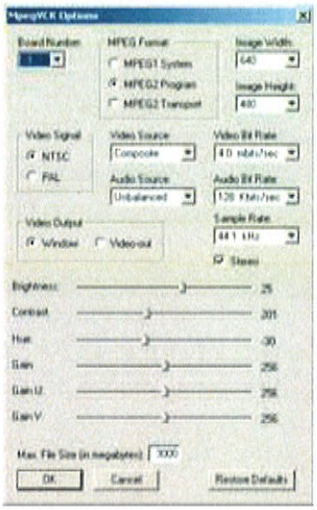


Figure E2 - MPEG VCR settings

Quad split

The quad split's four different views, and their orientation within the screen, are listed below:

a) Upper left: In-cab face camera
b) Upper right: In-dome forward view
c) Lower left: Feet
d) Lower right: In-cab over shoulder

Quad Split Text Overlay

The text overlay appears in the lower right quadrant of the quad split and is shown below, in Figure E3. Items in bold appear verbatim; other items reflect simulator variables as explained below. Whereas variable names are arbitrary, their length indicates the space that will be allowed for that variable on the overlay.

Note that the first line of numbers and the column of numbers on the left will not appear on the overlay; they exist to help determine the lineup of the text and variables of the overlay system.

```
 12345678901234567890
1
2
3BRAKECONDITIONNNN
4DiscBrake_Main
5RUNNAMERUNNAMERUN
6MM/DD/YY HH:MM:SS
7V: VVVVV  SA:STEER
8BP:BRAKE  AP:ACCL
9FRAMENUMD:DISTFT
```

Figure E3 - Text overlay

Table E2 Text overlay variable description

Variable	Meaning
BRAKECONDITIONNNN	The type of brake being used: Standard.inp means S-Cam brakes Enhanced.inp means Enhanced S-Cam brakes Disc.inp means Air disc brakes
RUNNAMERUNNAMERUN	The run's name
MM/DD/YY	Date
HH:MM:SS	Time
FRAMENUM	The frame number
VVVVV	The participant's velocity, in miles per hour
STEER	The steering wheel, angle in degrees
BRAKE	The brake pedal force, in pounds
ACCL	The gas pedal displacement, as a normalized value between 0 and 1
DISTFT	The distance to the vehicle in front of the driver, in feet

Stream 2

Stream 2 was the in-dome, forward view. It was recorded, in mpeg format, onto the hard disk, with each run being recorded to a different file. An example of the stream is shown in Figure E4, and the recording settings are shown in Figure E2.

Figure E4 - Example of forward view

Stream 3

Stream 3 was the quad split. It was recorded, in mpeg format, onto the hard disk, with each run being recorded to a different file.

Stream 4

Stream 4 was the in-dome, forward view. It was recorded, in mpeg format, onto the hard disk, with each run being recorded to a different file.

Details on LogStream1

For all scenarios, LogStream1 started out at 0 and was given a higher value the closer the driver gets to the event. After the event, if the driver hadn't lost control, the LogStream went to 3 or 4. Following are specifics on each scenario.

Table E3 LogStream1 values

Scenario	LogStream1 values
Stopped.scn	0 – at start 1 – set by same trigger that creates event
Stopping.scn	0 – at start 1 - set by same trigger that creates event
RightIncursion.scn	0 - at start 1 – set by Time to Arrival Trigger, same trigger that creates incursion vehicle. 2 - 260 feet beyond incursion driveway
LeftIncursion.scn	0 - at start 1 – set by Time to Arrival Trigger, at the same time as the incursion DDO is created. 2 – set by Time to Arrival Trigger, at the same time as the trigger starts the oncoming ADO to swerve into driver's lane. 3 – 325 feet back from parked DDO location.

Appendix F: Evaluation Of The Integration Of A Heavy Truck Model Into The National Advanced Driving Simulator (NADS)

SEA, Ltd.
7349 Worthington-Galena Rd., Columbus, OH 43085
August 2006

An on-site review of the heavy truck cab integration into NADS was conducted on Wednesday and Thursday, July 19 and 20, 2006. The following items were reviewed.

1) Steering Feel and Vehicle Lateral Response

This section includes:

- Confirmation of Steering Torque/Angle Relationships
- Confirmation of Appropriate Steering System Lash
- Confirmation of CFS Steering Angle Throughput
- Confirmation of CFS Steering Torque Throughput
- Subjective Evaluation of Lane Change and Handling Stability

The relationship between steering torque and steering angle was directly measured in the heavy truck cab using a handheld spring scale and a circle template. The comparable NADS CFS variables (CFS_Steering_Wheel_Torque and CFS_Steering_Wheel_Angle) were recorded simultaneously with the direct measurements. The NADS staff reported that they had replaced and calibrated the steering torque sensor on the heavy truck CFS prior to this evaluation. Figure F1 shows that the direct measurements and CFS variables match fairly well over the range of turning the steering wheel 360 degrees in either direction. The CFS variables are limited to be around 6.25 ft-lb. This is a reasonable level of maximum torque, and it is in line with values measured at VRTC for the actual Volvo-GM heavy truck. The U-shaped characteristic curve is typical of a power-assisted steering system.

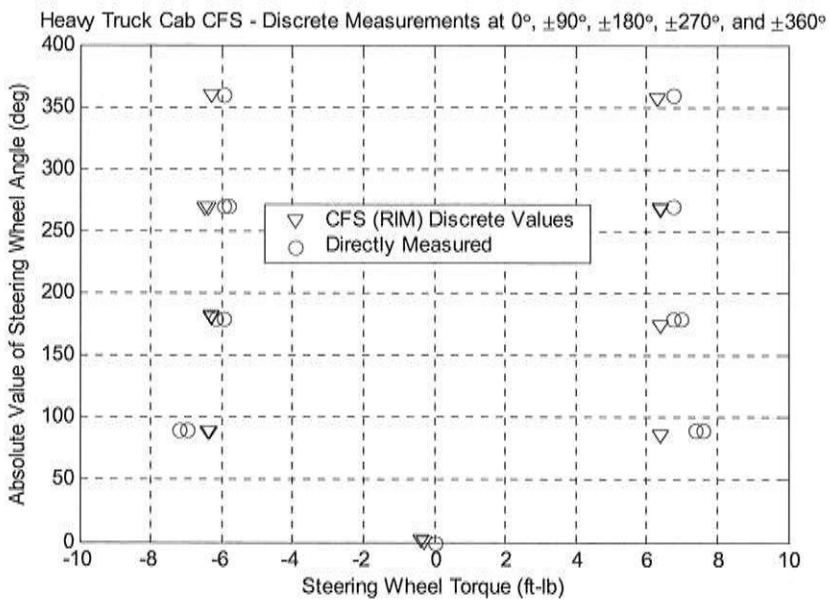


Figure F1 - Direct and CFS Measurements of Discrete Steering Properties

Following the discrete measurements, a continuous sweep of steering through positive and negative 360 degrees was conducted. Figure F2 contains time domain CFS steering data from this test, and Figure F3 shows the steering characteristic curve from this test superimposed over the discrete data (Figure F1). The CFS steering torque and angle measured during the continuous sweep test match the data collected during the discrete position test.

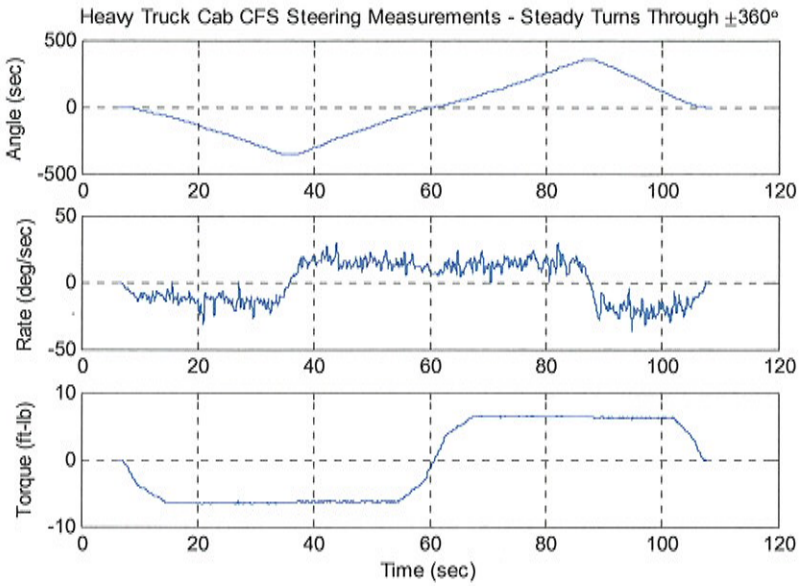


Figure F2 - Time Domain Steering Data from ±360° Steering Sweep

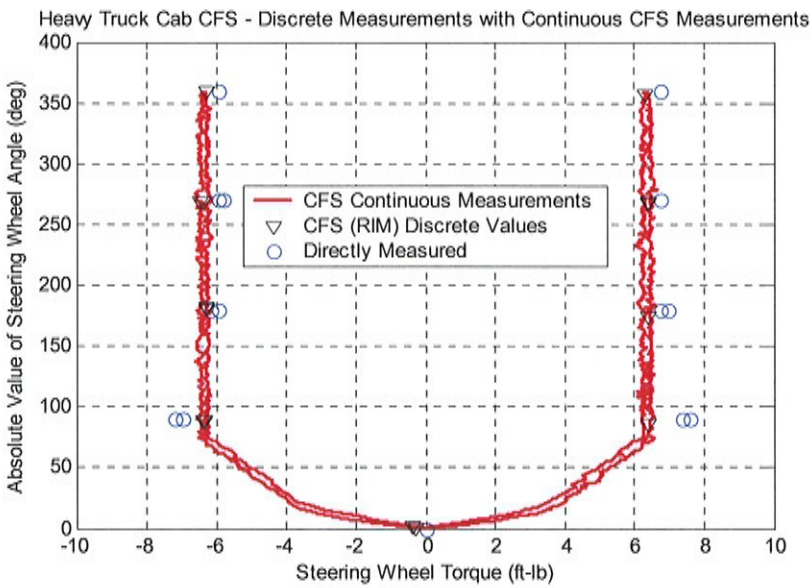


Figure F3 - Continuous CFS Steering Data with Discrete Measurements

To evaluate the on-center steering characteristics of the NADS heavy truck, lower values of discrete steering torque inputs were applied, and the torques and angles were directly measured as before. Figure F4 contains results from the NADS truck cab on-center steering characterization. These values compare very well with measurements made from the continuous steering sweep test, and with the steering characteristic curve measured using VRTC's Volvo-GM heavy truck.

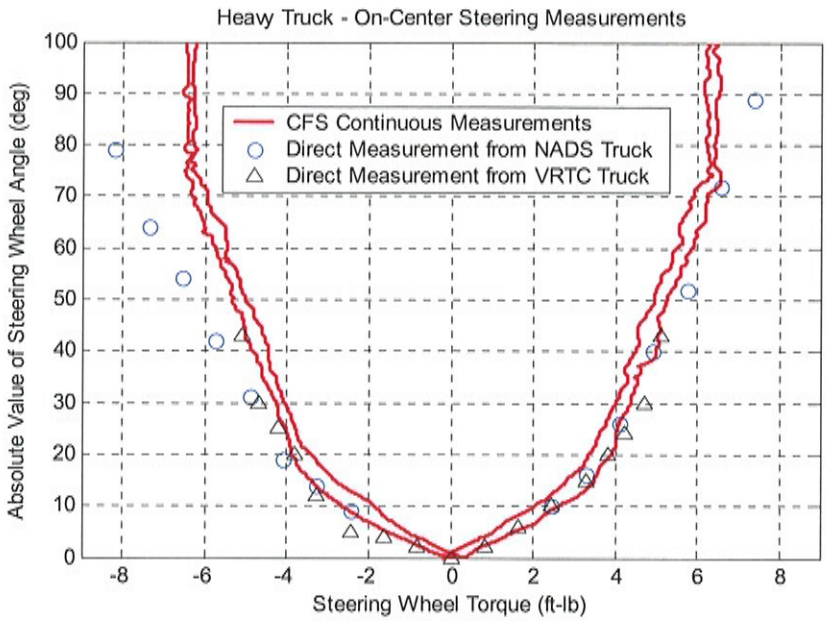


Figure F4 - NADS Heavy Truck On-Center Steering Confirmation

Figure F5 contains steering wheel angle, rate, and torque responses during 90-degree turn and release maneuvers. These tests were conducted to evaluate the free response of the steering wheel. After being released from 90 degrees, the steering wheel returned to its steady-state condition within 0.6 seconds for both the right steer and left steer directions. The responses after the releases did not overshoot, and the graphs indicate that the steering system response is nearly critically damped. The time response and damping of the NADS heavy truck steering is a close representation of the steering response of VRTC's Volvo-GM heavy truck.

Figure F6 is a graph showing CFS steering angles plotted against the measured input steering angles. The graph shows close correlation between the CFS and actual angles, with the greatest difference being less than one degree.

The lash or free play in the NADS heavy truck steering was also evaluated. The steering wheel returned to 1 to 2 degrees when released from 15 degrees. The desired, modeled free play is 2 degrees, so this response is quite good. Also, as before, the steering response was noted to behave as a critically damped system.

The results of the tests to evaluate the NADS heavy truck steering confirmed that the steering torque and angle relationships are being modeled and implemented correctly. The NADS staff made the necessary hardware and software modifications to correctly model the heavy truck

steering behavior, including the power assisted steering and on-center characteristics. The tests conducted also confirmed that the correct values for steering torque and angle are being throughput on the CFS, and that the steering system lash (free-play) on the NADS heavy truck is appropriate. Finally, the steering feel of the NADS heavy truck, evaluated during lane change and other handling maneuvers, was found to be subjectively quite good. The responsiveness, damping, and overall gains of the steering system are representative of the steering system on an actual heavy truck.

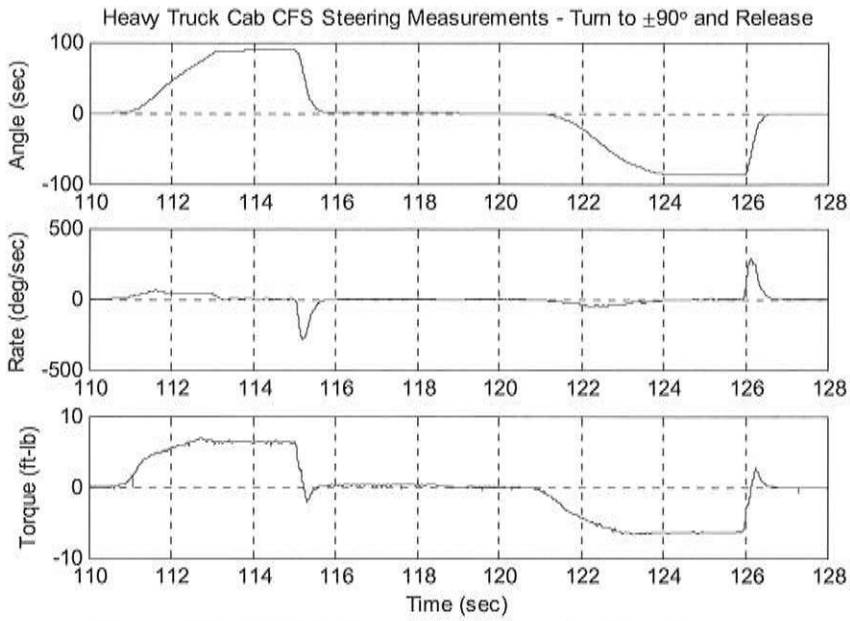


Figure F5 - NADS Heavy Truck Steering Free Response

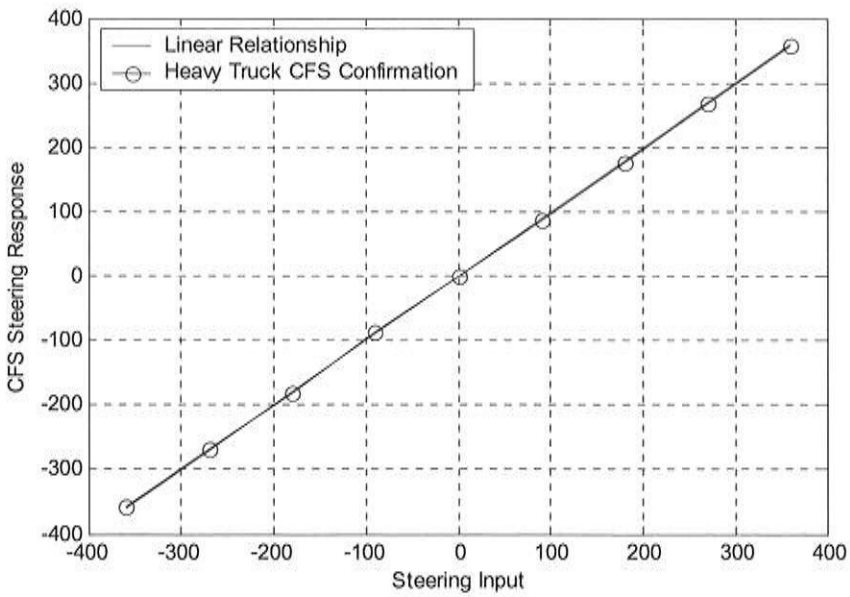


Figure F6 - Confirmation of NADS Heavy Truck Steering Angle

2) Braking System Feel and Vehicle Longitudinal Response

This section includes:

- Confirmation of CFS Brake Pedal Force Throughput
- Confirmation of Stopping Distances for Disk, Hybrid, and S-Cam Brakes

The NADS staff reported that they had recently calibrated the heavy truck CFS brake force sensor (since VRTC's June 2006 visit when the brake force was being scaled within NADSdyna). Correct calibration of the actual force sensor means the CFS brake pedal force is correct. As it should be, the CFS brake force is now being used directly as it is fed as input into NADSdyna.

Figure F7 is a graph of vehicle speed and brake pedal force as a function of distance traveled. This representative run was made with disk brakes modeled on the NADS heavy truck. The stopping distance is very close to the desired stopping distance from 60 mph, which is 215 feet. The stopping distance confirmation maneuvers performed involved very hard brake pedal applications. The brake pedal force on Figure F7 shows that full NADS heavy truck braking was applied. The CFS brake pedal force sensor for the heavy truck records a maximum of 80 lb. This value of 80 lb is also the maximum value of brake force used in the NADSdyna model, and it is very close to the pedal force on the actual Volvo-GM heavy truck that results in maximum brake pressure. The brake pedal force trace in Figure F7 substantiates that the CFS brake pedal force is correct. Stopping distances from 60 mph were also confirmed for the hybrid brake model (in the range of 256 ft) and S-cam brake model (in the range of 307 ft).

Overall, the NADS heavy truck brake system fidelity is very good. The mechanical and pneumatic system in place in the CFS of the heavy truck does a great job of representing the characteristics of the pneumatic braking system of an actual heavy truck. The brake pedal travel on the cab is appropriate and feels like an actual heavy truck brake pedal.

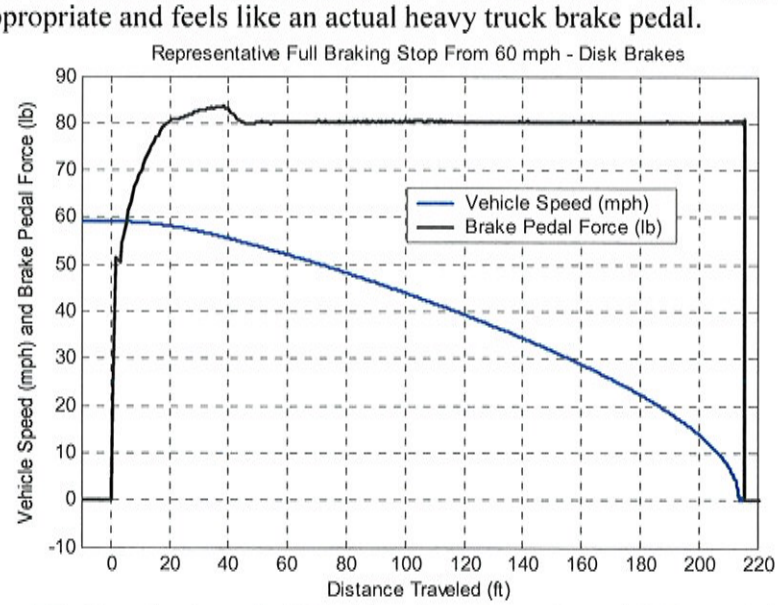


Figure F7 - Results from Full Braking Stop from 60 mph Using Disk Brakes

3) Gear Shift Fidelity

This section includes:

- Clutch Fidelity
- Review of Audio Fidelity
- Throttle (Powertrain) Fidelity and Longitudinal Performance

The NADS heavy truck gear shifting characteristics are quite similar to the actual Volvo-GM truck at VRTC. The shifting patterns are identical, and required shifting efforts are quite similar between the actual and simulator vehicles. The NADS cab exhibits appropriate lack of gear engagement "grinding", and engagement tolerances are appropriately synchronized with engine RPM and vehicle speed.

Engine audio has been added since VRTC's visit in June. Being able to "hear" the engine speed improved shifting realism as well as shifting ease. The engine sounds are good and they are well synchronized with engine RPM. Also, the volume of the engine audio was determined to be good (with the cab windows closed).

During this evaluation, the adjustable "ease-of-shifting" parameter setting was set to 0.5. (with 1.0 being the most difficult). This setting provided for somewhat easier shifting than when the parameter was set to 1.0. The current plan is to use 0.5 for the pilot study, which should provide for good shifting realism and not make it too difficult for the driver to shift.

The NADS heavy truck clutch response is very similar to the clutch response in the VRTC Volvo-GM heavy truck. Clutch engagement and disengagement both occurred near the clutch midstroke. Also, the force required for clutch application in the NADS heavy truck is appropriate.

The throttle displacement and resistance on the NADS heavy truck are good, and the truck's acceleration performance is subjectively good as well.

4) Visual Review

This section includes:

- Review of General Visual Scenes
- Review of Project-Specific Scenarios

There were several problems with the visual scenes identified in June while working on the SDM, such as trees having rectangular, planar frames; yellow center lane markings changing color or intensity; and a database vehicle with disoriented tires. Prior to the July evaluations, the NADS staff worked on fixing these problems, and none of these visual database problems were

noticed when the heavy truck was driven in the NADS. Also, there was some occasional "jitter" in ADO vehicles and the trailer object in the SDM, but none was noticed in the NADS.

All four of the project specific scenarios seem good. The timing of each of the events appears to be as designed, and the level of scenario detail and the "realism" associated with each scenario is appropriate. One of the scenarios includes concrete barriers positioned parallel to the roadway. The barriers were positioned directly on the edge of the travel lane. The proximity of these barriers could cause drivers to slow down and move to the left of the lane. A decision was made to move the barriers slightly off the road to avoid this potential problem.

At the time of this evaluation, NADS staff had not completed their adjustments to the rear view projections to compensate for the locations of the side mirrors. Unlike for a passenger vehicle, for the heavy truck the side mirrors need to reflect portions of the rear of the trailer. The reflected "eyepoint" of the side mirrors is further removed form the driver's actual eyepoint than in a passenger vehicle. Also, in the heavy truck, the driver was no rear window and no rearview mirror. NADS staff will need to complete tuning these adjustments prior to the heavy truck pilot study.

Another visual issue unique to the heavy truck is that the back of the heavy truck cab structure blocks portions of the images from one or more of the rear projectors. This results in a rectangular blacked-out image that can be seen in the side mirrors. This is unnatural and it will possibly be distracting to some subjects. The NADS staff was agreed to look into possibly removing portions of the heavy truck cab structure to alleviate some of this problem.

5) Motion Fidelity

This section includes

- Review of Motion Fidelity
- General Overall Drivability

The NADS staff reported that their preliminary heavy truck runs on the NADS prior to July 19, 2006 contained a steady, low frequency (less than 2 Hz) vertical motion. Review of NADSdyna runs made without motion revealed that there was a steady oscillatory component of vertical acceleration present, even when the vehicle was at zero speed. Oscillations of this type can occur in numerical simulations that are too lightly damped, which was the case here. The value for tire vertical damping (parameter td in the tire data file) that was being used in NADSdyna was too small. There was no testing done to evaluate the heavy truck tire damping, so the initial value used (10,000 N/(m/sec)), roughly five times the value used for passenger vehicle tires, was based on the fact that the tire vertical stiffness for a heavy truck tire is about five times greater than the vertical stiffness of a typical passenger car tire. Increasing the tire damping to 50,000 N/(m/sec) eliminated the numerically generated vertical oscillations. However, review of NADSdyna results from tests conducted during the evaluation period indicated that the value of 50,000 N/(m/sec) was too high. Using this value resulted in improper "settling" of NADSdyna as indicated by incorrect static load distribution among the trailer tires. Subsequent NADSdyna

runs using a value for tire vertical damping of 20,000 N/(m/sec) provided good results with no vertical oscillations and with correct static load distribution.

The NADS motion fidelity while driving through the heavy truck scenarios was good. All motion runs made during the evaluation period were conducted with the tire vertical damping set to 50,000 N/(m/sec). However, using the revised value of 20,000 N/(m/sec) should not affect the motion, as the numerical vertical oscillations are not present in NADSdyna using either value for vertical tire damping.

The overall heavy truck simulation experience in the NADS is very good. Having motion, a larger field of view than the SDM provides, and having engine noise all enhanced the driving experience beyond previous heavy truck experiences in the SDM. Adding high frequency vibrations should further improve the realism of the heavy truck simulations.

6) Review of Cab Vibrations via High Frequency Actuators

Heavy truck cab vibrations, which will be simulated primarily with the high frequency actuators, had not yet been implemented at the time of this evaluation. Subsequently, VRTC completed the heavy truck cab vibration measurements and provided NADS staff with a vehicle and engine speed dependent model for cab vibrations. The plan is to add these modeled vibrations to the NADSdyna vertical acceleration of the chassis. This way, the low frequency components of vertical acceleration will be handling by hexapod motions and the high frequency actuators will handle the high frequency components. This should work well, but it needs to be implemented and evaluated prior to the pilot study.

7) Low Speed Dynamics and Stopping Stability

Considerable effort has gone into the NADSdyna modeling of tire forces in the road plane as a vehicle slows to a stop. These forces must react to hold the vehicle in a steady stopped position. The NADSdyna low speed tire models work very for four wheeled vehicles, but they have not been thoroughly evaluated or tuned for 18 wheel vehicles.

During complete stops with the heavy truck there are small but perceivable transients in the vehicle motions. These transients are dependent on the severity of the stop, on the steer angles of the front wheels, and on the slope and grade of the road. The transients are evident in the visuals as small flutters of the visual scene, but they are not noticeable in the motion, probably because the specific forces generated from stopping mask them. It is likely that subjects will not perceive these stopping transients, because their magnitudes are small and they are not unlike the transients one might expect in a normal stop of a heavy truck. With the high frequency actuators active, the stopping transient issue will likely become even less noticeable. Nonetheless, attention should be paid to determine whether or not the pilot study subjects perceive of or react to these stopping transients.

DOT HS 811 367
October 2010

U.S. Department
of Transportation
**National Highway
Traffic Safety
Administration**

NHTSA
www.nhtsa.gov

May 24th, 2016

Mr. Steve Bywater
bywaterlaw@gmail.com

RE: Negotiated Rulemaking on Over-legal Permitting on the Interstate

Dear Mr. Bywater;

Thank you for the opportunity to comment on the state's efforts to implement Senate Bill 1229, which allows Idaho to permit vehicles up to 129,000 pounds? WinCo Foods LLC has five distribution centers (dc) in several states, with one here in Boise, servicing retail stores in Idaho, Utah, and Washington. Overall, we employee about 16,000 people, with about 1,800 of them in the state of Idaho, and we own and operate about 50 tractors, and about 120 trailers which includes refrigerated, and dry vans in Idaho.

We believe that the existing system of permitting vehicles up to 105,500 pounds on the Interstate works well. In addition, all that we believe is needed, is to implement Senate Bill 1229 is a rule that extends ITD's current ability to permit approved state routes to the Interstate system.

The return of the power to our state to permit vehicles on the Interstate system is a rare occurrence. The federal transportation act that arbitrarily froze Idaho weight limit at 105,500 pounds in 1991-left Idaho at a significant economic and logistical disadvantage compared to our surrounding states. Our ability to increase weights up to 129,000 pounds we believe will help us reduce 1 to 2 full loads out of our Boise DC each day, and at certain times of the month, that number could double. This may not seem like a lot, but several hundred gallons per load, affecting both the impact on the environment, reduce the impact on the fuel burned and our companies spend.

- The intent of the established current requirements, which the state has on 129,000 pounds vehicles, was to improve safety and limit impact on infrastructure. Reducing the number of tractors leaving our Boise DC while increasing the number of brakes will no doubt increase safety.
- Regulatory requirements among the states should be harmonious whenever possible, while at this time we will not be able to haul these heavier loads into Oregon or Washington, this helps us be competitive in Utah, and Montana. These other states have been running on higher truck weights for decades without incident.
- As previously mentioned, more efficient trucks mean fewer trucks on the road, reducing everyone's chances of running into conflict with a semi-tractor and trailer.
- It is our understanding and experience that other states are easier and cheaper when it comes to operating 129,000-pound vehicles, most have recognized that they have less impact on infrastructure. We would like the ability to reduce our impact on the Idaho infrastructure.
- With all of that said, we recognize that 129,000 is not a one-size-fits-all solution. Our research shows that it will work only for certain vehicles and certain commodities. However, a large segment of our business would benefit from this increase in weights, and we are asking for your support in this effort.

Again, thank you for the opportunity to comment on the Idaho Transportation Department's negotiated rulemaking on over-legal permits on the Interstate. If you need to contact me, please call me at 208-672-2317, or email me at david.altman@wincofoods.com

Sincerely,

David Altman

Senior Director of Transportation

WinCo Foods LLC

TRANSYSTEMS

Steve Bywater
Consultant to Idaho Transportation Department
Ramón Hobdey-Sanchéz,
Program Specialist Governmental Affairs
Idaho Department of Transportation
P.O. Box 7129
Boise, ID 83707-1129

RE: Negotiated Rule-making Over-legal permitting and safety requirements

Dear Mr. Bywater and Mr. Hobdey-Sanchéz

Thank you for the opportunity to comment on the over-legal rule making process.

I acknowledge this rule making is limited to permitting and safety issues. Issues that are outside have been addressed elsewhere.

The current Idaho system for permits for vehicles exceeding 80,000 pounds gross vehicle weight has been in place for many years and works well. I am in the camp that we should only change things that are broken and this is not one of them.

As to the safety of trucks over 80,000 and up to 129,000 pounds gross vehicle weight, this is well studied and the conclusions are as clear as they are inescapable. Larger more efficient trucks reduce exposure to potential crashes. If there are 30% fewer trucks on the road the exposure to accidents is reduced by the same percentage.

Without over simplification, the safest vehicle on the road is the one that is not there.

The safety of the more efficient 129,000 pound units has been heavily studied and documented.

Idaho Transportation Department studied 129k units for a fully ten years in its pilot project. The data from that project lead to the conclusion these trucks did not present any safety issues.

Testimony in the congressional record this past session confirmed the safety of these vehicles.

I acknowledge that some opponents will claim "the studies" indicate higher risks but when pressed to identify the specific study and the specific language these claims fail to materialize. In fact some "large truck studies" include every truck over 10,000 pound gross weight. This

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includes most ¾ ton pickup trucks in the "large" classification. This is more than a little misleading.

The equipment itself is also subject to rigorous standards.

The 129,000 pound gross weight trucks are subject to an annual inspection by a certified inspector or a state or federal representative. Each tractor and each trailer are subject to these inspections and the records must be kept for one year.

Additionally, these units have strict performance based braking requirements. The US Department of Transportation uses performance based standards because that places the burden on achieving the desired result rather than a simple equipment requirement that may or may not achieve the result.

It is important to understand these vehicles are not new to highways. They have operated on U.S. highways since the late 1960's. Indeed the 129,000 variant have been operating safely on selected Idaho state roads for more than 10 years. All that is new here is allowing them to be operated on the Interstate system.

Nevada, Utah, Wyoming (state roads only), and Montana have allowed the 129,000 pound units on their state highways and Interstates for decades.

In conclusion, for the scope of this rule making;

a. The current permit system is working and does not need to be changed to accommodate 129,000 pound trucks on the Interstate system
b. Increased training and testing is in place for multiple trailer trucks. This testing is rigorously enforced by FMSCA for all interstate carriers.
c. Equipment safety standards are reviewed and adjusted on at the federal level to assure the safety performance of the vehicles.
d. Allowing 129,000 gross vehicle weights on Idaho Interstates would provide harmonization between Idaho and the neighboring states of Montana, Nevada, Utah and Wyoming.

Thank you for the opportunity to participate in this process.

Kevin Iversen
Vice-president Idaho Operations
Transystems

IDAHO-OREGON FRUIT AND VEGETABLE ASSOCIATION

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May 24, 2016

Mr. Ramon Hobdey-Sanchez
ramon.hobdey-sanchez@itd.idaho.gov
Idaho Transportation Department
3311 W. State Street
P.O. Box 7129
Boise, Idaho 83707

Dear Mr. Hobdey-Sanchez:

The Idaho-Oregon Fruit and Vegetable Association (IOFVASN) was formed in 1962, as a non-profit corporation under the laws of the State of Idaho. It was formed primarily to give service to produce shippers on matters pertaining to transportation and other relative industry problems, particularly matters arising out of the preparation, inspection, and shipment of fresh fruits and vegetables. The IOFVASN represents onion and fruit packers in Idaho and Eastern Oregon. Idaho and Eastern Oregon is home to one of the largest onion growing regions in the United States. The IOFVASN thanks the ITD for the opportunity to provide comments on the potential formal rulemaking.

IOFVASN supports the addition of 129,000-pound trucks into Idaho's transportation system. The IOFVASN also feels that the current system works and should include the 129,000-pound trucks. The ability to haul 129,000-pound loads would be beneficial to the onion and fruit growers and shippers in this area. The larger truck limit would allow growers and shippers the opportunity to move more product to storage facilities and other locations within the state.

The addition of the 129,000 trucks would not be noticeable to the other motorists on the interstate. There are several states that already effectively maintain the 129,000-pound truck limit. The size of the equipment would not be different than what it is now, and the number of trucks would be reduced. With driver shortages being experienced in the United States, fewer trucks would ease this situation. Existing rules in place currently includes 80,000-pound and heavier trucks, should also include 129,000-pound trucks. ITD's study of the 129,000-pound truck safety found no additional safety hazards or additional harm to highways.

The IOFVASN feels that the only change to the rules that ITD would need is to eliminate the phrase "over-legal" and apply the current rules to all vehicles up to 129,000 lb.

Sincerely,

Bill Trask
President

IDAHO SUGARBEET GROWERS ASSOCIATION, INC.

1951 S. SATURN WAY, SUITE 100

BOISE, ID 83709-2924

May 23, 2016

Ramon Hobdey-Sanchez, Program Specialist

Governmental Affairs

Idaho Transportation Department

3311 W. State Street, P.O. 7129

Boise, ID 83707-1129

RE: Negotiated rulemaking concerning overlegal loads and/or vehicles.

Dear Mr. Hobdey-Sanchez;

Having noted ITD's notice of intent to enter into negotiated rulemaking to promulgate rules concerning overlegal loads and/or vehicles, we appreciate the opportunity to provide comments regarding this effort.

The Idaho Sugarbeet Growers Association is an agricultural association representing family farm operations that grow sugar beets across the Snake River Plain of southern Idaho. Safe, efficient transport of our commodity to local receiving stations and factories is very important to these operations.

We were in strong support of Senate Bill 1229 that became law this year authorizing the ITD Board to issue permits for trucks up to 129,000 pounds gross weight on Idaho's interstate highways. We also supported previous legislation including Senate Bill 1117 and pilot projects and studies throughout previous decades relating to 129,000 pound trucks on Idaho roads. The information gathered from these efforts, in addition to data from surrounding states with the more efficient 129,000 pound weight limits, is invaluable as we move forward with this rulemaking endeavor. With this background, we respectfully submit the following comments:

- Rulemaking implementing S1229 should be very simple, straightforward and timely. There are already rules in place for 129,000 pound trucks on state roads that recognize federal standards and accommodate local concerns. Bringing the interstate highways into this process need not be more complicated than the present practice. This should be done quickly to meet Governor Otter's charge "to apply consistent and objective standards for trucks up to 129,000 pounds that seek to use our interstate routes."
- Upon reviewing **IDPA 39.03.01,04,05,07,09,10,11,12,13,15,16,17,18,20,22,and 23** rules governing overlegal permits cited in the Omnibus Notice of Intent to Promulgate Rules-Negotiated Rulemaking (Docket No. 39-0300-1601) we do not identify glaring deficiencies in the existing rules that necessitate a more comprehensive rewrite/revision of the rules and the extensive negotiated rulemaking that would necessitate. It seems that monitoring and enforcing these existing rules would meet Governor Otter's goal of "making our highways safer for all motorists by insisting that all trucks, of every weight and classification, are configured, maintained and driven in ways that maximize public safety."
- If new ideas are proposed through this rulemaking exercise that would make the permit process more efficient, effective and improve customer service, they will likely require more time to promulgate and pass in a separate rulemaking procedure.

We agree with Governor Otter that "In an increasingly integrated and competitive world, safe and efficient transportation of goods and raw materials along our corridors of commerce is critical to our economic growth and prosperity."

Thank you for the opportunity to offer comments.

Respectfully submitted,

Randall Grant, President, Idaho Sugarbeet Growers Association

Mark Duffin, Executive Director, Idaho Sugarbeet Growers Association

cc: The Honorable C.L. 'Butch' Otter, Governor of Idaho

The Honorable Senator Bert Brackett, Chairman, Senate Transportation Committee

The Honorable Representative Joe Palmer, Chairman, House Transportation Committee

Mr. Jerry Whitehead, Chairman, Idaho Transportation Board

the Right Truck for Idaho

Right for Idaho's Economy
Right for Idaho's Road Safety
Right for Idaho's Environment

Idaho Transportation Department
3311 W. State St.
P.O. Box 7129
Boise ID 83707-1129

May 25, 2016

Mr. Ramon Hobdey-Sanchez,

The Right Truck for Idaho Coalition represents a broad cross-section of Idaho business and industry in the development of public policy allowing for the operation of efficient and safe trucks on local, state and federal highways throughout our state. Since 1997, the Coalition has been a strong advocate for policies that allow technologically advanced, fuel efficient and safe state-of-the –art vehicles to access Idaho's highway system. Coalition members – who are listed in an attached document – compose a majority of both Idaho shippers and truckers engaged in intra and interstate shipping in the state and region. As a coalition we are united in our dedication to road safety and are committed to making sure we run our businesses in a manner that protects everyone on Idaho's roads.

As an initial comment, the Coalition extends its appreciation to the Governor, to the Department, the Idaho State Police and to the members of the Legislature who initiated this rulemaking process. This proceeding demonstrates a strong commitment to maintaining the safety of the public on Idaho's highway system.

We begin our comments by addressing the scope of this proceeding. The Notice of Intent in this rulemaking succinctly states the scope as:

> *This negotiated rulemaking is being promulgated in order for the Department to receive public feedback and comments <u>regarding potential improvements</u> to the permitting process and safety requirements for vehicles and loads that are required to operate under an over legal-permit. There will be a focus on potential improvements to the permitting process, safety requirements, regional harmonization, and customer service. (emphasis provided).*

By speaking to "potential improvements" the initial question to be answered in this proceeding is whether the existing rules of the Department or the Idaho State Police by which over legal loads are regulated need to be modified or expanded. The answer to that question is simply answered with a

"no". We submit that there is absolutely no factual basis demonstrating a need to modify or expand the rules. To quote the old adage – "if it isn't broken there's nothing to fix."

What the facts do show is that the existing permitting process and the related safety rules for vehicles requiring "over-legal permits" are fully adequate to protect public safety and have a long, extensive history of doing so. Absent facts that clearly demonstrate the need to amend or expand them they must remain in force as written.

We also note for the record that this proceeding is exclusively for the purpose of potentially modifying existing administrative rules – not amending or modifying existing statutory law. Accordingly, any comments submitted requiring amendments to existing statutes are beyond the scope of this proceeding.

Among many others there are 3 significant and relevant public record documents that support the conclusion that there is no factual basis to amend or expand existing rules. Although these three documents address the use of vehicles operating up to 129,000 pounds' gross weight, by definition vehicles that operate at lesser weights are equally as safe.

1. <u>ITD's Report to the 62nd Legislature on the 129,000 Pound Pilot Project.</u>

In 2003, the Idaho Legislature approved a pilot project to examine the effects of increased truck weights on Idaho roadways and required that the Department conduct extensive studies for a ten-year period to evaluate all potential impacts of 129,000 pound trucks on Idaho state highways. The studies involved more than 264,000 trips made by 127 shipping companies. In its Report to the Legislature on the Pilot Project, which is attached, the Department concluded that "ITD did not observe any significant effect of the 129,000-pound pilot project trucks on pavements, bridges, or safety." In the years since the study was concluded, and as usage of 129,000 pound trucks in Idaho grows, there are no facts that change this conclusion.

2. <u>ITD's Highway Safety Manager's Letter to the Idaho Congressional Delegation.</u>

At the request of Idaho's Congressional Delegation during the recent consideration by Congress of legislation allowing the state to determine vehicle weight limits on the Federal Interstate Highway System in Idaho, the Department's Highway Safety Officer submitted a letter to Congress The letter addressed highway safety as well as bridge and roadway impacts resulting from the operation of vehicles operating at 129,000 pounds. The Highway Safety Manager stated that "allowing heavier trucks on Idaho's Interstate system enhances highway safety by eliminating intersection points of conflict and reducing the potential of violent head-on collisions." A related

conclusion contained in the letter was that the majority of contributing factors in highway accidents would be substantially reduced or completely eliminated allowing 129,000 pound trucks on "Interstate type roadway systems." With the enactment of the federal legislation and the subsequent state enacting legislation allowing 129,000 pound trucks on the interstate, we anticipate a reduction in points of conflict and agree with the Highway Safety Manager's conclusion

3. Governor Otter's Letter to the Idaho Congressional Delegation.

Again, at the request of the Delegation, Governor Otter sent to Congress, during its consideration of the federal legislation, the attached letter which in relevant part stated that vehicle combinations at higher weights "provide notable safety benefits to Idaho motorists."

Conclusion

Idaho has permitted and regulated vehicles with over-legal loads for decades. The system in place is working in an excellent fashion. There is absolutely no evidence to support changing the existing rules providing for the permitting and operation of over-legal vehicles on Idaho highways. Changes to this system could detrimentally affect Idaho businesses who currently work within the rules to safely and efficiently deliver products throughout Idaho and into neighboring states.

Respectfully submitted,

THE RIGHT TRUCK FOR IDAHO COALITION

Arlo G Lott Trucking
Milk Producers of Idaho
Idaho Trucking Association
Food Producers of Idaho
Idaho Forest Group
Transystems LLC
Glanbia Foods
Associated Food Stores
The Amalgamated Sugar Company
NW Dairy Association
Darigold
Idaho Cattle Association

Monsanto
US Ecology Inc.
Scoular Company
Idaho Grain Producers
Idaho Oregon Fruit and Vegetable Association
Idaho Grower Shippers Association
Idaho Farm Bureau Federation
Northwest Grocery Association
Winco
Idaho Dairymen's Association
Idaho Sugar beet Growers Association

IDAHO TRANSPORTATION DEPARTMENT
P.O. Box 7129
Boise ID 83707-1129

(208) 334-8000
itd.idaho.gov

April 2, 2014

Idaho Congressional Delegation
United States Capitol, Washington, DC.

Dear Idaho Congressional Delegation:

Highway Safety is a top priority at the Idaho Transportation Department along with efficient traveler mobility and effective economic growth. In order to enhance market-place competitiveness, Idaho now allows shippers to utilize truck weights up to 129,000 pounds (129K) on certain rural roadway corridors, with the exception of the Interstate system.

Between 2004 and 2012 a pilot study was undertaken to allow 129K trucks to travel on designated two lane two way rural highways. This pilot saw over 264,000 trips made by 127 shipping companies. The top commodities hauled were sugar beets, hazardous waste, aggregates, agricultural feed, coal and hay. The shipping companies reported economic benefits that resulted in significant savings. The most utilized routes by the 129K trucks were on State highways 24, 25, and 78; routes that parallel Interstate 84. These routes are located in southern Idaho.

For the duration of the 129K pilot, highway crash rates were examined for the route classifications of:

- All 129K pilot routes,
- The 129K pilot routes of State highways 24,25, and 78, and;
- All state routes, including Interstates.

The crash rate was greater on the State highway 24, 25, and 78 classification than the other two. It should be pointed out that ITD could not segregate the 129K trucks separately and it is noted that none of the crash rate increases are statistically significant.

For the last ten (10) years, the top contributing factors of crashes involving trucks on State highways 24, 25, and 78 are:

- Intersection conflicts, including improper turn movements and failure to yield
- Inattention
- Improper overtaking – sight distance
- Speed too fast for conditions
- Overcorrection (run-off-the -road) on narrow roadway
- Drove left of center (lane departure) on narrow roadway

These contributing crash factors are reduced or eliminated by the introduction of an Interstate type roadway system with interchanges and grade separations. Allowing 129K trucks on Idaho's Interstate system enhances highway safety by eliminating intersection points of conflict and reducing the potential of violent head-on collisions.

The conclusions of the 129K pilot study indicate there is no significant impact on pavements, bridges, and highway safety. There is also no basis in national research or pavement models for impact to flexible pavements. National research does suggest that bridges are more susceptible to increased loading; however, this was not observed in the 129K pilot.

The economic benefits are proven with this pilot project and allowing 129K trucks on the Interstate system aligns with and fulfills the Idaho Transportation Departments strategic plan of *Your Safety, Your Mobility, Your Economic Opportunity.* It simply makes sense to allow 129K trucks on Idaho's Interstate system, particularly from a safety standpoint. In doing so, this action will support the Idaho Transportation Department's mission of *Toward Zero Deaths* on all of Idaho's roadways.

Sincerely,

Brent Jennings, P.E.
Highway Safety Manager
Idaho Transportation Department

C.L. "BUTCH" OTTER
GOVERNOR

February 21, 2014

The Honorable Mike Simpson
U.S. House of Representatives
2312 Rayburn House Office Building
Washington, DC 20515

Dear Congressman Simpson,

I am writing today to ask your support for amending 23 U.S.C. §127 to increase truck weight limits on interstate highways in Idaho up to 129,000 pounds. This amendment simply removes the current 105,500-pound gross truck weight limit on the federal interstate system in Idaho and allows the state to decide whether to increase the limit up to 129,000 pounds. It is a matter of economic competitiveness and, just as importantly, a matter of enabling a state to make such decisions itself and in its own best interest.

Our Idaho Legislature studied the issue for ten years through a pilot project on state highways, overseen by the Idaho Transportation Department (ITD). The study of 35 southern Idaho pilot routes concluded that there are no significant effects on our pavements and bridges, notable safety benefits for Idaho motorists, and significant economic benefits for Idaho's businesses. Seeing such positive outcomes, our Legislature voted in 2013 to permanently increase the weight limit on the pilot routes, and authorized ITD to establish an administrative process for adding additional routes to the statewide inventory.

Those conclusions were reached based on the ITD study that found the three additional axles on larger trucks provide greater breaking power by distributing the extra weight over more breaks. Additionally, the greater hauling capacity that came from raising the weight limit on the pilot project routes took one out of every five trucks off those roads, reducing traffic and improving safety.

Our economy will grow with the change in interstate weight limits. Local businesses will be able to transport goods to market in fewer truckloads, saving time and money. Accessibility to markets in our neighboring states also will grow. Nevada and Utah already allow 129,000-pound trucks on their interstate highways and Montana and Wyoming have no weight limits at all. Without the authority to raise the weight limits on the interstates connecting to our neighbors, our truckers and the businesses and producers they serve are at a competitive disadvantage.

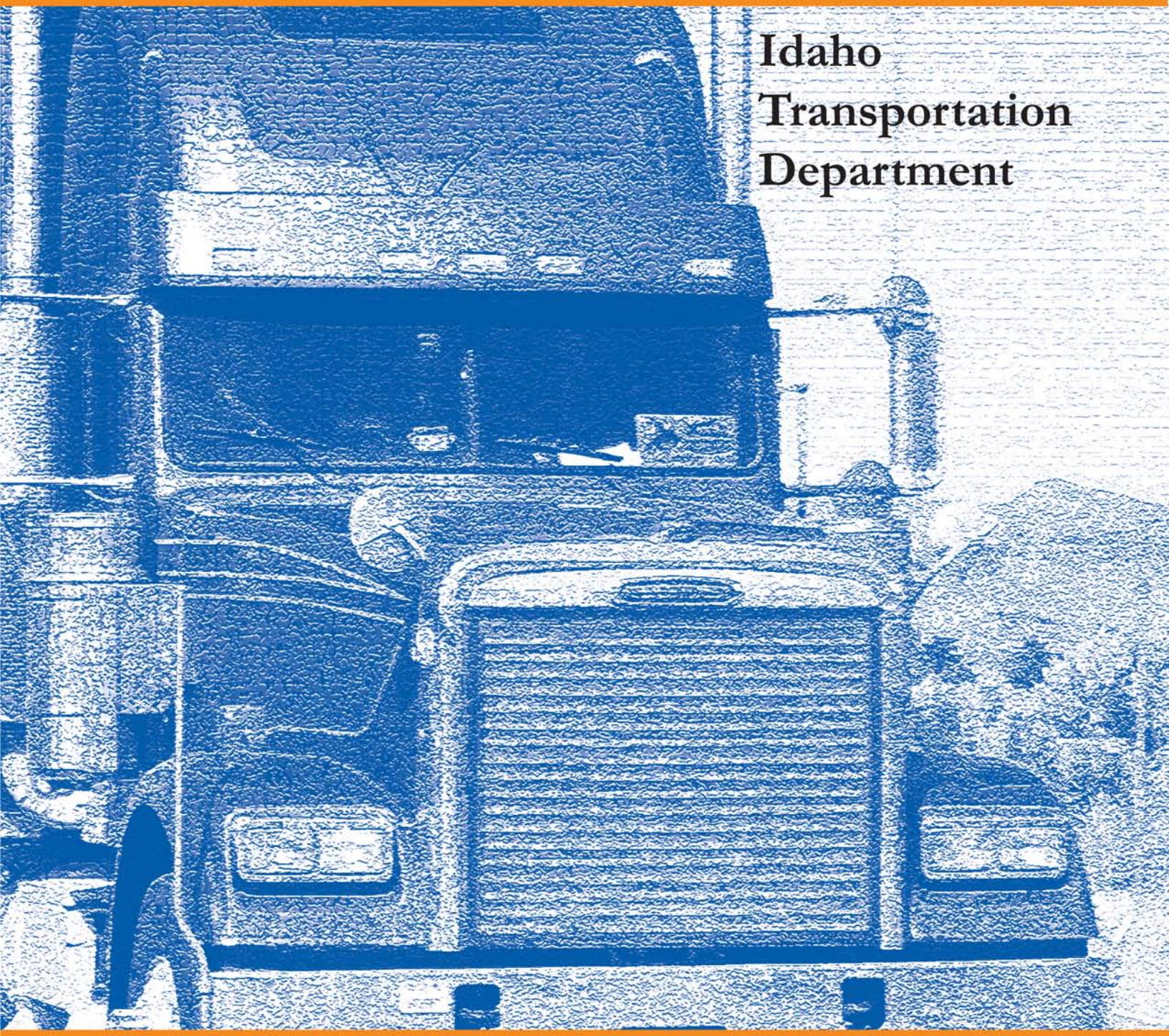
In short, I hope you will join me in standing by efforts to enable Idaho to choose allowing truck weight limits up to 129,000 pounds on Idaho's interstate highway system. Please do what you can to help Idaho progress toward its goals for competitiveness, economic growth and traffic safety. Thank you for your positive consideration.

As Always – Idaho, "Esto Perpetua"

C.L. "Butch" Otter
Governor of Idaho

STATE CAPITOL • BOISE, IDAHO 83720 • (208) 334-2100

129,000 Pound Pilot Project



Idaho
Transportation
Department

Report to the 62nd Idaho Legislature 2013

129,000 POUND PILOT PROJECT

REPORT TO THE 62nd IDAHO STATE LEGISLATURE

JANUARY 2013

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EXECUTIVE SUMMARY

In 2003, the Idaho Legislature passed House Bill 395, which created a pilot project to test the effect of increasing the legal truck weights on State Highways. Trucks configured to increase gross vehicle weight (GVW) from 105,500 pounds to 129,000 pounds were permitted on 16 specified routes. In 2005 and 2007, an additional 19 routes were included for a total of 35 specified routes. At the time the Idaho pilot project began, four states that border Idaho (Montana, Utah, Nevada and Wyoming) already permitted trucks with gross vehicles weights greater than 105,500 pounds.

The Idaho Transportation Department (ITD) was tasked with studying the impacts of the pilot project on roadway safety, bridges, and pavement, and reporting to the Legislature every three years. Previous reports were submitted to the Legislature in 2007 and 2010. This is the final report of ITD's observations over the 10 years of the pilot project.

Between fiscal years 2004 and 2012, there were 264,169 pilot project trips made by 1,359 trucks from 127 different shipping companies. The main commodities hauled were sugar beets, hazardous waste, aggregates, agricultural feed, coal, and hay.

ITD did not observe any significant effect of the 129,000 pound pilot project trucks on pavements, bridges, or roadway safety. Project participants have reported economic benefits associated with this pilot project. Amalgamated Sugar Company estimated that they saved over $2.5 million during the pilot project. US Ecology, Inc. estimated that they had a 6% reduction in the number of trips per year amounting to an estimated total of 7,800 loads since 2004 using pilot project trucks. Their estimated savings from trip reductions has been $70,000-$180,000 per year.

129,000 POUND PILOT PROJECT

BACKGROUND

For years, the trucking industry has requested that the Legislature increase the maximum allowable gross vehicle weight on State routes. They asserted that this weight increase would reduce the number of trips, therefore reducing costs.

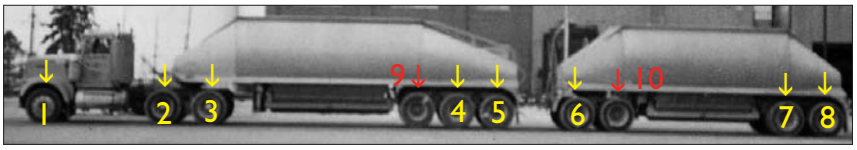
House Bill 623 established the first 129,000 pound pilot project in 1998, allowing 129,000 pound gross vehicle weight trucks on two State routes. It ran from 1998-2001, but because of very limited participation, the results of industry savings or effect on pavements, bridges, or safety were inconclusive. The trucking industry reported that because of the limited routes and short project time frame, it was not economically feasible to purchase specialized vehicles or convert any of their current fleet.

In 2003, the Idaho Legislature reestablished the 129,000 pound pilot project program with the passing of House Bill 395. The bill established a new 10-year study similar to the one implemented in 1998, providing haulers the option to transport heavier loads (up to a GVW of 129,000 pounds) if they purchased a special permit from ITD and used trucks specifically configured to carry the extra weight (see Figure 1 for typical truck configuration). The bill also granted local public highway agencies the authority to allow or disallow the pilot project vehicles on roads in their jurisdiction. Additional routes were added in 2005 (House Bill 146) and 2007 (Senate Bills 1138 and 1180), for a total of 35 designated routes. Senate Bill 1390 in 2008 revised the descriptions of some of the routes for clarification.

House Bill 395 directed the Idaho Transportation Department to "report to the Legislature on the effect of the pilot project program. The Department shall report on the results of its monitoring and evaluation of all important impacts, including impacts to safety, bridges, and pavement on all the State pilot project routes designated." As required, previous reports were submitted to the Legislature in 2007 and 2010. This report is the final report including all observations over the past 10 years.

FIGURE 1

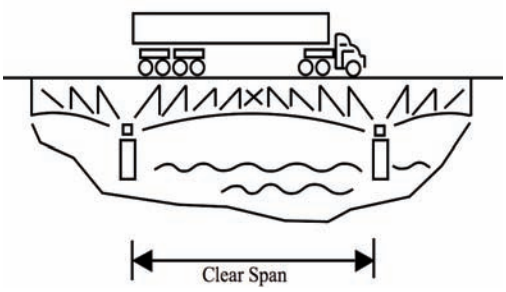
Typical truck configured for 105,500 pounds GVW. (8 axles)



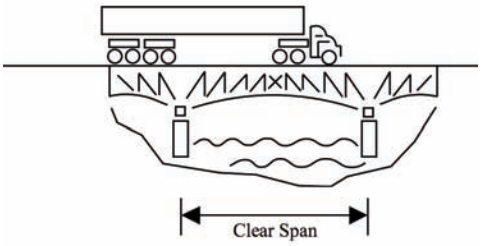
Pilot project truck configured for 105,500 to 129,000 pounds GVW. (10 axles)

NATIONAL RESEARCH

The National Cooperative Highway Research Program (NCHRP) developed a Directory of Significant Truck Size and Weight Research under NCHRP Project 20-07, Task 303 to provide a brief, well organized summary of significant research related to large truck size and weight for use by decision-makers. The Directory was published in October, 2011. This research generated some pertinent information on pavements, bridges, and safety summarized below.



For pavements, axle weight is a more significant determinant of pavement damage than gross vehicle weight. Truck weight limits that allow a higher GVW distributed over more axles do not necessarily lead to higher pavement costs and can even produce savings. Pavement damage typically varies by design/road classification; the same weight vehicle will do exponentially more damage to a rural road than an interstate highway.



For bridges, proposed increases to truck size and weight limits are consistently predicted to increase infrastructure costs. The number of axles on a truck has little impact on bridges; bridge stress is affected more by the total amount of load than by the number of axles. Bridge stress generally increases with axle group weight and, except on some continuous bridges with long spans, generally decreases with the separating distance.

Regarding safety, with some consistency, heavier trucks were associated with less crashes due to fewer trucks needed, but higher crash severity. Oversized, overweight trucks were observed to have slightly higher crash rates due to vehicle handling and stability characteristics. Overall, results relating to truck configuration are inconclusive.

At the time the Idaho pilot project began, four states that border Idaho already permitted trucks with gross vehicle weights greater than 105,500 pounds. Because none of these states have changed their weight policies in many years, it is an indication that they do not consider the heavier trucks to be detrimental. Montana, Utah and Nevada allow gross weights of 129,000 pounds or higher using Federal Bridge Formula B. Wyoming allows 117,000 pounds on Interstate highways and higher gross weights for non-interstate routes. Federal Bridge Formula B is used to determine maximum axle weights and groups of axle weights as well as gross weight. These weight calculations are determined by the number of axles and the axle spacing of the vehicle configuration.

ECONOMIC IMPACT

House Bill 395, which established the 129,000 pound pilot project in 2003 contained the following in its Statement of Purpose:

> "Idaho's sugar beet, potato, wheat and grain, milk and phosphate industries have identified a small number of state highways in southwest, south-central and southeastern Idaho that they would use if selected as test routes under the new pilot project that this bill creates. These industries calcu-

> late that over the 10 year life of the new pilot project they will save millions of dollars in transportation costs because heavier trucks substantially reduce the total number of truck trips necessary to transport their commodities. Because the routes in the bill will be used by these industries, the data necessary to fully evaluate the use of 129,000 pound trucks can finally be obtained."

In order to determine how the pilot project has impacted industry, we looked at studies from other states and we received statements from the companies who have had the greatest participation in the pilot project.

According to the *Directory of Significant Truck Size and Weight Research*, increased truck size and weight limits consistently result in industry cost savings and the magnitude of industry cost savings varies by carrier type, the nature of transportation services offered, and typical commodities transported. Estimated industry cost savings — attributable to increased truck size and weight limits and subsequent use of alternative configurations — generally range from 1.4 to 11.4 percent of annual transport costs in the United States.

In a study titled *Infrastructure and Economic Impacts of Changes in Truck Weight Regulations in Montana* published by Montana State University in Transportation Research Record 1653, the authors note:

> "The infrastructure costs … are but one way in which truck weight limits affect the state's economy. The other economic effect, usually not addressed in truck size and weight studies, is the effect on economic productivity and its consequences."

The Montana study also states "An increase in maximum GVW has a positive impact on the state's economy."

In Idaho, US Ecology, Incorporated (USEI) reported a 3% reduction in costs per year by reducing the number of trips and increasing the payload transported per load from 66,000 pounds to 78,000 pounds, while at the same time slightly reducing average axle weights. They estimate an approximate 6% reduction in the total number of trips per year amounting to an estimated total of 7,800 loads since 2004 using pilot project trucks. Their estimated savings from trip reductions has been $70,000-$180,000 per year. They also realized a large indirect benefit when the Mountain Home Highway District (MHHD) authorized pilot project trucks on roads under its jurisdiction in 2004. This provided an opportunity for USEI to partner with MHHD and the J.R. Simplot Company to pave Simco Road near their rail transfer facility in Elmore County. USEI was then able to bypass the city of Mountain Home and reduce truck-miles traveled, thereby reducing their costs. USEI has estimated their annual savings from paving Simco road to be $1M – $2.1M per year depending on their yearly volume.

The Amalgamated Sugar Company, LLC uses Transystems, Inc. to haul their sugar beets. They reported a total three-year savings of $289,573 for the first three years of the pilot project (2004-2006); a yearly savings between $250,000 and $350,000 for each year from 2007-2009; and a savings of over $450,000 for each year from 2010-2012. They reported that tonnage hauled on pilot project routes has increased from roughly three-quarters of a million tons each year to over 1.3 million tons over the course of the ten years. In the 2011-2012 crop year they reported an estimated 6,212 round trips reduced and an estimated 54,855 gallons of diesel fuel saved through use of pilot project trucks.

Burns Concrete 11-axle bulk cement powder transfer truck for pilot program routes.

Burns Concrete 10-axle aggregate transfer truck and trailer for pilot program routes.

Burns Concrete 5-axle truck and 5-axle pup for pilot program routes.

Several of the industries noted in the Statement of Purpose for House Bill 395 have not been able to participate in the pilot project because the inability to use Interstate Highway routes has limited connectivity to important destinations for these industries. Without the connectivity, they cannot achieve sufficient cost savings to justify the cost of acquiring new trucks or converting existing trucks to be able to haul the additional weight.

DATA COLLECTION

Trips

As a condition of their permit, trucking companies were required to enter into a database the commodity, trip date, origin, destination, and routes traveled for each pilot project load hauled. They entered the information via an online data collection form within 30 days of the trip. Descriptive statistics on this data is presented in Appendix B. During the first three years of the pilot project, trucking companies were sent questionnaires aimed at determining strengths and weaknesses of the program.

Safety

The Office of Highway Safety continuously compiles crash data in an effort to identify disproportionately dangerous road segments and to track improvements in safety. Crashes are separated into categories of

vehicle crashes and commercial vehicle crashes. Pilot program truck crashes were not able to be tracked separately from commercial vehicle crashes. Truck crash rates include all commercial motor vehicle crashes and not just those trucks over 105,500 pounds gross vehicle weight. Commercial motor vehicles are buses, truck tractors, tractor-trailer combinations, trucks with more than two axles, trucks with more than two tires per axle, or trucks exceeding 8,000 pounds gross vehicle weight.

Crashes are tracked on each roadway segment and measured in total number of crashes and crash rate per hundred million vehicle miles traveled. Truck crash rates fluctuate more dramatically than vehicle crash rates because the numbers involved are much smaller, and a small change in the number of crashes can result in a large change in the crash rate.

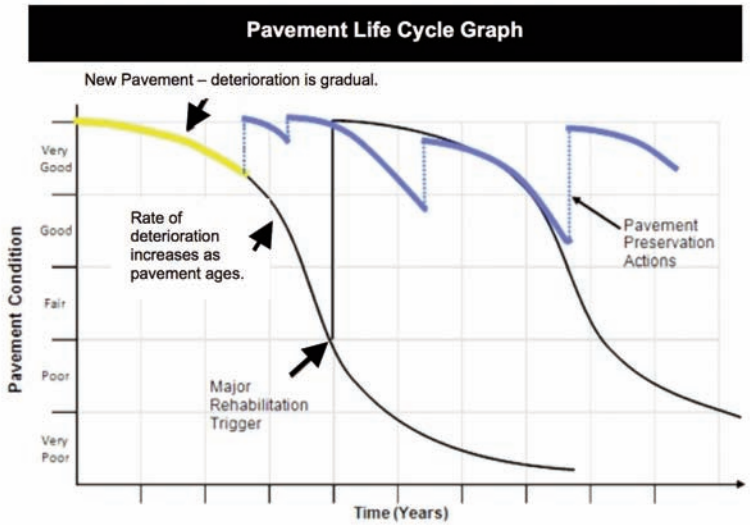
Pavement

Pavement deterioration, over time, is caused by a variety of factors including but not limited to traffic volume and loading; moisture; allowable speed limit; terrain type; solar radiation; and temperature changes. Pavement data is collected annually by both a Pathways Profiler van that measures International Roughness Index and rutting depth, and by visual windshield survey for cracking on all state highways. This data is averaged over road segments to measure a cracking index, roughness index, and rutting depth.

Cracking Index: Repeated cycles of axle loads can cause progressive cracking which results in pavement deterioration. This cracking is due to both the axle weight of each vehicle and the accumulation of the incremental damage that occurs after each axle load passes.

A condition index (Cracking Index) between 0.0 and 5.0 is given to the pavement, based on size and location of cracks, percentage of the roadway surveyed that shows distress, and type of road surface. A 5.0 rating is good pavement with no visible distress and 0.0 is maximum distress. Additionally, the roadways are rated for 6 different types of cracking, and each of those cracking types is assessed for severity and extent (low, medium, and high).

Roughness Index: ITD uses a worldwide standard for measuring pavement smoothness called the International Roughness Index, or IRI. IRI was developed by the World Bank in the 1980's and is used in all of the states, as well as several countries. IRI is used to define a characteristic of the longitudinal profile of a traveled wheel track and constitutes a standardized roughness measurement. The commonly recommended units are meters per kilometer (m/km) or millimeters per meter (mm/m). IRI is gathered by the Profiler van.



The index measures pavement roughness in terms of the number of inches per mile that a laser, mounted on the

Profiler van, jumps as the van is driven along the roadway. Typically, the lower the IRI number, the smoother the ride; **but IRI is not known as a direct measure of rider discomfort.**

Idaho takes the measured IRI values for pavement and compresses them onto a 0.0-5.0 scale, similar to the Cracking Index scale, where 0.0 is very rough and 5.0 is very smooth. ITD calls this the pavement Roughness Index, or "RI". These numbers are collected and reported annually.

Rutting: Like cracking, rutting is dependent upon both the axle load and the number of passes of the axle load. However, because the characteristic (stiffness) of an asphalt pavement that helps it resist rutting can actually make the pavement more prone to cracking, rutting is measured independently to assure the pavement is providing the optimal service. Rutting is the average (in inches) of the rutting that occurs in the left and right wheel paths. This data is collected by the Pathways Profiler Van.

From 1995 to 2008 ITD used Pathway® Profiler van technology and its predecessors to gather the majority of the pavement data. In 2008 ITD purchased a new road profiler van that greatly enhances the quality and quantity of data that can be obtained and processed. The profiler van drives every mile of the state highway system annually and records its progress on video images of both the front view out of the van and the pavement surface. With the new van, the images are of much higher resolution and the rutting detection lasers have been vastly improved. Previous versions used five laser points to collect rutting data; the new van employs 1,280 points.

Bridges

The Code of Federal Regulations requires every state transportation department to conduct bi-annual bridge inspections (pilot route bridges were inspected annually) of all bridges on State routes for the National Bridge Inventory (NBI). As part of the NBI inspection bridge inspectors assign a condition rating for the bridge deck, superstructure, and substructure.

Deck: The bridge deck is the element most susceptible to damage from heavy vehicles. It can exhibit all the same distresses of pavements including rutting, and cracking. The deck rating is on a scale of 0-9 where a 9 represents a new deck and 0 represents a bridge that is closed to service due to a poor deck condition.

Superstructure: The bridge superstructure includes all structural members of the bridge. The superstructure should be less susceptible to damage from heavy vehicles but the damage may be less apparent and more likely to cause a catastrophic failure. The superstructure rating is on a scale of 0-9 where a 9 represents a new superstructure and 0 represents a bridge that is closed to service due to a poor superstructure condition.

Substructure: The bridge substructure includes piers, abutments, piles, fenders, and footings. Deterioration of the substructure is typically due to environmental conditions such as water flow and channel migration rather than traffic. The substructure rating is on a scale of 0-9 where a 9 represents a new substructure and 0 represents a bridge that is closed to service due to a poor substructure condition.

DISCUSSION OF STUDY DATA

Trips

Reported data indicates 127 trucking companies with 1,359 trucks configured to haul a maximum of 129,000 pounds made 264,169 trips on the 35 specified pilot project routes. Of those trucking companies, 12 companies hauled 1 load, 43 companies hauled less than 10 loads, 79 companies hauled less than 100 loads, and 110 companies hauled less than 1,000 loads. Transystems, US Ecology, Inc. and Burns Concrete hauled more than 10,000 loads each, accounting for nearly 80% (180,991 loads) of the total loads. Transystems accounted for more than half of the total loads with 126,999 total loads. The most heavily utilized routes were SH-24, SH-25, and SH-78.

There was a 110% increase in participation in the pilot project between FY 2007 and FY 2008 due to the addition of 18 routes by the Legislature. There were 94,160 total trips made on these additional routes through FY 2012. It allowed additional shipping companies to participate in the pilot program and provided enhanced efficiency for those companies already participating.

Safety

For the purpose of analysis, a crash rate for all vehicles and trucks was calculated for individual pilot project routes, all project routes combined, the most utilized pilot project routes (SH-24, 25, 78) and all State Roads including the Interstate system. Crash rates were calculated for five time periods, one before the pilot project and four during the pilot project. For full results refer to Appendix C.

There was very little difference in the total vehicles crash rate between the pilot project routes, most utilized pilot project routes, and all routes. There was a slight increase (Table 1) in the crash rate for trucks on pilot routes compared to commercial crash rates on non-pilot routes. There was also an increase on the most utilized pilot project routes in comparison to the rest of the pilot routes and non-pilot routes.

Table 1: Commercial Vehicle Crash Rates per Hundred Million Vehicle Miles Traveled.

	FY 2001-2003	FY 2004-2006	FY 2007	FY 2008-2009	FY 2010-2012
All Pilot Routes	103.94	118.93	127.67	115.69	64.00
Pilot SH-24, 25, 78	227.78	301.45	209.46	141.92	152.63
All State Routes	86.74	90.31	87.99	85.62	36.30

None of the increases in crash rates observed are statistically significant. ITD was not able to track pilot project trucks separately from all trucks. ITD requested crash information from the two main haulers. US Ecology, Inc. reported that none of their pilot project trucks were involved in any crashes during the pilot project period. Transystems reported that pilot project trucks were involved in 17 total crashes during the pilot project of which one included an injury and one included a fatality.

Pavement

For the purpose of the analysis, all State Highways in Districts 3, 4, 5, and 6 were separated into two groups:

- Non-pilot project routes which are routes that were never part of the pilot project, and
- Pilot project routes which were at some point involved in the pilot project.

A subset of the most utilized pilot project routes (SH-24, 25, and 78) was also analyzed. A weighted average for the rutting depth, roughness index, and cracking index was calculated for each year. **All segments with incomplete data were removed from the analysis.**

The weighted average for rutting, cracking index, and roughness index for each year were plotted, the results are included in Appendix D. The difference between the weighted average in 2003 prior to the pilot project, and 2012, after the pilot project, are presented below in Table 2. This number represents the deterioration that occurred over that time span, a positive number indicates an improvement.

Table 2: Change in Pavement Indices from 2003-2012.

	Rutting	Cracking Index	Roughness Index
Pilot	0.015	0.434	0.074
Pilot 24, 25, 78	-0.011	0.227	-0.594
Non-Pilot	-0.005	0.412	0.098

For **rutting depths**, the pilot routes improved slightly while the non-pilot and most heavily traveled pilot routes deteriorated slightly.

The **roughness index** improved for both the pilot and non-pilot routes but it deteriorated on the most utilized routes. None of these differences were statistically significant.

The **cracking index** improved for all groups, improving most for the pilot routes and least for the most utilized pilot routes.

The improvement of rutting depth, roughness index and cracking index can be attributed to the pavement projects that were performed on these routes as part of the maintenance that our Districts perform to keep pavement serviceable to the public.

Bridges

For the purpose of analysis, all bridges on State Highways were split into groups: Bridges on Pilot Project routes since 2003 (120 bridges), non-pilot project bridges since 2003 (1,180 bridges), and the most utilized pilot project routes SH-24, SH-25, and SH-78 (16 bridges). For the pilot project routes that were added to the study in 2008 (133 bridges,) the Inspector bridge ratings were compared before and after their inclusion in the project. Bridges that were built during this time period (2003-2011), and bridges that did not have ratings for the entire 10 year period were removed from the analysis.

Table 3: Change in Bridge Condition Indices from 2003-2012.

	Deck	Superstructure	Substructure
Pilot	-0.031	-0.036	-0.030
Pilot SH-24, 25, 78	-0.025	-0.033	-0.024
Non-Pilot	-0.021	-0.007	0.000

Deck, superstructure, and substructure ratings for all three groups deteriorated, with the pilot routes deteriorating the most followed by the most utilized pilot routes, then the non-pilot routes. These results are interesting in that one would expect that if the pilot trucks were causing the observed increase in damage

between the pilot and non-pilot routes, you would see an increase in the deterioration on the most utilized routes over all the pilot routes, which was not the case.

No significant differences were observed in the rate of deterioration on deck, superstructure, and substructure inspector ratings for pilot project bridges, the heaviest used pilot project bridges, and non-pilot project bridges. No significant differences were observed in the rate of deterioration on deck, superstructure, and substructure inspector ratings for the added bridges before and after inclusion in the pilot project. Please refer to Appendix E for the full results.

ISSUES AFFECTING DATA ANALYSIS

There are several issues that have complicated the data analysis for the 129,000 pound pilot project:

- Small sample size
- Pilot project truck impacts vs. annual permit trucks and other truck impacts
- Pavement and bridge rehabilitation
- Route changes

Small sample size
The number of trips made by the project trucks represents a small portion of the total truck traffic on the study routes, and an even smaller portion of the total vehicle volume on most of the routes. Even for those highways most heavily used by study participants (i.e. portions of SH-24, SH-25 and SH-78), the pilot project trucks generally make up less than two percent of the total truck volume. For example, the highest volume of pilot project trips occurred on SH-24 where 97,969 trips were recorded during the past 10 years. By comparison, the ten-year total truck volume for this route was nearly 1.7 million trucks and the 10-year total traffic was 38.4 million vehicles.

Pilot project truck impacts vs. annual permit trucks and other truck impacts
Pavement deterioration over time is caused by a variety of factors, such as traffic volume and loading, moisture, terrain type, allowable speed limit, and temperature changes. Repeated cycles of axle loads can cause progressive cracking which results in pavement deterioration. This cracking is due to both the axle weight of each vehicle and the accumulation of the incremental damage that occurs after each axle load passes. It is not possible to determine what portion of pavement cracking is attributable to pilot project trucks, what portion is due to all other trucks, and what portion is due to moisture and temperature changes.

Annual overweight permits are issued to companies to allow them to haul non-reducible loads in excess of legal weights on designated routes that include all of the pilot project routes. Each permit is issued for a specific truck, but the number and location of the trips made by these trucks is unknown, as they are only required to report the mileage that they travel. Due to the overall weights and the individual axle weights of the trucks allowed by these annual permits, they can exceed those allowed for pilot project trucks, and their effect on pavements and bridges may be considerable. The ratio of annual overweight permits issued compared to pilot project truck permits has been about 20:1.

Also, although the number of non-permitted (illegal) overweight trucks is not known, their impact can be quite significant. The weight carried by these trucks is often concentrated on a limited number of axles within a short wheelbase. This type of configuration is the most damaging to both pavements and bridges, and can also be a safety concern because the truck carries more weight than it was designed to handle.

Pavement and bridge rehabilitation
Planned pavement preservation projects, such as seal coats and maintenance overlays, continue to occur on pilot project routes. Maintenance and preservation projects like sealcoats and thin overlays improve a crack indices by 0.3 points. Larger and deeper projects, such as mill and inlays, cold in place recycles, and partial depth reclamations return a pavement to its best condition at 5.0. It is not possible to establish if there is any long-term pavement deterioration caused by the pilot project in these areas.

Since 2003, bridge rehabilitation and replacement projects on the pilot project routes have continued as scheduled. Since bridge condition is positively influenced by this work, it poses a problem in evaluating the effect of the pilot project on bridges similar to that discussed for pavements.

Route changes
A total of 16 pilot project routes were originally designated in House Bill 395 in 2003. In 2005, the Idaho Legislature passed House Bill 146 which corrected a segment of an originally designated route and resulted in a total of 17 designated routes. In 2007, Senate Bill 1138 was passed which corrected the descriptions of three routes and added 17 new routes for a total of 34 designated routes. Later in the same session. Senate Bill 1180 was passed and added one more route for a total of 35 designated routes.

The goal of adding new highway segments to the study was to increase participation. However, even though the addition of routes has resulted in a proportionate increase in permits, it also means that only half of the routes will have been monitored for the entire duration of the study.

CONCLUSIONS

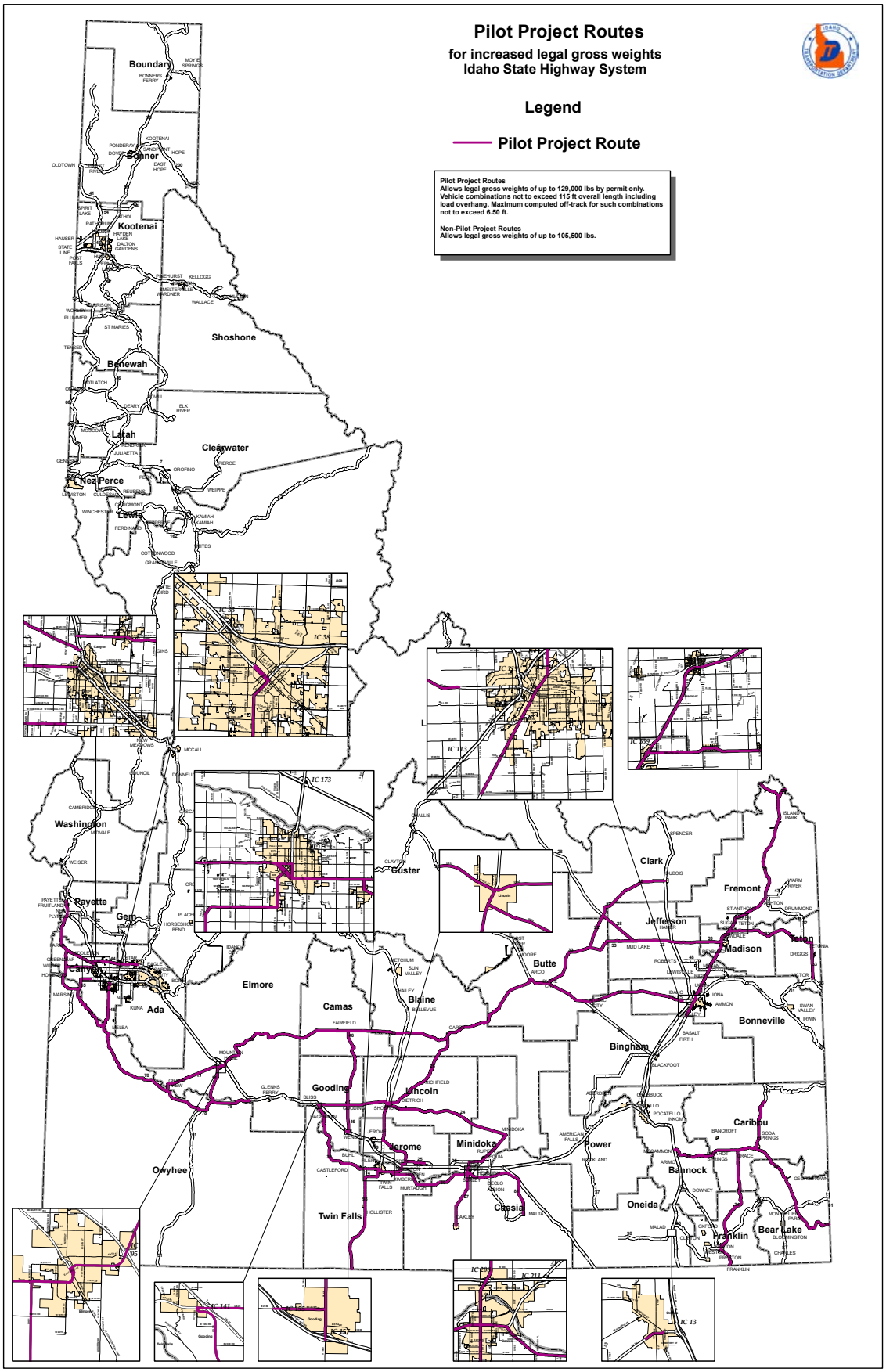
ITD did not observe any significant effect of the 129,000 pound pilot project trucks on pavements, bridges, or safety. The pilot project trucks comprise a small percentage of the overall truck traffic. The collected data has a high variability due to untracked annual permits, illegal loads, and continued pavement and bridge rehabilitation.

There is no basis in national research or current pavement stress models to expect that more weight spread over more axles would cause more damage to flexible asphalt pavements, and none was observed. National research has suggested that rigid concrete pavement may experience increased damage due to some axle combinations, but this relationship has had mixed results in research. This research did not include any pilot project routes on concrete pavement.

National research has suggested that bridges may be more susceptible to damage from vehicles with a higher gross vehicle weight regardless of the amount of axles but it was not observed in this study. A 129,000 pound load exceeds the inventory rating on many State bridges but not the operating rating. According to AASHTO Guidelines (The Manual for Bridge Evaluation) allowing unlimited numbers of vehicles to use the bridge at operating level may shorten the life of the bridge.

Project participants have reported economic benefits associated with this pilot project. Amalgamated Sugar Company estimated that they saved over $2.5 million during the pilot project. US Ecology, Inc. estimated that they had a 6% reduction in the number of trips per year amounting to an estimated total of 7,800 loads since 2004 using pilot project trucks. Their estimated savings from trip reductions has been $70,000-$180,000 per year.

APPENDIX A
Route Information


Pilot Project Routes
for increased legal gross weights
Idaho State Highway System
Legend
Pilot Project Route
Pilot Project Routes
Allows legal gross weights of up to 129,000 lbs by permit only.
Vehicle combinations not to exceed 115 ft overall length including load overhang. Maximum computed off-track for such combinations not to exceed 6.50 ft.
Non-Pilot Project Routes
Allows legal gross weights of up to 105,500 lbs.
Boundary
Bonner
Kootenai
Shoshone
Benewah
Latah
Clearwater
Nez Perce
Lewis
Washington
Payette
Gem
Canyon
Ada
Elmore
Camas
Blaine
Custer
Clark
Fremont
Jefferson
Madison
Teton
Butte
Bonneville
Bingham
Gooding
Lincoln
Jerome
Minidoka
Power
Caribou
Bannock
Oneida
Franklin
Bear Lake
Cassia
Twin Falls
Owyhee

Pilot Project Routes

ROUTE	HIGHWAY	ITD SEGMENT CODE	BEGIN MILEPOST	END MILEPOST	LENGTH	DESCRIPTION
a	US-93	002220	0.000	38.050	38.050	Nevada state line to junction with SH-74
	SH-74	016297	0.010	0.050	0.040	Junction US-93 to SH-74 connector
	SH-74	002210	0.000	7.835	7.835	Junction US-93 to intersection Shoshone Street with 2nd Avenue E and 2nd Avenue N
	SH-74 Conn	007630	0.000	0.129	0.129	SH-74 connector from Washington Street to 3600 N Road
	US-30	002040	217.915	223.505	5.590	2nd Avenue W and Shoshone Street to junction with SH-50
	US-30	002043	217.931	218.674	0.743	2nd Avenue N and Addison Avenue to 2nd Avenue E and Blue Lakes Boulevard
	SH-50	002260	0.000	8.092	8.092	Junction with US-30 to junction with SH-25
	SH-50 Conn	016035	0.000	0.140	0.140	Junction with SH-50 to junction with SH-25
	SH-25	002270	5.353	19.258	13.905	Junction with SH-50 to junction with US-93
	US-93	002220	58.731	73.659	14.928	Junction with SH-25 to junction with SH-75
	US-93	002240	165.950	199.270	33.320	Junction with SH-75 to junction with Old US-93
	US-93	007356	199.270	201.684	2.414	Junction with Old US-93 to milepost 201.684
	US-93	002240	201.850	226.286	24.436	Milepost 201.850 to milepost 226.286
	US-93	002240	226.327	248.555	22.228	Milepost 226.327 to intersection of Grand Avenue and Front Street in Arco
	US-20	002240	248.555	256.073	7.518	Intersection of Grand Avenue and Front Street in Arco to junction with SH-33
	SH-33	002460	0.000	78.236	78.236	Junction with US-20 to junction with US-20 EB off ramp IC #133
	US-20	002070	333.190	348.082	14.892	Junction with US-20 EB off ramp IC #133 to milepost 348.082
	US-20	002070	349.000	406.300	57.300	Milepost 349.000 to Montana state line
				Total Length =	**329.796**	**Miles**
b	US-91	002350	0.000	9.265	9.265	Utah state line to junction with SH-34
				Total Length =	**9.265**	**Miles**
c	I-15B	001340	3.610	4.338	0.728	Junction with I-15 SB On/Off ramps IC#47 to junction with US-30
	US-30	002040	359.493	362.903	3.410	Junction with I-15B to end 2009 realignment
	US-30	002040	362.937	387.020	24.083	Milepost 362.937 to milepost 387.020
	US-30	002040	399.026	455.481	56.455	Milepost 399.026 to Wyoming state line
				Total Length =	**84.676**	**Miles**
d	US-95	001540	26.266	28.941	2.675	Junction with SH-55 to milepost 28.940
	US-95	001540	29.000	33.345	4.345	Milepost 29.000 to milepost 33.345
	US-95	001541	33.345	34.253	0.908	Milepost 33.345 to milepost 34.230
	US-95	001540	34.642	45.440	10.798	Milepost 34.642 to milepost 45.440
	US-95 Conn	030838	45.440	45.509	0.069	Junction with US-95 to junction with US-20/26
	US-95	002070	9.492	9.647	0.155	Junction with US-95 connector to junction with US-20/26
	US-95	001540	45.640	48.630	2.990	Milepost 45.640 to milepost 48.630
	US-95	016040	48.630	49.120	0.490	Milepost 48.630 to milepost 49.120
	US-95	001540	49.120	63.800	14.680	Milepost 49.120 to milepost 63.800
	US-95	001540	64.000	66.000	2.000	Milepost 64.000 to milepost 66 (Fruitland)
				Total Length =	**39.110**	**Miles**

ROUTE	HIGHWAY	ITD SEGMENT CODE	BEGIN MILEPOST	END MILEPOST	LENGTH	DESCRIPTION
e	SH-19	002050	9.070	19.860	10.790	Junction with US-95 (Wilder) to junction with I-84B (Caldwell)
				Total Length =	**10.790**	**Miles**
f	SH-78	002190	0.000	76.004	76.004	Junction with SH-55 (Marsing) to junction with SH-51
	SH-51	002170	69.918	76.582	6.664	Junction with SH-78 to junction with SH-78
	SH-78	002190	82.680	98.640	15.960	Junction with SH-51 to junction with I-84B (Hammett)
				Total Length =	**98.628**	**Miles**
g	SH-67	005320	0.000	2.735	2.735	Junction with SH-78 (Grandview) to milepost 2.735
	SH-67	016410	2.735	3.123	0.388	Milepost 2.735 to milepost 3.123
	SH-67	005320	3.230	16.319	13.089	Milepost 3.230 to Grandview Road
	SH-67	002180	1.471	8.948	7.477	Grandview Road to junction with SH-51 (Mountain Home)
				Total Length =	**23.689**	**Miles**
h	SH-55	001990	0.000	10.614	10.614	Junction with US-95 to junction with Farmway Road
				Total Length =	**10.614**	**Miles**
i	SH-25	002270	46.025	50.830	4.805	Junction with SH-27 (Paul) to its junction with SH-24.
	SH-25	025310	50.830	50.978	0.148	
				Total Length =	**4.953**	**Miles**
j	SH-25	002270	5.353	27.000	21.647	Junction with US-93 to milepost 27 (Hazelton)
				Total Length =	**21.647**	**Miles**
k	SH-24	002280	3.549	3.735	0.186	Junction with SH-25 to junction with old SH-25
	SH-24	002270	51.068	52.455	1.387	Junction with SH-25 to junction with SH-25
	SH-24	002280	5.120	67.533	62.413	Junction with SH-25 to junction with US-93
				Total Length =	**63.986**	**Miles**
l	US-20	002240	256.073	272.000	15.927	Junction with SH-22/33 to junction with US-26
	US-20	002070	263.770	303.512	39.742	Junction with US-26 to Shelley New Sweden Road
				Total Length =	**55.669**	**Miles**
m	SH-34	002360	7.620	50.476	42.856	Junction with US-91 to junction with US-30
	US-30	002040	386.450	387.020	0.570	Junction with SH-34 to milepost 387.020
	US-30	002040	399.026	405.543	6.517	Milepost 399.026 to junction with SH-34
	SH-34	002360	57.757	78.000	20.243	Junction with US-30 to milepost 78
				Total Length =	**70.186**	**Miles**
n	I-15B	001380	4.526	5.250	0.724	Yellowstone Avenue from junction with US-91 to Gallatin Road
				Total Length =	**0.724**	**Miles**
o	US-91	002350	120.561	122.866	2.305	Junction with Canyon Road to junction with I-15B
	US-91	001380	2.323	4.526	2.203	Junction with I-15B to junction with US-26 (Sunnyside Road)
				Total Length =	**4.508**	**Miles**
p	SH-22	002470	24.670	68.606	43.936	Junction with SH-33 to junction with I-15 NB ramps (Dubois)
				Total Length =	**43.936**	**Miles**

ROUTE	HIGHWAY	ITD SEGMENT CODE	BEGIN MILEPOST	END MILEPOST	LENGTH	DESCRIPTION
q	SH-45	002160	9.740	27.725	17.985	Junction with SH-78 to intersection of 2nd Street South and 11th Avenue (Nampa)
	SH-45	002161	27.580	27.650	0.070	Intersection of 3rd Street S and 12th Avenue to intersection of 3rd Street S and 11th Ave.
	I-84B	002040	57.935	58.665	0.730	Junction with SH-55 to intersection of 11th Avenue S and 3rd Street S (eastbound)
	I-84B	002042	57.904	58.670	0.766	Junction with SH-55 to intersection of 11th Avenue S and 2nd Street S (westbound)
	SH-45 Conn	015992	0.000	0.250	0.250	Junction with SH-78 to junction with SH-45
				Total Length =	**19.801**	**Miles**
r	SH-87	002520	0.000	9.133	9.133	Montana border to junction with US-20
				Total Length =	**9.133**	**Miles**
s	SH-33 Spur	002460	99.335	100.000	0.665	Junction with US-20 to junction with SH-33
	SH-33	002460	100.000	135.830	35.830	Junction with SH-33 Spur to MP 135.83
	SH-33	002460	136.000	149.622	13.622	MP 136.00 to junction with SH-31 (Victor).
				Total Length =	**50.117**	**Miles**
t	SH-28	002500	15.150	30.610	15.460	Junction with SH-22 to junction with SH-33
				Total Length =	**15.460**	**Miles**
u	SH-38	002320	0.689	1.318	0.629	Milepost 0.689 to milepost 1.318 at Malad
				Total Length =	**0.629**	**Miles**
v	SH-27	002290	0.000	21.807	21.807	Milepost 0 (Oakley) to junction with I-84B
	I-84B	002290	21.807	24.106	2.299	Junction with I-84B to I-84 WB on-ramp IC#208
	SH-27	002290	24.106	26.561	2.455	I-84 WB on-ramp IC#208 to junction with SH-25 (Paul)
				Total Length =	**26.561**	**Miles**
w	SH-81	002310	0.000	33.978	33.978	Junction with SH-77 (Malta) to junction with US-30 (Burley)
				Total Length =	**33.978**	**Miles**
x	US-30	002040	223.505	257.481	33.976	Junction with SH-50 at Kimberly to junction with SH-27 at Burley
	I-84B	002040	257.481	258.723	1.242	Junction with SH-27 at Burley to junction with SH-81 at Burley
				Total Length =	**35.218**	**Miles**
y	US-93 Spur	002221	0.000	0.910	0.910	Junction with US-30 to junction with US-93 at Twin Falls
				Total Length =	**0.910**	**Miles**
z	US-93 B	002220	46.549	47.457	0.908	Junction with US-30 to junction with US-93 spur at Twin Falls
				Total Length =	**0.908**	**Miles**
aa	US-30	002040	172.595	212.078	39.483	Junction with I-84B at Bliss to junction with US-93 east of Filer
	US-93 B	002040	212.078	216.899	4.821	Junction with US-30 east of Filer to Washington Street at Twin Falls
	US-30	002040	216.899	216.925	0.026	Addison Avenue from Washington Street to MP 216.925
	US-30	002040	217.186	217.915	0.729	MP 217.186 to junction with SH-74 (Shoshone Street)
	US-93 B	002043	217.199	217.282	0.083	Addison Avenue from Washington Street to 2nd Avenue N
	US-30	002043	217.282	217.931	0.649	2nd Avenue N from US-93 (Addison Avenue) to SH-74 (Shoshone Street)
				Total Length =	**45.791**	**Miles**

ROUTE	HIGHWAY	ITD SEGMENT CODE	BEGIN MILEPOST	END MILEPOST	LENGTH	DESCRIPTION
bb	I-84B	002240	138.600	138.970	0.370	Junction with US-30 (Bliss) to junction with I-84 WB on/off ramps IC#141
	US-26	002240	138.970	165.928	26.958	Junction with I-84 WB on/off ramps IC#141 to junction with SH-75 (Shoshone)
				Total Length =	**27.328**	**Miles**
cc	SH-46 Spur	002201	0.000	1.187	1.187	Junction with I-84 EB on/off ramps IC#155 to junction with SH-46 (Wendell)
				Total Length =	**1.187**	**Miles**
dd	SH-46	002200	100.000	116.998	16.998	Junction with I-84 EB on/off ramps IC#157 (Wendell) to MP 116.998
	SH-46	002202	116.998	118.951	1.953	Milepost 116.998 to milepost 118.951
	SH-46	002200	118.951	142.470	23.519	MP 118.951 to junction with US-20
				Total Length =	**42.470**	**Miles**
ee	I-84B	002170	93.538	95.308	1.770	Junction with SH-51 to Milepost 95.308
	I-84B	002070	95.308	95.467	0.159	Milepost 95.308 to junction with US-20
	US-20	002070	95.467	105.940	10.473	Junction I-84B to Milepost 105.94
	US-20	002070	106.000	112.910	6.910	Milepost 106.000 to Milepost 112.910
	US-20	002070	112.980	195.483	82.503	Milepost 112.980 to Milepost 195.483
	US-20	002070	195.530	196.039	0.509	Milepost 195.530 to junction with US-93 at Carey
	SH-51	002170	90.785	92.240	1.455	Junction with SH-67 to Jackson Street in Mountain Home
	SH-51	001021	4.062	4.206	0.144	Junction with I-84B to Jackson Street
	SH-51	001020	4.116	4.309	0.193	Junction with I-84B to end divided SH-51
				Total Length =	**104.116**	**Miles**
ff	SH-51	002170	76.582	90.785	14.203	Junction with SH-78 to Junction with SH-67
				Total Length =	**14.203**	**Miles**
gg	SH-44	002130	0.000	16.180	16.180	Junction with I-84 EB on/off ramps IC#25 to begin Eagle Bypass (Eagle)
	SH-44	015914	16.180	17.640	1.460	Begin Eagle Bypass (Eagle) to Junction with SH-55 (Eagle)
				Total Length =	**17.640**	**Miles**
hh	US-20	002070	9.647	22.129	14.203	Junction with US-95 (Parma) to junction with I-84 WB on/off ramps IC#26
				Total Length =	**14.203**	**Miles**
ii	I-15B	001380	5.250	6.315	1.065	Yellowstone Avenue from Gallatin Road to junction with US-20B (Broadway)
	US-20B	002240	333.044	334.374	1.330	Yellowstone Avenue from Broadway Avenue to Holmes Avenue
	US-20B	002073	2.270	3.717	1.447	Holmes Avenue from Yellowstone Avenue to Junction with US-20
	US-20	002070	309.883	338.927	29.044	Junction with US-20B at Holmes Avenue in Idaho Falls to junction with SH-33at Sugar City
				Total Length =	**32.886**	**Miles**
					1329.498	**Total Pilot Project Miles**

PILOT PROJECT ROUTE DESCRIPTIONS

2003	House Bill 395:	Designated 16 pilot project routes.
2005	House Bill 146:	Changed description of route (n), added 1 route.
2007	Senate Bill 1138:	Changed description of routes (a), (n), and (q), added 17 routes.
2007	Senate Bill 1180:	Added 1 route.
2008	Senate Bill 1390:	Changed several route descriptions to clarify beginning and end.

2003 PILOT PROJECT ROUTES (HB 395)

(a) Ashton to Kimberly to Twin Falls to Nevada using US-20, US-30, SH-33, US-93, SH-25, SH-50 and SH-74.
(b) US-91 from its junction with SH-34 to the Utah border.
(c) US-30 from its junction with I-15 to the Wyoming border.
(d) US-95 south from Fruitland to junction with SH-55.
(e) SH-19 between Wilder and Caldwell.
(f) SH-78 between Marsing and Hammett.
(g) SH-67 from Mountain Home to junction with SH-78 at Grandview.
(h) SH-55 from intersection with Farmway Road to junction with US-95.
(i) SH-25 from the intersection of SH-24 to Paul.
(j) SH-25 from intersection with US-93 to Hazelton.
(k) SH-24 from intersection with US-93 to intersection with SH-25.
(l) US-20 from its intersection with New Sweden Road to its junction with SH-22/33.
(m) SH-34 from milepost 78 to the junction with US-91.
(n) US-26 from the intersection with 45th West to the junction with US-91; and US-91 from the intersection with Canyon Road to the junction with US-26.
(o) SH-22 from Dubois to the junction with SH-33.
(p) SH-45 from junction with SH-78 to intersection with I-84 business loop; I-84 business loop to intersection with SH-55; SH-55 to I-84 interchange no. 35.

2005 PILOT PROJECT ROUTES (HB 146)

(a) through (m) remained the same
(n) US-26 from the intersection with 45th West to the junction with US-91; and US-26 from its junction with US-91 north to its intersection with Gallatin/West 23rd Street.
(o) US-91 from the intersection with Canyon Road to the junction with US-26.
(p) SH-22 from Dubois to the junction with SH-33.
(q) SH-45 from junction with SH-78 to intersection with I-84 business loop; I-84 business loop to intersection with SH-55; SH-55 to I-84 interchange no. 35.

2007 PILOT PROJECT ROUTES (SB 1138)

(a) Montana border to Kimberly to Twin Falls to Nevada using US-20, US-30, SH-33, US-93, SH-25, SH-50 and SH-74.
(b) through (m) remained the same.

(n) US-26 from its junction with US-91 north to its intersection with Gallatin/West 23rd Street in Idaho Falls.
(o) and (p) remained the same.
(q) SH-45 from junction with SH-78 to intersection with I-84 business loop; I-84 business loop to intersection with Nampa Boulevard.
(r) SH-87 from Montana border to junction with US-20.
(s) SH-33 from Victor to junction with US-20.
(t) SH-28 from junction with SH-22 to junction with SH-33.
(u) SH-38 from milepost 0.689 to milepost 1.318 at Malad.
(v) SH-27 from junction with SH-25 at Paul to Oakley.
(w) SH-81 from Malta to junction with US-30 at Burley.
(x) US-30 from junction with SH-81 at Burley to junction with SH-50 at Kimberly.
(y) US-93 spur from junction with US-30 to junction with US-93 at Twin Falls.
(z) US-93 from junction with US-93 spur to junction with US-30 at Twin Falls.
(aa) US-30 from junction with SH-74 at Twin Falls to junction with I-84 business loop at Bliss.
(bb) US-26 from junction with SH-75 at Shoshone to eastbound exit of I-84 interchange no. 141 at Bliss; I-84 business loop from eastbound exit of I-84 to junction with US-30 at Bliss.
(cc) SH-46 spur from junction with SH-46 at Wendell to I-84 interchange no. 155.
(dd) SH-46 from junction with US-20 to I-84 interchange no. 157 at Wendell.
(ee) US-20 from junction with US-93 at Carey to junction with I-84 business loop at interchange 95; I-84 business loop from interchange 95 to junction with SH-51; SH-51 to junction with SH-67.
(ff) SH-51 from junction with SH-67 to junction with SH-78.
(gg) SH-44 from junction with SH-55 at Eagle to junction with I-84 interchange no. 25.
(hh) US-20/26 from junction with US-95 at Parma to junction with I-84 interchange no. 26.

2007 PILOT PROJECT ROUTES (SB 1180)

(a) through (hh) remained the same.
(ii) US-20 from junction with US-33 at Sugar City south to junction with US-20 business loop/Holmes Avenue; US-20 business loop/Holmes Avenue south to junction with US-26/Yellowstone; US-26 from intersection with US-20 business loop/Holmes Avenue south to Gallatin.

2008 PILOT PROJECT ROUTES (SB 1390)

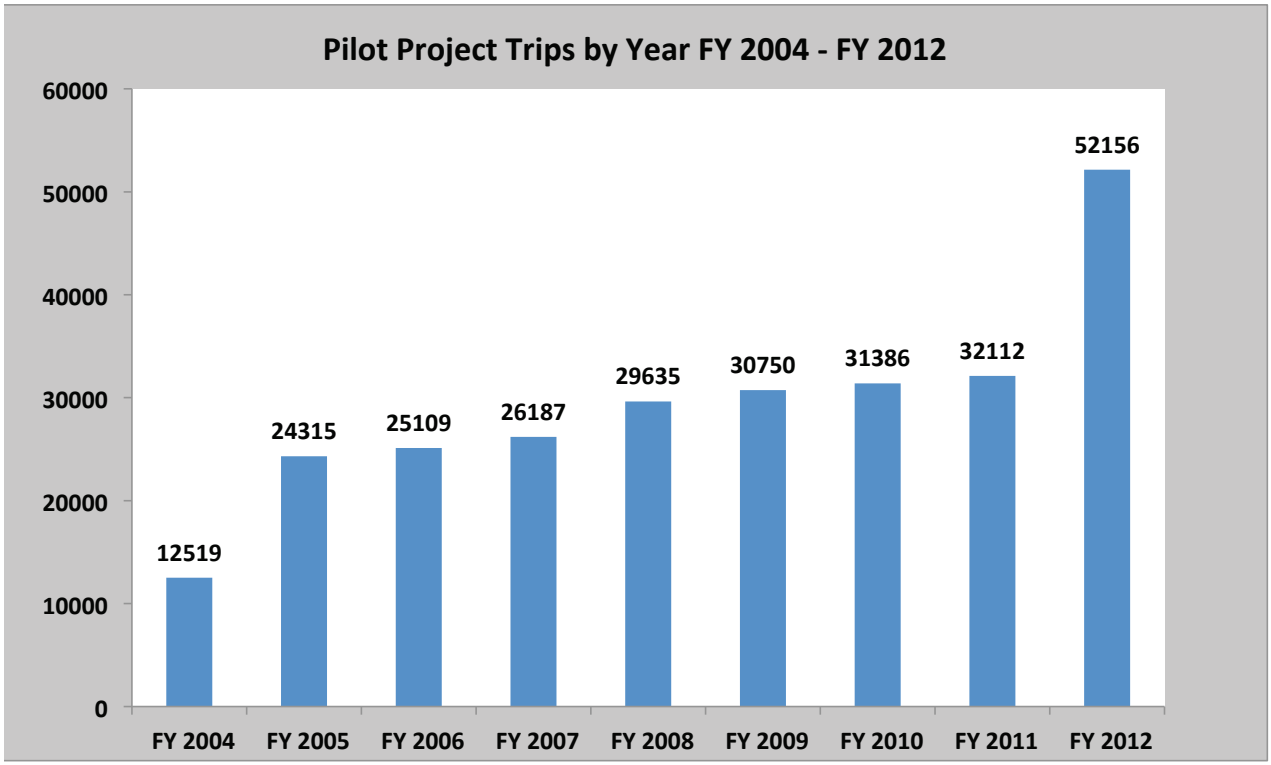
(a) US-20 Montana border to its junction with SH-33; SH-33 to its junction with US-20; US-20 to its junction with US-93; US-93 to its junction with SH-25; SH-25 to its junction with SH-50; SH-50 to its junction with US-30; US-30 to its junction with SH-74; SH-74 to its junction with US-93; US-93 to the Nevada border.
(b) and (c) remained the same.
(d) US-95 south from milepost 66 (Fruitland) to its junction with SH-55.
(e) SH-19 from its junction with US-95 (Wilder) to its junction with I-84B (Caldwell).
(f) SH-78 from its junction with SH-55 (Marsing) to its junction with SH-51; SH-51 to its junction with SH-78; SH-78 to its junction with I-84B (Hammett).
(g) SH-67 from its junction with SH-51 (Mountain Home) to its junction with SH-78 (Grandview).

(h) remained the same.
(i) SH-25 from its junction with SH-24 to its junction with SH-27 (Paul).
(j) SH-25 from its junction with US-93 to milepost 27 (Hazelton).
(k) SH-24 from intersection with US-93 to its intersection with SH-25.
(l) through (o) remained the same.
(p) SH-22 from its junction with I-15 northbound ramps (Dubois) to its junction with SH-33.
(q) SH-45 from its junction with SH-78 to its junction with I-84 business loop; I-84 business loop to its junction with exit 35 (Nampa Boulevard/Northside Boulevard).
(r) remained the same.
(s) SH-33 from its junction with SH-31 (Victor) to its junction with SH-33 spur; SH-33 spur to its junction with US-20.
(t) and (u) remained the same.
(v) SH-27 from its junction with SH-25 (Paul) to its junction with I-84B (Burley); I-84B to its junction with SH-27; SH-27 to milepost 0 (Oakley).
(w) SH-81 from its junction with SH-77 (Malta) to its junction with US-30 (Burley).
(x) through (aa) remained the same.
(bb) US-26 from its junction with SH-75 (Shoshone) to its junction with I-84 exit 141 westbound ramps (Bliss); I-84 business loop from its junction with I-84 exit 141 westbound ramps to its junction with US-30 (Bliss).
(cc) SH-46 spur from its junction with SH-46 (Wendell) to its junction with I-84 exit 155 eastbound ramps.
(dd) SH-46 from its junction with US-20 to its junction with I-84 exit 157 eastbound ramps (Wendell).
(ee) and (ff) remained the same
(gg) SH-44 from its junction with SH-55 (Eagle) to its junction with I-84 exit 25 eastbound ramps.
(hh) US-20/26 from its junction with US-95 (Parma) to its junction with I-84 exit 26 westbound ramps.
(ii) remained the same.

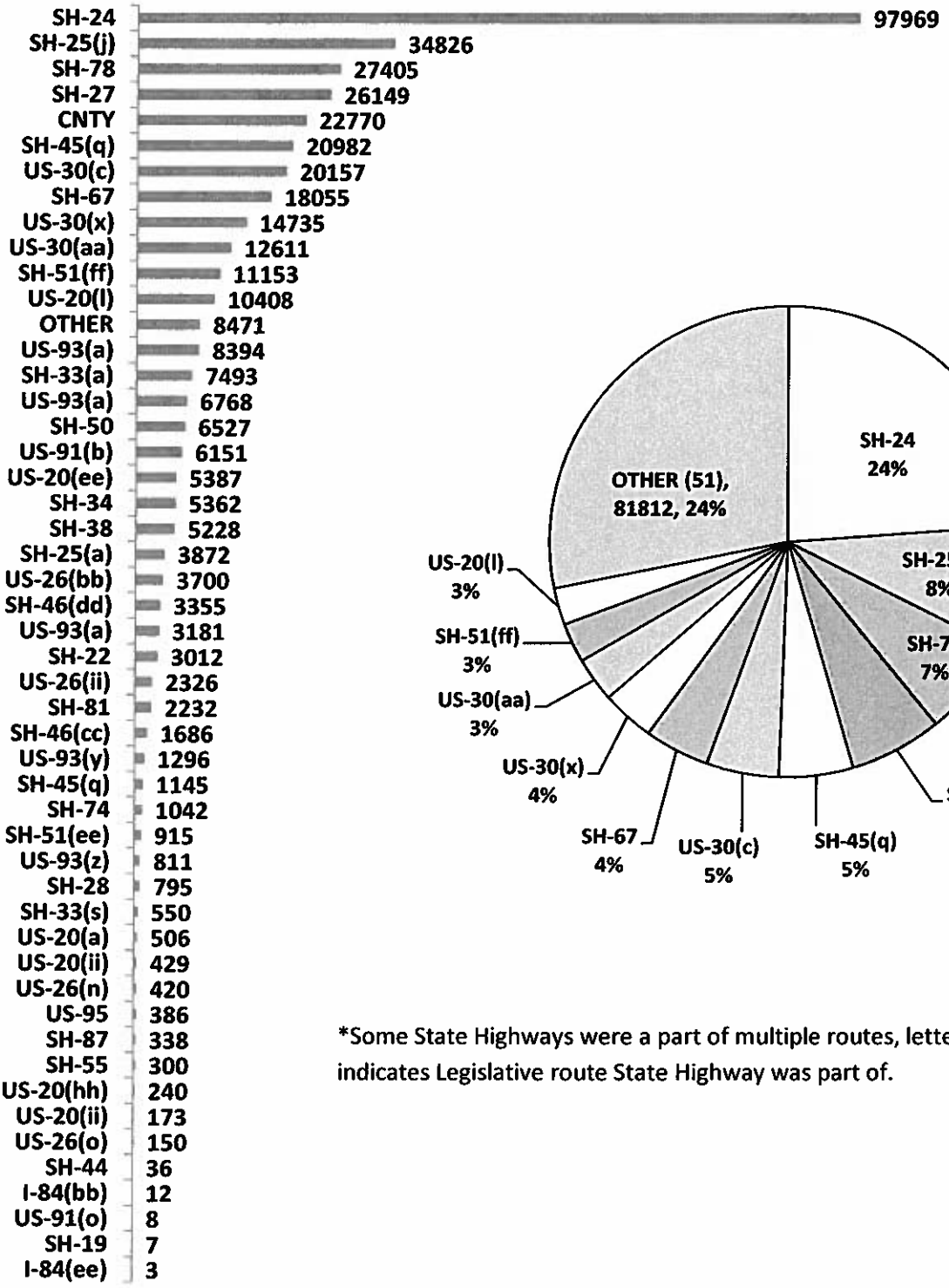
APPENDIX B
Trip Information

PILOT PROJECT TRIPS BY MONTH AND YEAR

Pilot Project Trips by Month FY 2004 - FY 2012										
Month	FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	
July	44	81	974	3,016	1,235	978	1,003	2,114	1,359	10,804
August	199	25	856	971	1,299	792	1,038	2,218	1,427	8,825
September	244	1,188	1,013	1,178	2,532	1,873	2,777	2,556	2,978	16,339
October	269	2,837	5,982	2,956	1,579	5,323	5,740	2,177	5,399	32,262
November	2,043	5,103	5,960	3,099	2,080	6,314	6,269	1,203	7,760	39,831
December	1,868	5,200	3,478	2,748	945	3,880	7,317	967	8,587	34,990
January	4,340	3,956	2,321	4,412	6,278	5,915	735	6,495	7,811	42,263
February	3,031	2,344	2,621	3,369	5,670	2,013	840	5,233	7,395	32,516
March	293	945	595	1,520	4,407	995	923	5,336	4,912	19,926
April	104	580	404	998	1,277	1,037	1,155	1,169	1,836	8,560
May	43	875	457	905	1,249	761	1,513	1,380	1,419	8,602
June	41	1,181	448	1,015	1,084	869	2,076	1,264	1,273	9,251
	12,519	24,315	25,109	26,187	29,635	30,750	31,386	32,112	52,156	



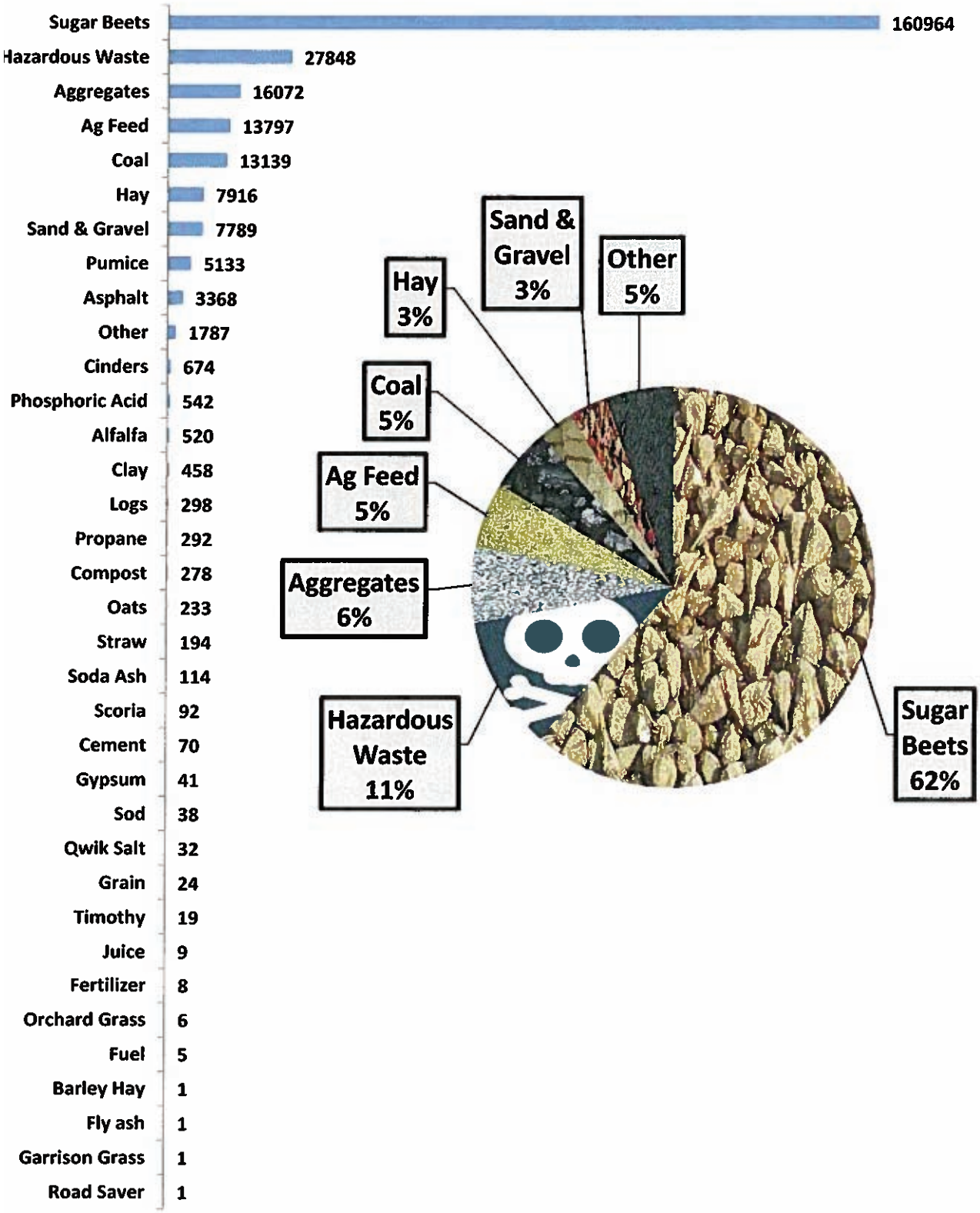
PILOT PROJECT TRIPS BY ROUTE FY 2004 - FY 2012



*Some State Highways were a part of multiple routes, letter indicates Legislative route State Highway was part of.

PILOT PROJECT TRIPS BY COMMODITY

FY 2004 - FY 2012



TRAFFIC VOLUMES PER HIGHWAY

Segment Information					All Vehicles				Trucks				Pilot Trucks				Totals	
Code	Route	Segment	SecBeg	SecEnd	FY 4'-6'	FY 7'-9'	FY 10'-12'	Total	FY 4'-6'	FY 7'-9'	FY 10'-12'	Total	FY 4'-6'	FY 7'-9'	FY 10'-12'	Total	% Truck	% Veh
a	US-93	002220	0.000	38.050	4,287,578	4,314,846	3,987,260	12,589,684	899,519	907,832	844,245	2,651,596	72	251	2,858	3,181	0.120%	0.025%
	SH-74	016297	0.010	0.050	1,899,800	1,059,400	912,500	3,871,700	230,160	164,400	164,250	558,810	92	207	743	1,042	0.186%	0.027%
	SH-74	002210	0.000	7.835	9,665,846	10,745,582	5,292,500	25,703,928	437,688	455,936	359,160	1,252,784						
	SH-74 Conn	007630	0.000	0.129	2,305,833	2,791,135	2,869,265	7,966,233	214,102	311,264	310,980	836,346						
	US-30***	002040	217.915	223.505	8,252,943	12,421,797	11,774,900	32,449,640	121,650	1,274,270	1,157,050	2,552,970	0	106	12,505	12,611	0.494%	0.039%
	US-30***	002043	217.931	218.674	7,207,890	8,260,552	7,885,460	23,353,902	149,029	199,472	195,275	543,776						
	SH-50	002260	0.000	8.092	3,959,183	4,122,270	4,244,585	12,326,038	877,884	782,206	812,490	2,472,580	47	1,739	4,741	6,527	0.264%	0.053%
	SH-50 Conn	016035	0.000	0.140		255,700		255,700		87,680		87,680						
	SH-25*	002270	5.353	19.258	658,417	724,485	862,130	2,245,032	71,588	218,104	237,615	527,307	268	845	2,759	3,872	0.734%	0.172%
	US-93	002220	58.731	73.659	5,536,631	5,717,528	5,706,410	16,960,569	784,000	858,140	825,995	2,468,135	530	2,339	3,899	6,768	0.274%	0.040%
	US-93	002240	165.950	199.270	1,337,899	1,274,666	1,467,665	4,080,230	230,042	279,506	293,460	803,008	585	3,025	4,784	8,394	1.045%	0.206%
	US-93	007356	199.270	201.684	935,240	1,052,100	1,237,350	3,224,690	219,200	204,600	186,150	609,950						
	US-93	002240	201.850	226.286	1,267,992	1,177,104	1,427,515	3,872,611	248,802	253,893	248,565	751,260						
	US-93	002240	226.327	248.555	1,267,992	1,638,208	1,344,295	4,250,495	248,802	260,831	249,295	758,928						
	US-20**	002240	248.555	256.073	2,349,228	2,148,433	2,337,460	6,835,121	353,645	339,750	335,070	1,028,465	34	7,136	3,238	3,238	0.315%	0.047%
	SH-33	002460	0.000	78.236	1,316,602	1,324,360	1,397,950	4,038,912	239,012	216,653	230,680	686,345	320	2,569	4,604	7,207	1.050%	0.178%
	US-20	002070	333.190	348.082	7,852,882	10,802,133	10,515,285	29,170,300	1,051,206	1,178,934	1,166,540	3,396,680	4	98	404	506	0.015%	0.002%
	US-20	002070	349.000	406.300	7,852,882	5,467,654	3,871,920	17,192,456	1,051,206	862,552	819,425	2,733,183						
b	US-91	002350	0.000	9.265	6,224,333	6,653,063	7,045,595	19,922,991	456,725	438,768	407,705	1,303,198	2,477	3,490	184	6,151	0.472%	0.031%
c	I-15B	001340	3.610	4.338	7,883,364	7,439,532	7,104,360	22,427,256	595,755	1,260,400	1,266,915	3,123,070	1,062	6,373	12,722	20,157	0.524%	0.134%
	US-30	002040	359.493	362.903	4,889,375	4,711,326	5,448,355	15,049,056	1,435,159	1,276,408	1,132,230	3,843,797						
	US-30	002040	362.937	387.020	5,496,642	4,711,326	4,760,330	14,968,298	1,202,447	1,276,408	1,093,540	3,572,395						
	US-30	002040	399.026	455.481	3,277,195	3,105,747	2,926,570	9,309,512	1,213,409	999,878	860,305	3,073,592						
d	US-95	001540	26.266	28.941	2,171,739	2,186,532	2,455,720	6,813,991	396,662	471,280	457,710	1,325,652	57	127	202	386	0.029%	0.006%
	US-95	001540	29.000	33.345	2,171,739	2,633,768	2,604,275	7,409,782	396,662	487,720	473,040	1,357,422						
	US-95	001541	33.345	34.253	3,901,151	3,876,818	4,127,420	11,905,389	458,647	499,442	535,820	1,493,909						
	US-95	001540	34.642	45.440	4,340,319	4,458,254	4,390,220	13,188,793	448,736	655,420	660,285	1,764,441						
	US-95 Conn	030838	45.440	45.509	1,937,100	2,301,800	2,664,500	6,903,400	277,780	438,400	416,100	1,132,280						
	US-95	002070	9.492	9.647	3,762,000	6,320,400	6,241,500	16,323,900	218,880	767,200	744,600	1,730,680						
	US-95	001540	45.640	48.630	6,213,976	6,348,528	6,605,040	19,167,544	582,886	890,756	970,170	2,443,812						
	US-95	016040	48.630	49.120	5,136,302	5,135,544	5,508,945	15,780,791	679,520	1,030,240	1,029,300	2,739,060						
	US-95	001540	49.120	63.800	5,334,396	5,691,472	5,824,305	16,850,173	587,353	630,552	625,975	1,843,880						
	US-95	001540	64.000	66.000		17,892,312	17,922,595	35,814,907		643,352	631,815	1,275,167						
e	SH-19	002050	9.070	19.860	6,099,884	8,012,517	7,542,360	21,654,761	604,986	850,777	648,970	2,104,733	0	2	5	7	0.000%	0.000%
f	SH-78	002190	0.000	76.004	815,061	862,943	953,380	2,631,384	152,566	180,111	195,640	528,317	11,515	13,719	2,171	27,405	5.187%	1.041%
	SH-51	002170	69.918	76.582	1,195,927	1,152,575	1,204,500	3,553,002	111,846	98,660	120,450	330,956						
	SH-78	002190	82.680	98.640	502,302	649,947	862,495	2,014,744	54,800	54,800	65,700	175,300						
g	SH-67	005320	0.000	2.735	1,734,044	1,726,304	1,525,335	4,985,683	99,760	140,288	140,160	380,208	7,331	9,952	772	18,055	4.749%	0.362%
	SH-67	016410	2.735	3.123	1,680,600	1,534,400	1,314,000	4,529,000	76,720	131,520	131,400	339,640						
	SH-67	005320	3.230	16.319	1,401,523	1,482,888	1,311,810	4,196,221	140,603	143,576	143,445	427,624						
	SH-67	002180	1.471	8.948	12,056,000	10,665,200	8,541,000	31,262,200	350,720	350,720	343,100	1,044,540						
h	SH-55	001990	0.000	10.614	5,532,801	6,204,547	6,081,265	17,818,613	405,917	543,616	665,760	1,615,293	61	31	208	300	0.019%	0.002%
i	SH-25	002270	46.025	50.830	5,650,318	5,297,838	5,187,015	16,135,171	265,433	299,650	383,250	948,333	17,483	13,620	3,723	34,826	3.672%	0.216%
	SH-25	025310	50.830	50.978	4,000,200	4,612,025	5,201,250	13,813,475	230,160	281,400	492,750	1,004,310						
j	SH-25*	002270	5.353	27.000	1,216,299	916,657	1,022,730	3,155,686	71,588	217,008	229,585	518,181	268	845	2,759	3,872	0.747%	0.123%
k	SH-24	002280	3.549	3.735		12,970,500	14,235,000	27,205,500		591,840	591,300	1,183,140	38,082	27,920	31,967	97,969	8.280%	0.360%
	SH-24	002270	51.068	52.455	13,855,150	12,477,428	12,023,100	38,355,678	573,184	569,182	548,595	1,690,961						
	SH-24	002280	5.120	67.533	820,103	741,570	727,445	2,289,118	97,827	117,272	128,845	343,944						

Segment Information					All Vehicles				Trucks				Pilot Trucks				Totals	
Code	Route	Segment	SecBeg	SecEnd	FY 4'-6'	FY 7'-9'	FY 10'-12'	Total	FY 4'-6'	FY 7'-9'	FY 10'-12'	Total	FY 4'-6'	FY 7'-9'	FY 10'-12'	Total	% Truck	% Veh
l	US-20**	002240	256.073	272.000	1,904,983	2,014,648	2,280,520	6,200,151	235,413	274,000	283,240	792,653	34	7,136	3,238	10,408	1.313%	0.168%
	US-20**	002070	263.770	303.512	2,102,031	2,194,528	2,411,555	6,708,114	254,187	272,534	272,655	799,376						
m	SH-34	002360	7.620	50.476	1,292,451	1,405,093	1,476,060	4,173,604	155,667	143,211	143,445	442,323	557	773	4,032	5,362	1.212%	0.128%
	SH-34	002360	57.757	78.000	1,371,418	1,378,038	1,206,690	3,956,146	163,004	191,800	187,975	542,779						
	US-30	002040	386.450	387.020	5,496,642	4,858,800	4,818,000	15,173,442	1,202,447	1,169,000	1,029,300	3,400,747						
	US-30	002040	399.026	405.543	5,496,642	6,081,521	5,877,595	17,455,758	1,202,447	1,220,830	1,029,300	3,452,577						
n	I-15B	001380	4.526	5.250	15,767,062	19,362,000	18,797,500	53,926,562	1,353,677	1,644,000	1,642,500	4,640,177	0	9	411	420	0.009%	0.001%
o	US-91	002350	120.561	122.866	7,793,859	8,443,950	8,040,950	24,278,759	325,541	372,640	383,250	1,081,431	0	4	4	8	0.001%	0.000%
	US-91	001380	2.323	4.526		9,676,898	13,816,710	23,493,608		752,199	1,126,755	1,878,954	14	111	25	25	0.001%	0.000%
p	SH-22	002470	24.670	68.606	284,514	334,660	329,960	949,134	66,159	82,934	62,780	211,873	253	1,141	1,618	3,012	1.422%	0.317%
q	SH-45	002160	9.740	27.725	6,575,299	8,175,149	8,099,350	22,849,798	186,109	230,158	229,950	646,217	9,964	5,763	5,255	20,982	3.247%	0.092%
	SH-45 Conn	015992	0.000	0.250		701,400		701,400		142,480		142,480						
	SH-45	002161	27.580	27.650	14,248,000	16,440,000	16,425,000	47,113,000	252,080	252,080	251,850	756,010						
	I-84B	002040	57.935	58.665	13,444,689	13,882,000	12,592,500	39,919,189	670,737	657,600	657,000	1,985,337	0	540	605	1,145	0.058%	0.003%
	I-84B	002042	57.904	58.670	13,827,343	13,882,000	13,140,000	40,849,343	829,641	829,672	828,915	2,488,228						
r	SH-87	002520	0.000	9.133		799,455	1,111,060	1,910,515		70,907	106,215	177,122		0	338	338	0.191%	0.018%
s	SH-33 Spur	002460	99.335	100.000		2,225,564	2,971,830	5,197,394		200,294	300,030	500,324		427	123	550	0.110%	0.011%
	SH-33	002460	100.000	135.830		1,957,204	2,691,510	4,648,714		217,446	230,315	447,761						
	SH-33	002460	136.000	149.622		4,228,835	6,352,095	10,580,930		132,311	219,730	352,041						
t	SH-28	002500	15.150	30.610		468,571	735,110	1,203,681		89,970	208,050	298,020		216	579	795	0.267%	0.066%
u	SH-38	002320	0.689	1.318		866,235	1,382,985	2,249,220		40,936	61,320	102,256		3,007	2,221	5,228	5.113%	0.232%
v	SH-27	002290	0.000	21.807		1,899,848	2,523,610	4,423,458		122,808	184,325	307,133		10,915	15,234	26,149	8.514%	0.591%
	I-84B	002290	21.807	24.106		13,174,082	20,878,365	34,052,447		1,231,735	1,964,430	3,196,165						
	SH-27	002290	24.106	26.561		4,309,245	8,193,885	12,503,130		163,013	244,185	407,198						
w	SH-81	002310	0.000	33.978		1,028,143	1,481,900	2,510,043		169,592	264,625	434,217		1,848	384	2,232	0.514%	0.089%
x	US-30	002040	223.505	257.481		1,733,863	2,584,930	4,318,793		309,575	435,445	745,020		145	14,590	14,735	1.978%	0.341%
	I-84B	002040	257.481	258.723		9,408,701	13,233,805	22,642,506		905,709	1,343,565	2,249,274						
y	US-93 Spur	002221	0.000	0.910		8,169,656	11,808,480	19,978,136		438,600	657,000	1,095,600		102	1,194	1,296	0.118%	0.006%
z	US-93 B	002220	46.549	47.457		12,229,630	19,414,350	31,643,980		530,706	773,070	1,303,776		138	673	811	0.062%	0.003%
aa	US-30***	002040	172.595	212.078		2,312,506	3,501,080	5,813,586		218,631	382,520	601,151		106	12,505	12,611	2.098%	0.217%
	US-93 B	002040	212.078	216.899		9,039,546	15,338,030	24,377,576		569,449	851,545	1,420,994						
	US-30***	002040	216.899	216.925		11,696,000	20,805,000	32,501,000		138,890	671,600	810,490						
	US-30***	002040	217.186	217.915		6,025,633	8,854,170	14,879,803		81,141	120,815	201,956						
	US-93 B	002043	217.199	217.282		16,813,000	26,280,000	43,093,000		599,420	897,900	1,497,320						
	US-30***	002043	217.282	217.931		5,207,644	7,503,670	12,711,314		73,100	105,850	178,950						
bb	I-84B	002240	138.600	138.970		2,057,791	2,964,895	5,022,686		87,720	131,400	219,120		0	12	12	0.005%	0.000%
	US-26	002240	138.970	165.928		1,245,238	2,006,770	3,252,008		237,577	363,540	601,117		0	3,700	3,700	0.616%	0.114%
cc	SH-46 Spur	002201	0.000	1.187		2,016,098	2,518,500	4,534,598		201,025	301,125	502,150		403	1,283	1,686	0.336%	0.037%
dd	SH-46	002200	0.000	16.998		3,377,951	5,529,020	8,906,971		439,331	642,035	1,081,366		401	2,954	3,355	0.310%	0.038%
	SH-46	002202	16.998	18.951		350,880	554,800	905,680		7,310	10,950	18,260						
	SH-46	002200	18.951	42.470		344,301	519,395	863,696		23,392	35,040	58,432						
ee	I-84B	002170	93.538	95.308		8,314,643	11,672,335	19,986,978		306,289	458,805	765,094		0	3	3	0.000%	0.000%
	I-84B	002070	95.308	95.467		7,310,000	7,920,500	15,230,500		950,300	1,423,500	2,373,800						
	US-20	002070	95.467	105.940		1,485,681	2,280,885	3,766,566		199,551	304,410	503,961		1,144	4,243	5,387	1.069%	0.143%
	US-20	002070	106.000	112.910		1,206,100	1,839,600	3,045,700		153,510	251,850	405,360						
	US-20	002070	112.980	195.483		1,044,936	1,629,725	2,674,661		144,008	213,525	357,533						
	US-20	002070	195.530	196.039		986,800	1,533,000	2,519,800		138,890	182,500	321,390						
	SH-51	002170	90.785	92.240		10,117,292	14,543,790	24,661,082		217,107	325,215	542,322		112	803	915	0.169%	0.004%
	SH-51	001021	4.062	4.206		6,432,600	9,271,000	15,703,600		131,580	197,100	328,680						
	SH-51	001020	4.116	4.309		7,675,000	10,374,760	18,049,760		226,610	339,450	566,060						

Segment Information					All Vehicles				Trucks				Pilot Trucks				Totals	
Code	Route	Segment	SecBeg	SecEnd	FY 4'-6'	FY 7'-9'	FY 10'-12'	Total	FY 4'-6'	FY 7'-9'	FY 10'-12'	Total	FY 4'-6'	FY 7'-9'	FY 10'-12'	Total	% Truck	% Veh
ff	SH-51	002170	76.582	90.785		986,226	1,491,755	2,477,981		76,032	122,640	198,672		2,468	8,685	11,153	5.614%	0.450%
gg	SH-44	002130	0.000	16.180		7,371,047	10,685,740	18,056,787		309,944	478,880	788,824		32	4	36	0.005%	0.000%
	SH-44	015914	16.180	17.640		13,889,000	23,646,160	37,535,160		409,360	613,200	1,022,560						
hh	US-20	002070	9.647	22.129		3,773,205	5,713,345	9,486,550		248,540	372,300	620,840		9	231	240	0.039%	0.003%
ii	I-15B	001380	5.250	6.315		12,385,416	16,699,480	29,084,896		1,327,496	1,704,915	3,032,411		985	1,341	2,326	0.077%	0.008%
	US-20B	002240	333.044	334.374		14,164,587	20,591,475	34,756,062		903,516	1,353,420	2,256,936		18	155	173	0.008%	0.000%
	US-20B	002073	2.270	3.717		9,361,917	12,849,460	22,211,377		603,075	903,375	1,506,450						
	US-20	002070	309.883	338.927		12,278,167	18,678,875	30,957,042		1,313,615	1,925,740	3,239,355		61	368	429	0.013%	0.001%

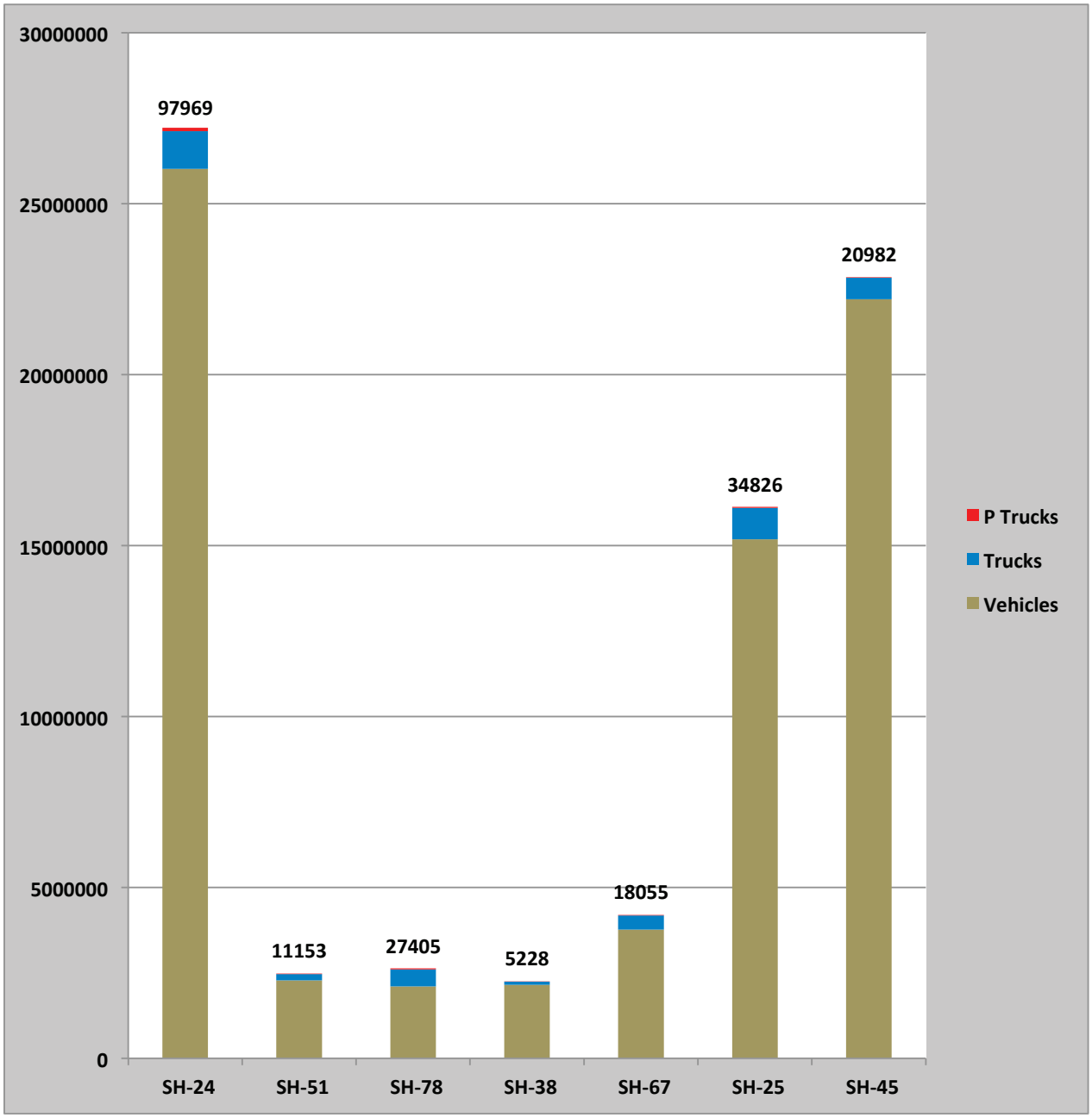
*SH-25b is in section a and j

**US-20a is in section a and l

***US-30c is in section a and aa

Pilot Trucks by Volume of Total Traffic and Truck Traffic

Route	Vehicles	Trucks	P Trucks	% Trucks	% Vehicles
SH-24	26,022,360	1,099,901	97,969	8.907%	0.376%
SH-51	2,279,309	187,519	11,153	5.948%	0.489%
SH-78	2,103,067	500,912	27,405	5.471%	1.303%
SH-38	2,146,964	97,028	5,228	5.388%	0.244%
SH-67	3,768,597	409,569	18,055	4.408%	0.479%
SH-25	15,186,838	913,510	34,826	3.812%	0.229%
SH-45	22,203,581	627,768	20,982	3.342%	0.094%



APPENDIX C

Safety

CRASHES AND CRASH RATES FOR ALL VEHICLES

	Total Crashes					Total Crash Rates					
	Before	After				Before	After				
	7/1/2000-6/30/2003	7/1/2003-6/30/2006	7/1/2006-6/30/2007	7/1/2007-6/30/2009	7/1/2009-6/30/2012	7/1/2000-6/30/2003	7/1/2003-6/30/2006	7/1/2006-6/30/2007	7/1/2007-6/30/2009	7/1/2009-6/30/2012	Ave Change in Rate
Route A	914	918	288	757	951	113.1	110.3	100.6	109.6	93.3	-4.3%
Route B	120	136	35	92	96	206.8	238.6	175.5	214.1	147.2	-5.1%
Route C	292	314	89	146	219	69.9	80.5	86.4	69.7	72.4	1.7%
Route D	199	187	81	135	157	124.8	113.5	117.0	95.3	73.4	-11.9%
Route E	46	47	32	58	74	75.7	74.9	111.4	99.8	91.8	7.3%
Route F	128	108	48	76	92	185.4	141.2	174.6	133.1	97.6	-12.7%
Route G	87	61	21	57	31	83.2	53.5	55.0	93.1	36.0	-6.2%
Route H	94	110	25	63	64	167.2	179.9	114.9	141.2	99.9	-8.7%
Route I	31	26	6	21	29	124.7	99.6	65.0	131.2	112.9	8.3%
Route J	32	25	9	14	19	186.4	141.7	139.2	103.4	84.3	-17.5%
Route K	114	98	40	49	66	162.8	143.2	176.8	115.4	102.1	-8.7%
Route L	105	84	33	68	84	95.0	72.6	83.9	84.3	63.3	-8.1%
Route M	232	176	63	111	170	119.3	94.2	144.7	127.3	132.4	6.1%
Route N	106	93	26	26	22	166.2	132.9	113.8	276.7	162.4	16.9%
Route O	16	29	6	64	64	94.2	156.4	90.4	190.7	131.6	25.9%
Route P	13	14	4	10	11	100.4	114.0	83.8	95.6	76.1	-4.8%
Route Q	753	902	233	329	419	461.9	510.1	339.8	304.2	250.1	-12.8%

These routes didn't take effect until 7/1/2007	Before	After		Before	After		
	7/1/2004-6/30/2007	7/1/2007-6/30/2009	7/1/2009-6/30/2012	7/1/2004-6/30/2007	7/1/2007-6/30/2009	7/1/2009-6/30/2012	Ave Change in Rate
Route R	9	7	28	96.2	91.3	270.5	95.6%
Route S	303	181	157	182.9	140.9	86.7	-30.7%
Route T	1	8	5	9.2	110.4	44.3	523.2%
Route U	4	2	4	480.3	367.1	451.0	-0.4%
Route V	278	215	262	236.9	261.8	213.1	-4.1%
Route W	75	57	71	159.9	163.7	139.5	-6.2%
Route X	181	165	186	160.6	236.1	177.6	11.1%
Route Y	23	26	36	205.2	349.7	341.2	34.0%
Route Z	54	23	20	350.1	207.1	113.5	-43.0%
Route AA	263	177	223	123.9	122.7	98.1	-10.5%
Route BB	38	32	45	73.6	93.8	80.4	6.5%
Route CC	8	2	5	218.5	83.6	167.3	19.2%
Route DD	122	73	65	122.1	110.1	61.3	-27.1%
Route EE	295	191	272	135.1	134.6	126.5	-3.2%
Route FF	48	20	22	261.5	137.4	107.0	-34.8%
Route GG	384	227	301	188.7	162.6	145.2	-12.3%
Route HH	79	44	55	120.6	92.1	67.8	-25.0%
Route II	512	356	406	87.4	88.7	67.3	-11.3%

	Total Crashes					Total Crash Rates					
	7/1/2000-6/30/2003	7/1/2003-6/30/2006	7/1/2006-6/30/2007	7/1/2007-6/30/2009	7/1/2009-6/30/2012	7/1/2000-6/30/2003	7/1/2003-6/30/2006	7/1/2006-6/30/2007	7/1/2007-6/30/2009	7/1/2009-6/30/2012	Ave Change in Rate
All Pilot Routes*	3,192	3,257	1,018	3,986	4,731	137.8	137.6	124.3	130.8	103.4	-7.9%
All State Routes	32,053	34,358	10,475	20,592	24,692	136.9	140.7	124.0	124.8	98.9	-10.0%

*All Pilot Routes only include Routes A through Q through the time period ending June 30, 2007. All Pilot Routes for time periods after July 1, 2007, include Route A through Route II.

The 2012 crash data and 2012 AVMT are preliminary and subject to change.

CRASHES AND CRASH RATES FOR TRUCKS

	Truck Crashes					Truck Crash Rates					
	Before	After				Before	After				
	7/1/2000-6/30/2003	7/1/2003-6/30/2006	7/1/2006-6/30/2007	7/1/2007-6/30/2009	7/1/2009-6/30/2012	7/1/2000-6/30/2003	7/1/2003-6/30/2006	7/1/2006-6/30/2007	7/1/2007-6/30/2009	7/1/2009-6/30/2012	Ave Change in Rate
Route A	110	123	49	136	98	88.6	93.0	108.5	115.9	57.5	-5.5%
Route B	6	9	5	11	5	144.0	217.1	370.6	404.3	132.8	15.8%
Route C	76	95	27	34	48	61.5	80.6	85.5	56.8	60.6	2.6%
Route D	44	32	16	20	9	247.0	161.8	195.5	121.0	36.0	-30.5%
Route E	7	11	5	10	5	117.8	173.0	155.1	174.6	71.1	-2.6%
Route F	19	22	5	13	18	145.5	154.6	99.2	125.7	107.5	-4.3%
Route G	9	8	2	3	3	197.6	165.2	121.8	91.2	61.8	-25.0%
Route H	11	14	5	4	5	260.5	296.9	260.2	103.9	70.8	-22.6%
Route I	4	5	1	2	5	325.0	409.6	236.4	172.2	261.2	2.1%
Route J	5	2	2	2	1	334.4	90.9	127.8	63.8	20.0	-37.7%
Route K	14	24	8	7	8	212.8	340.1	292.8	127.9	89.2	-10.2%
Route L	8	3	3	11	6	57.3	21.0	58.9	108.9	38.5	34.4%
Route M	28	14	5	16	9	78.9	42.1	78.7	132.1	52.5	12.0%
Route N	11	14	2	1	1	205.6	251.7	114.1	126.0	84.1	-13.8%
Route O	1	2	2	9	2	166.8	251.1	699.2	404.0	59.4	25.4%
Route P	1	4	3	1	5	35.1	129.0	252.9	39.4	176.2	156.5%
Route Q	34	59	17	20	11	558.8	894.9	714.3	578.3	206.2	-10.9%

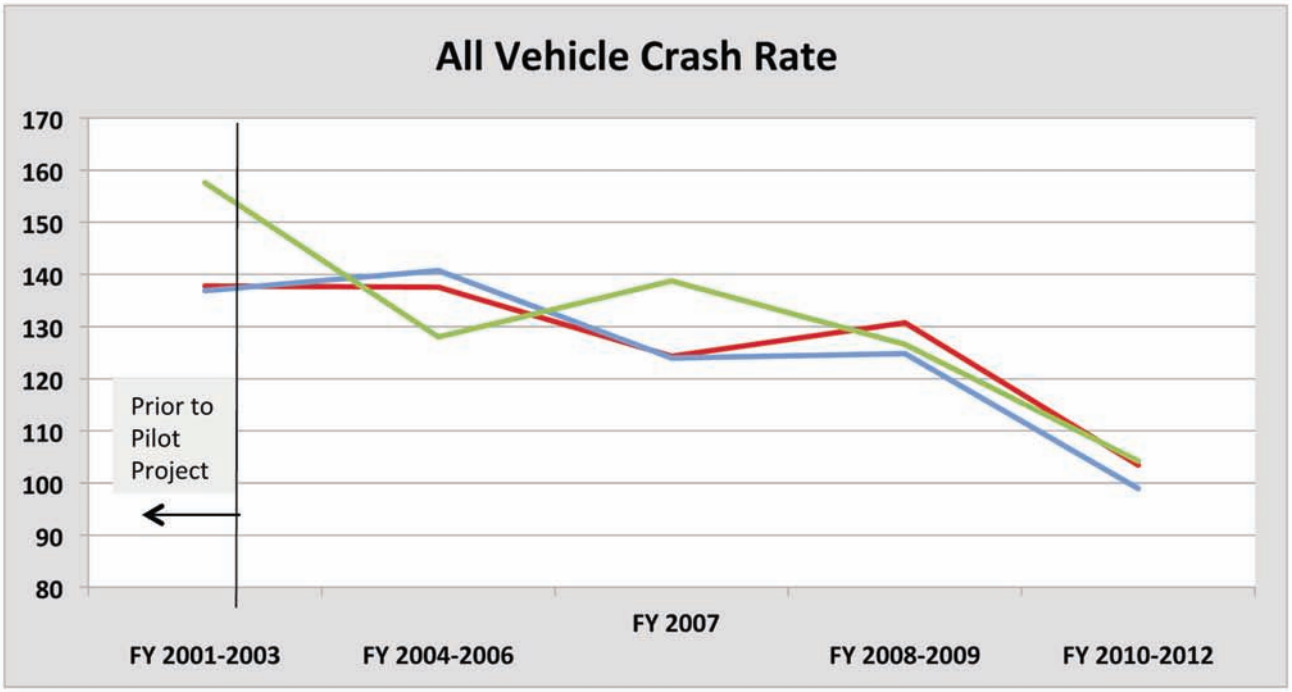
These routes didn't take effect until 7/1/2007	Before	After		Before	After		
	7/1/2004-6/30/2007	7/1/2007-6/30/2009	7/1/2009-6/30/2012	7/1/2004-6/30/2007	7/1/2007-6/30/2009	7/1/2009-6/30/2012	Ave Change in Rate
Route R	2	3	7	200.7	462.6	721.6	93.2%
Route S	22	20	5	156.7	212.8	43.6	-21.9%
Route T	0	0	1	0.0	0.0	31.1	
Route U	0	0	0	0.0	0.0	0.0	0.0%
Route V	21	18	16	240.0	304.0	175.2	-7.9%
Route W	8	7	6	93.4	121.5	66.8	-7.4%
Route X	33	28	14	213.3	241.1	85.6	-25.7%
Route Y	0	1	2	0.0	250.5	334.5	66.8%
Route Z	6	0	3	827.4	0.0	427.4	
Route AA	23	12	12	163.6	96.6	62.5	-38.1%
Route BB	8	7	10	83.5	108.5	101.0	11.5%
Route CC	2	0	1	568.2	0.0	279.8	
Route DD	17	3	3	137.8	37.2	25.8	-51.9%
Route EE	35	16	18	144.0	99.0	75.5	-27.5%
Route FF	4	3	2	258.9	267.6	114.8	-26.9%
Route GG	33	21	9	387.5	374.4	103.2	-37.9%
Route HH	13	1	4	279.7	32.2	75.6	23.0%
Route II	44	24	12	70.8	57.5	19.6	-42.3%

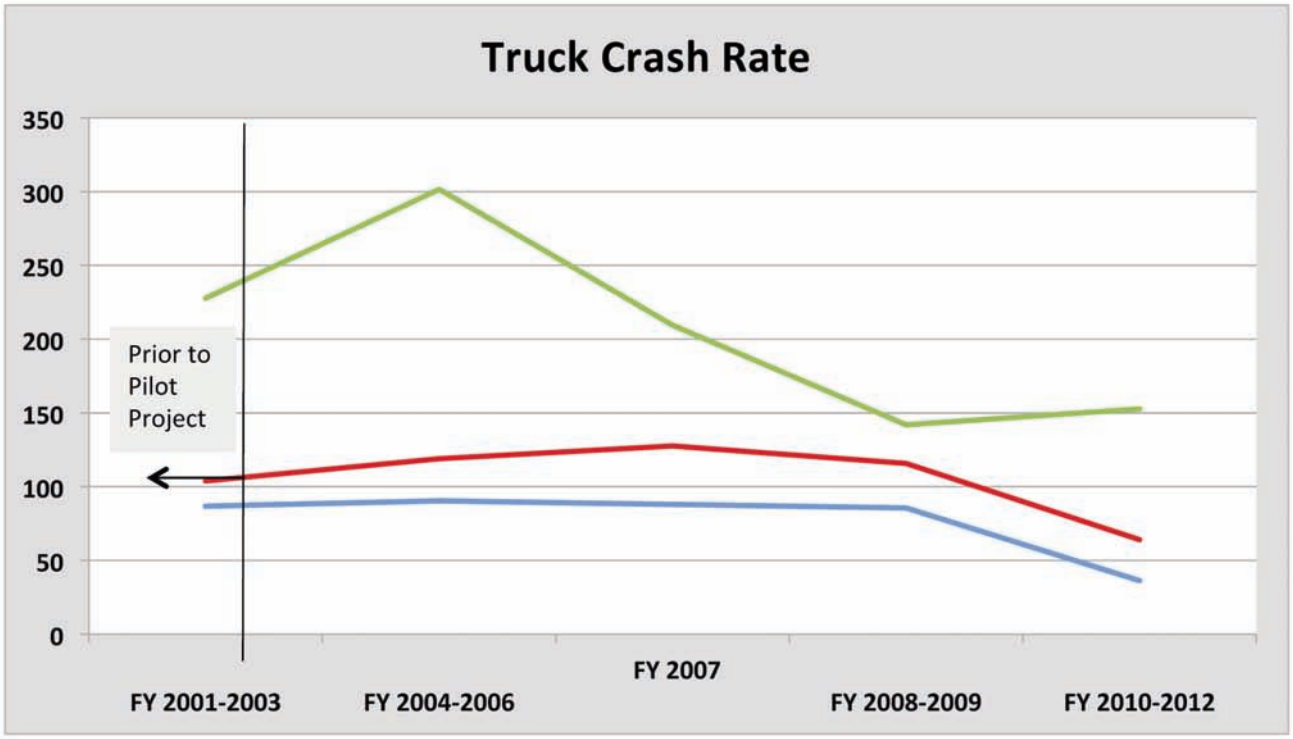
	Truck Crashes					Truck Crash Rates					
	7/1/2000-6/30/2003	7/1/2003-6/30/2006	7/1/2006-6/30/2007	7/1/2007-6/30/2009	7/1/2009-6/30/2012	7/1/2000-6/30/2003	7/1/2003-6/30/2006	7/1/2006-6/30/2007	7/1/2007-6/30/2009	7/1/2009-6/30/2012	Ave Change in Rate
All Pilot Routes*	371	432	153	453	364	103.9	118.9	127.7	115.7	64.0	4.1%
All State Routes	3,102	3,366	1,147	2,153	1,340	86.7	90.3	88.0	85.6	36.3	-0.4%

*All Pilot Routes only include Routes A through Q through the time period ending June 30, 2007. All Pilot Routes for time periods after July 1, 2007, include Route A through Route II.

The 2012 crash data and 2012 AVMT are preliminary and subject to change.

SAFETY





Pilot Project Routes
Pilot Project Routes SH-24, 25, 78
Non Pilot Project Routes

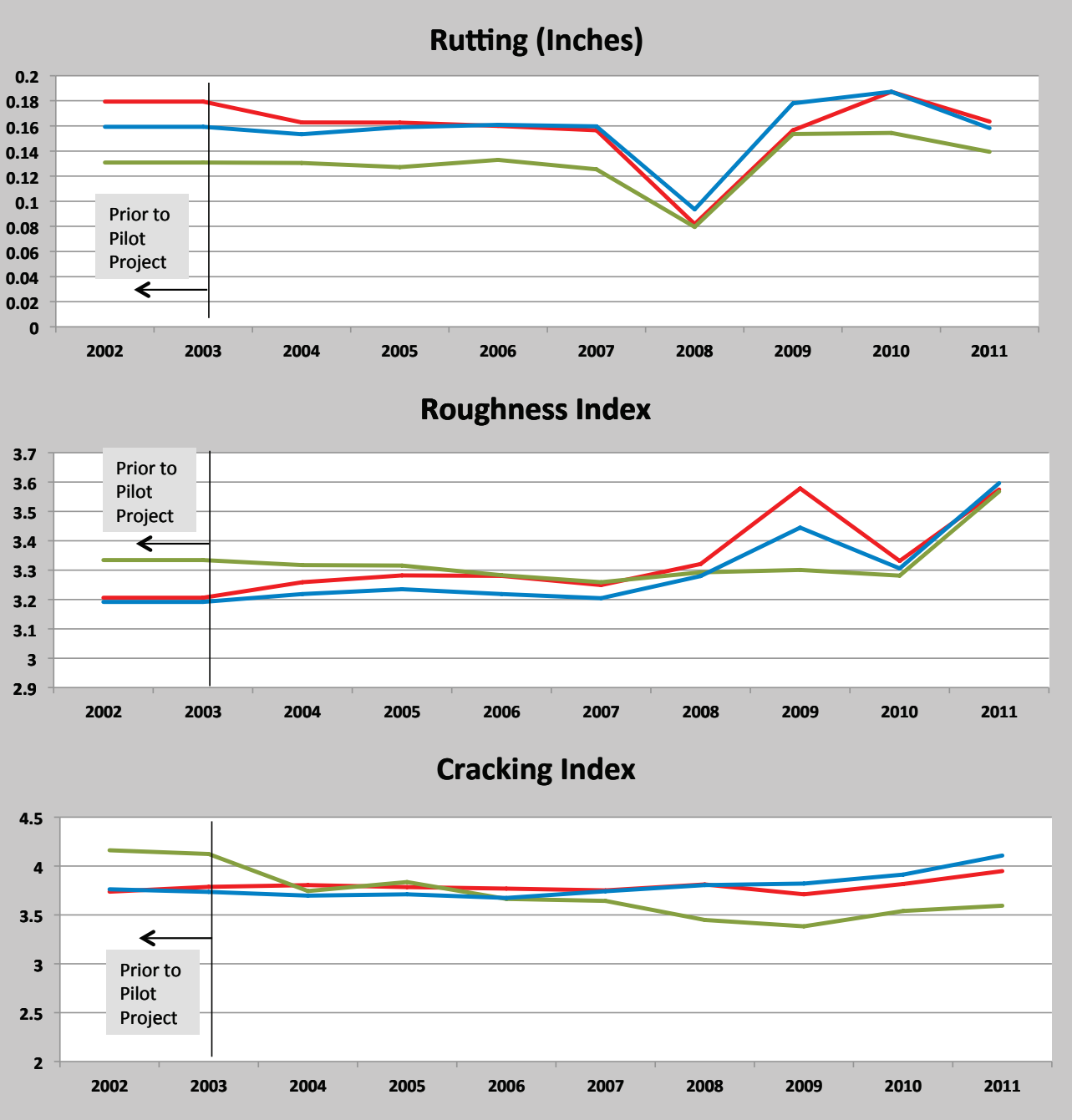
APPENDIX D

Pavements

PAVEMENT

Pavement Condition

Pilot	855 Segments	1288 Miles
Non-Pilot	1778 Segments	2865 Miles



Pilot Project Routes
Pilot Project Routes SH-24, 25, 78
Non Pilot Project Routes

APPENDIX E

Bridges

National Bridge Inventory Ratings by Fiscal Year on State Bridges

National Bridge Inventory Ratings by Fiscal Year on State Bridges

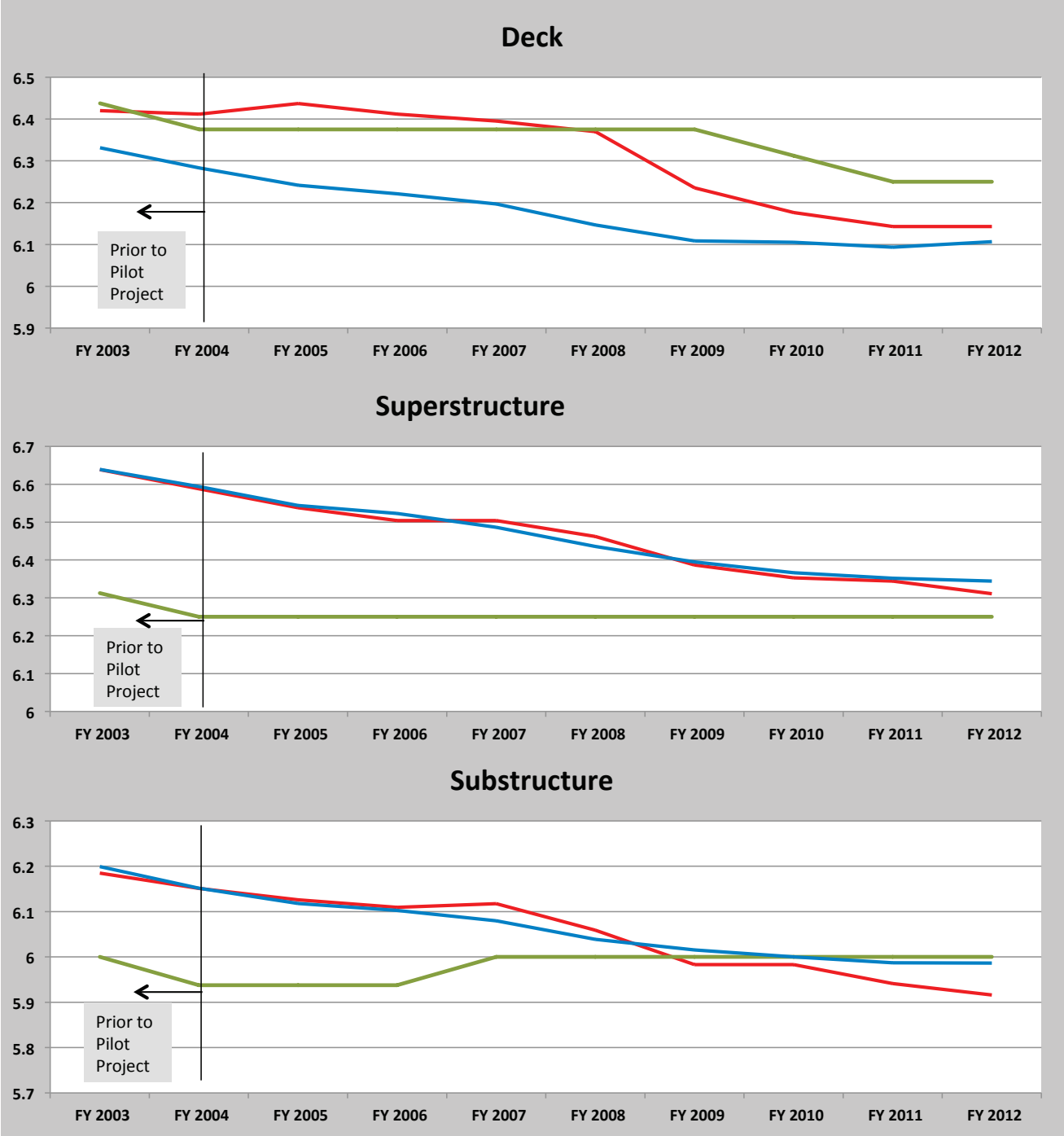
	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	Deterioration
Pilot 2003-2012 (120)											
Deck	6.42	6.41	6.44	6.41	6.39	6.37	6.24	6.18	6.14	6.14	**-0.031**
Super	6.64	6.59	6.54	6.50	6.50	6.46	6.39	6.35	6.34	6.31	**-0.036**
Sub	6.18	6.15	6.13	6.11	6.12	6.06	5.98	5.98	5.94	5.92	**-0.030**
Non-Pilot 2003-2012 (1180)											
Deck	7.00	6.28	6.24	6.22	6.20	6.15	6.11	6.11	6.09	6.11	**-0.099**
Super	6.64	6.59	6.54	6.52	6.49	6.44	6.39	6.37	6.35	6.34	**-0.033**
Sub	6.20	6.15	6.12	6.10	6.08	6.04	6.02	6.00	5.99	5.99	**-0.024**
SH-24, 25, 78 (16)											
Deck	6.44	6.38	6.38	6.38	6.38	6.38	6.38	6.31	6.25	6.25	**-0.021**
Super	6.31	6.25	6.25	6.25	6.25	6.25	6.25	6.25	6.25	6.25	**-0.007**
Sub	6.00	5.94	5.94	5.94	6.00	6.00	6.00	6.00	6.00	6.00	**0.000**
	Year 1	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	
Pilot 2008-2012 (133)											
Deck	6.00	6.37	6.35	6.29	6.28						**0.070**
Super	6.55	6.49	6.49	6.47	6.44						**-0.028**
Sub	6.32	6.26	6.25	6.22	6.20						**-0.028**
Pilot 2008-2012 (133)											
Deck						6.19	6.17	6.12	6.13	6.12	**-0.017**
Super						6.38	6.36	6.32	6.26	6.25	**-0.032**
Sub						6.14	6.10	6.07	6.02	6.02	**-0.030**

Notes:

1. Data smoothed to account for inspections on some bridges not being completed each year. Ratings carried over from previous year if no inspection was completed.
2. Bridges with no inspections in FY 2002 or FY 2003 were removed from consideration.
3. Increases in ratings are largely due to improvements on bridges or a change of the bridge inspector.
4. Bridges were added in FY 2008. These bridges have been analyzed separately they are not included in Pilot 2003 - 2012 or Non-Pilot 2003 - 2012 numbers.
5. Rate of deterioration for Pilot and Non-Pilot 2003 - 2012 was calculated by taking FY 2012 # - FY 2003 #/ 9 years
6. Rate of deterioration for the Pilot 2008 - 2012 group calculated based on years available

BRIDGES

Charts comparing NBI Ratings on 120 Bridges participating in Pilot Project from FY 2003 - FY 2012 with 1180 bridges not part of Pilot Project from FY 2003 - FY 2012



Idaho Transportation Department
Bridge Inspection 8/29/2012
Pilot Project Structures

BrKey	Structure No.	Route	Milepost	Features	# Spans	Span Lgth	Sq.Ft.	Material Type	Structure Type
13920	03310A 101.56	SH 33	101.559	TETON RIVER OVERFLOW	1	51	2025	Concrete	Slab
12385	02020K 313.94	US 20 WBL	313.959	RIRIE OUTLET CHANNEL	1	58	2529	Concrete	Slab
16631	03310A 44.74	SH 33	044.736	OWSLEY CANAL	2	18	2013	Concrete	Slab
12390	02020K 313.95	US 20 EBL	313.960	RIRIE OUTLET CHANNEL	1	58	2573	Concrete	Slab
14345	04610A 111.84	SH 46	111.844	LITTLE WOOD RIVER	1	24	2340	Concrete	Slab
Count: 5									
13660	03020L 237.80	US 30	237.760	DRY CREEK	1	55	1798	Concrete	Arch-Deck
Count: 1									
12475	S02020K 324.08	US 20 EBL & WBL	324.078	WEST LA BELLE CANAL	1	20	3025	Concrete	Culvert
13125	S02620A 149.53	US 26	149.529	CANAL	1	15	563	Concrete	Culvert
14945	S08071B 94.86	I 84B	094.860	EAST SIDE CANAL	1	13	1359	Concrete	Culvert
12491	S02020K 325.62	US 20 EBL & WBL.	325.615	ISLAND CANAL	1	17	8840	Concrete	Culvert
13570	S03020K 183.36	US 30	183.353	BIG BEND DITCH	1	14	672	Concrete	Culvert
14535	S05110A 70.11	SH 51	070.114	SOUTH SIDE CANAL	1	12	483	Concrete	Culvert
17451	S09120A 1.68	US 91	001.670	CUB RIVER OVERFLOW	1	18	2236	Concrete	Culvert
12580	S02020K 338.32	US 20 WBL & EBL	338.318	SALEM CANAL	2	10	3541	Concrete	Culvert
13046	S02510A 18.34	SH 25	018.340	'C' CANAL	1	11	840	Concrete	Culvert
13575	S03020K 184.90	US 30	184.908	CANAL	1	15	731	Concrete	Culvert
13342	S02710A 20.43	SH 27	020.430	'G' CANAL	1	15	3401	Concrete	Culvert
12545	S02020K 333.31	US 20 & IC RAMPS	333.306	WESTFIELD CANAL	1	11	3645	Concrete	Culvert
13120	S02620A 148.68	US 26	148.679	CANAL	1	14	683	Concrete	Culvert
17461	S09120A 4.87	US 91	004.863	CUB CANAL	1	16	1998	Concrete	Culvert
13596	S03020K 196.11	US 30	196.107	TWIN FALLS LATERAL CANAL	1	17	1851	Concrete	Culvert
12505	S02020K 327.33	US 20 EBL & WBL	327.237	BANNOCK JIM SLOUGH	1	11	1649	Concrete	Culvert
13565	S03020K 179.66	US 30	179.653	BUCKEYE DITCH	1	17	716	Concrete	Culvert
12510	S02020K 327.75	US 20 EBL & WBL	327.746	LIBERTY PARK CANAL	1	18	3420	Concrete	Culvert
13590	S03020K 195.81	US 30	195.804	LATERAL CANAL	1	10	600	Concrete	Culvert
12210	S02020B 12.95	US 20	012.949	SAND HOLLOW CREEK	1	12	684	Concrete	Culvert
14515	S05010A 1.13	SH 50	001.127	LATERAL NO.22	1	20	883	Concrete	Culvert
13560	S03020K 179.55	US 30	179.555	BELL DITCH	1	12	588	Concrete	Culvert
Count: 22									
15295	07810B 93.02	SH 78	093.021	BROWN CREEK	2	30	1647	Concrete	Stringer/Girder
12215	02020B 21.95	US 20	021.954	FARMERS COOP CANAL	4	35	6049	Concrete	Stringer/Girder
15265	07810A 29.25	SH 78	029.252	RABBIT CREEK	3	39	3660	Concrete	Stringer/Girder
14000	03410B 28.97	SH 34	028.967	BEAR RIVER;CLEVELAND BR.	8	34	7987	Concrete	Stringer/Girder
14540	05110A 70.53	SH 51	070.536	BRUNEAU RIVER SLOUGH	1	34	1012	Concrete	Stringer/Girder
18070	09520A 45.05	US 95	045.052	SAND HOLLOW CREEK	3	34	3479	Concrete	Stringer/Girder
14550	05110A 70.97	SH 51	070.974	BRUNEAU RIVER SLOUGH	1	34	1012	Concrete	Stringer/Girder

Idaho Transportation Department
Bridge Inspection 8/29/2012
Pilot Project Structures

BrKey	Structure No.	Route	Milepost	Features	# Spans	Span Lgth	Sq.Ft.	Material Type	Structure Type
13580	03020K 185.27	US 30	185.282	SNAKE RIVER;GRIDLEY BR.	39	39	51182	Concrete	Stringer/Girder
14385	04610A 139.26	SH 46	139.264	SOLDIER CREEK	1	27	915	Concrete	Stringer/Girder
14370	04610A 138.66	SH 46	138.662	CAMAS CREEK	2	39	2443	Concrete	Stringer/Girder
14560	05110A 76.92	SH 51	076.919	SNAKE RIVER	19	35	20082	Concrete	Stringer/Girder
13665	03020L 238.23	US 30	238.184	MAIN CANAL	3	46	4618	Concrete	Stringer/Girder
13925	03310A 102.46	SH 33	102.457	S.FK.TETON RIVER	1	78	3178	Concrete	Stringer/Girder
13750	03020P 454.31	US 30	454.312	THOMAS FORK CREEK	2	28	2099	Concrete	Stringer/Girder
14325	04610A 101.40	SH 46	101.403	'W' CANAL	1	39	1442	Concrete	Stringer/Girder
14390	04610A 139.32	SH 46	139.322	SOLDIER CREEK	1	27	915	Concrete	Stringer/Girder
13585	03020K 190.62	US 30	190.632	SALMON FALLS CREEK	3	29	3303	Concrete	Stringer/Girder
16635	03310A 47.75	SH 33	047.745	OWSLEY CANAL;TERRETON BR	3	39	3940	Concrete	Stringer/Girder
15065	02010A 155.60	US 20	155.596	KNOWLTON CREEK	1	28	915	Concrete	Stringer/Girder
14400	04610A 140.84	SH 46	140.837	POWELL CREEK	1	27	915	Concrete	Stringer/Girder
14380	04610A 139.17	SH 46	139.173	FORK OF CAMAS CREEK	1	27	915	Concrete	Stringer/Girder
15280	07810A 48.19	SH 78	048.191	CASTLE CREEK	2	30	1647	Concrete	Stringer/Girder
18065	09520A 43.84	US 95	043.837	BOISE RIVER	10	42	13896	Concrete	Stringer/Girder
13985	03410B 12.98	SH 34	012.978	BEAR RIVER;RIVERDALE BR	6	35	7083	Concrete	Stringer/Girder
14375	04610A 138.93	SH 46	138.932	DRAIN DITCH	1	38	1216	Concrete	Stringer/Girder
14545	05110A 70.85	SH 51	070.845	BRUNEAU RIVER	3	34	3014	Concrete	Stringer/Girder
15055	02010A 153.29	US 20	153.285	E.FK.SOLDIER CREEK	1	22	732	Concrete	Stringer/Girder
12365	02020K 310.17	US 20 EBL & RAMP	310.172	IDAHO CANAL	1	81	4822	Concrete	Stringer/Girder
15060	02010A 154.06	US 20	154.056	JOHNSON CREEK	1	22	732	Concrete	Stringer/Girder
14395	04610A 139.74	SH 46	139.735	SOLDIER CREEK	1	27	915	Concrete	Stringer/Girder
15050	02010A 152.38	US 20	152.378	SOLDIER CREEK	1	22	732	Concrete	Stringer/Girder
15045	02010A 152.03	US 20	152.034	W.FK.SOLDIER CREEK	1	22	732	Concrete	Stringer/Girder
14340	04610A 110.44	SH 46	110.436	'X' CANAL	1	39	1442	Concrete	Stringer/Girder
14405	04610A 141.77	SH 46	141.770	KNOWLTON CREEK	1	37	1220	Concrete	Stringer/Girder
13555	03020K 179.51	US 30	179.518	BILLINGSLEY CREEK	3	28	3138	Concrete	Stringer/Girder
Count:	35								
13955	03310A 134.20	SH 33	134.200	SPRING CREEK	1	41	1624	Concrete	Channel Beam
Count:	1								
13130	02620A 149.96	US 26	149.956	'X' CANAL	1	40	2908	Concrete	Tee Beam
15090	02010B 183.95	US 20	183.947	GROVE CREEK	1	30	1056	Concrete	Tee Beam
13345	02710A 25.52	SH 27	025.518	B-4 CANAL	1	34	1516	Concrete	Tee Beam
14305	04510A 18.01	SH 45	018.011	MORA CANAL	1	48	1518	Concrete	Tee Beam
18060	09520A 42.73	US 95	042.715	RIVERSIDE CANAL	1	53	1991	Concrete	Tee Beam
13105	02620A 145.25	US 26	145.249	MALAD RIVER	3	39	3644	Concrete	Tee Beam
13135	02620A 151.54	US 26	151.538	S.GOODING MAIN CANAL	1	35	1360	Concrete	Tee Beam

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13040	02510A 8.51	SH 25	008.507	'L' CANAL	1	41	1281	Concrete	Tee Beam
14310	04510A 22.31	SH 45	022.306	NEW YORK CANAL	1	60	2271	Concrete	Tee Beam
13205	02620C 300.72	US 26	300.715	PEOPLES CANAL	1	38	1302	Concrete	Tee Beam
14995	02010A 143.77	US 20	143.768	CHIMNEY CR.;SHEEP CR.	1	25	1066	Concrete	Tee Beam
13195	09320D 246.88	US 93	246.879	BIG LOST RIVER	1	51	1938	Concrete	Tee Beam
13140	02620A 154.02	US 26	154.021	S.GOODING MAIN CANAL	1	46	1762	Concrete	Tee Beam
13215	02620C 303.38	US 26	303.384	DANSKIN CANAL	1	54	1894	Concrete	Tee Beam
13210	02620C 301.41	US 26	301.406	ABERDEEN CANAL	1	61	2056	Concrete	Tee Beam
Count:	15								
13965	03310A 142.32	SH 33	142.312	TETON CREEK	2	26	2164	Concrete	Multiple Box Beam
13960	03310A 135.73	SH 33	135.560	S.FK.LEIGH CREEK	1	33	1405	Concrete	Multiple Box Beam
13601	03020K 196.51	US 30	196.517	DEEP CREEK	1	57	2640	Concrete	Multiple Box Beam
Count:	3								
14275	04410A 5.74	SH 44	005.739	CANYON CREEK	1	25	1425	Concrete	Frame
15010	S02010A 146.31	US 20	146.310	E.BRANCH CORRAL CREEK	1	14	672	Concrete	Frame
14685	05510A 7.05	SH 55	007.054	HIGH LINE CANAL	1	34	1768	Concrete	Frame
19845	16710A 0.05	SH 167	000.045	GRANDVIEW IRRIG.DIST.CNL	1	25	1242	Concrete	Frame
12410	S02020K 315.62	US 20	315.620	S.BRANCH HARRISON CANAL	1	18	6561	Concrete	Frame
13990	03410B 14.84	SH 34	014.831	TWIN LAKES CANAL	1	28	2022	Concrete	Frame
18081	09520A 49.80	US 95	049.801	FARMERS COOP CANAL	1	21	2260	Concrete	Frame
13115	S02620A 148.10	US 26	148.102	CANAL	1	14	493	Concrete	Frame
15260	S07810A 1.62	SH 78	001.617	'A' LINE CANAL	1	18	640	Concrete	Frame
12635	S02020K 349.50	US 20 EBL & WBL	349.498	N.BR.FALL RIVER CANAL	1	18	1812	Concrete	Frame
12525	S02020K 329.11	US 20 EBL & WBL	329.109	REID CANAL	1	18	3720	Concrete	Frame
12445	S02020K 321.88	US 20 & US 20B	321.880	RIGBY CANAL	1	16	2930	Concrete	Frame
14965	S02010A 139.21	US 20	139.205	COW CREEK	1	18	689	Concrete	Frame
15075	S02010A 176.40	US 20	176.397	CRYSTAL CREEK	1	17	736	Concrete	Frame
12600	02020K 344.24	US 20 EBL & WBL	344.240	SALEM UNION CANAL	1	29	3414	Concrete	Frame
15040	S02010A 151.54	US 20	151.540	SOLDIER MTN.RUNOFF CHNL	1	16	756	Concrete	Frame
14975	02010A 141.10	US 20	141.100	NO NAME CREEK	1	22	837	Concrete	Frame
13015	S02410B 57.96	SH 24	057.956	'702' LATERAL CANAL	1	14	1184	Concrete	Frame
14980	S02010A 141.58	US 20	141.576	TEXAS CREEK	1	16	686	Concrete	Frame
14960	S02020E 97.78	US 20	097.778	RATTLE SNAKE CREEK	1	16	702	Concrete	Frame
12570	S02020K 334.97	US 20 EBL & WBL	334.960	TETON ISLAND CANAL	1	17	3534	Concrete	Frame
13010	02410B 54.40	SH 24	054.400	'702-A' CANAL	1	23	1518	Concrete	Frame
15030	S02010A 150.24	US 20	150.238	DRAIN	1	20	924	Concrete	Frame
15085	S02010A 177.57	US 20	177.570	M.FK.SPRING CREEK	1	12	520	Concrete	Frame
17560	S09320A 20.95	US 93	020.902	LATERAL CANAL	1	13	786	Concrete	Frame

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12420	02020K 320.06	US 20	320.060	GARFIELD UCON CANAL	1	21	3143	Concrete	Frame
15080	S02010A 177.19	US 20	177.192	SPRING CREEK	1	12	520	Concrete	Frame
12175	01910B 9.70	SH 19	009.700	GOLDEN GATE CANAL	1	30	3300	Concrete	Frame
14700	S05510A 10.14	SH 55	010.139	BURRIS LATERAL CANAL	1	12	728	Concrete	Frame
12595	S02020K 343.62	US 20	343.634	TWIN GROVES CANAL	1	15	2790	Concrete	Frame
12460	S02020K 322.93	US 20 EBL & WBL	322.930	NORTH RIGBY CANAL	1	13	1949	Concrete	Frame
14330	S04610A 107.47	SH 46	107.467	'X-4' CANAL	1	20	958	Concrete	Frame
13065	S02510B 48.80	SH 25	048.800	DRAIN DITCH	1	20	990	Concrete	Frame
18090	S09520A 60.57	US 95	060.573	FARMERS DITCH	1	13	1326	Concrete	Frame
12540	S02020K 332.94	US 20 EBL & WBL	332.940	REXBURG CANAL	1	14	2976	Concrete	Frame
19853	16710A 3.29	SH 167	003.290	MIDDLE LINE CANAL	1	25	1195	Concrete	Frame
13745	S03020P 423.12	US 30	423.128	GEORGETOWN CREEK	1	11	456	Concrete	Frame
14280	04410A 14.99	SH 44	014.987	MIDDLETON CANAL	1	38	2052	Concrete	Frame
12660	S02020K 353.69	US 20	353.691	CURR CANAL	1	15	765	Concrete	Frame
14010	03410B 33.66	SH 34	033.656	TROUT CREEK	1	25	1245	Concrete	Frame
13350	S02810A 30.45	SH 28	030.453	BIRCH CREEK;HYDRO PROJ	1	16	1010	Concrete	Frame
13915	S03310A 100.53	SH 33	100.501	TETON ISLAND CANAL	1	20	880	Concrete	Frame
14270	S04410A 4.15	SH 44	004.144	MILL CREEK	1	17	1195	Concrete	Frame
13605	S03020K 198.00	US 30	198.001	SEEPAGE DRAIN	1	18	698	Concrete	Frame
13935	S03310A 105.20	SH 33	105.199	EAST TETON CANAL	1	16	1008	Concrete	Frame
13805	08400B 57.68	I 84B	057.677	PHYLLIS CANAL	1	26	2423	Concrete	Frame
14265	04410A 3.50	SH 44	003.502	WILLOW CREEK	1	24	1200	Concrete	Frame
14005	S03410B 29.97	SH 34	029.968	WILLIAMS CREEK	1	20	764	Concrete	Frame
13020	S02410B 60.77	SH 24	060.770	'978' LATERAL CANAL	1	16	1183	Concrete	Frame
13930	03310A 103.73	SH 33	103.730	SIDDOWAY CANAL	1	21	1176	Concrete	Frame
12970	S03310A 16.14	SH 33	016.142	LITTLE LOST RIVER	1	10	409	Concrete	Frame
13640	S03020L 225.90	US 30	225.854	COULEE CANAL	1	12	409	Concrete	Frame
15035	S02010A 150.999	US 20	150.888	SOLDIER MTN.RUNOFF DRAIN	1	20	924	Concrete	Frame
13325	S02710A 15.82	SH 27	015.818	'G-20' CANAL	1	18	800	Concrete	Frame
15095	02010B 184.47	US 20	184.468	LOVING CREEK	1	24	1008	Concrete	Frame
15255	S07810A 1.13	SH 78	001.131	'B' LINE CANAL	1	18	640	Concrete	Frame
13146	02620A 154.39	US 26	154.383	S. GOODING MAIN CANAL	1	23	2106	Concrete	Frame
14015	S03410B 43.33	SH 34	043.325	BENCH CANAL	1	12	679	Concrete	Frame
14025	S03410B 46.73	SH 34	046.776	TANNER CANAL	1	11	971	Concrete	Frame
14263	S04410A 4.02	SH 44	004.023	CANYON CANAL	1	11	792	Concrete	Frame
12395	02020K 314.20	US 20	314.200	SAGE CANAL	1	21	2250	Concrete	Frame
15020	S02010A 149.60	US 20	149.600	DRAIN	1	18	836	Concrete	Frame
15306	07810B 96.32	SH 78	096.318	BENNETT CREEK	1	30	1496	Concrete	Frame
16615	S08110A 26.06	SH 81	026.059	MARSH CREEK	1	20	660	Concrete	Frame
13026	02410B 65.12	SH 24	065.120	MILNER GOODING CANAL	3	25	3192	Concrete	Frame

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13621	03020K 211.35	US 30	211.339	'S' COULEE CANAL	1	21	2896	Concrete	Frame
15298	S07810B 93.20	SH 78	093.200	IRRIGATION PIPES	1	16	512	Concrete	Frame
14681	05510A 6.11	SH 55	006.106	LOW LINE CANAL	1	25	3740	Concrete	Frame
13005	02410B 9.46	SH 24	009.455	'B-1' CANAL	1	21	667	Concrete	Frame
15275	S07810A 47.85	SH 78	047.848	CATHERINE CREEK	1	20	704	Concrete	Frame
15116	S02010B 195.87	US 20	195.873	WEST CANAL	1	16	1046	Concrete	Frame
12985	S02210A 61.69	SH 22	061.687	MEDICINE LODGE CREEK	1	17	861	Concrete	Frame
13910	S03310A 100.49	SH 33	100.456	SALEM CANAL	1	20	880	Concrete	Frame
15025	S02010A 150.05	US 20	150.050	SOLDIER MTN.FLOOD CH.	1	16	745	Concrete	Frame
18055	09520A 38.65	US 95	038.649	GOLDEN GATE CANAL	1	22	1755	Concrete	Frame
12630	02020K 347.84	US 20 WBL & EBL	347.838	N.BR.FALL RIVER CANAL	1	22	3541	Concrete	Frame
16620	08110A 26.28	SH 81	026.284	'G' CANAL	1	21	688	Concrete	Frame
12380	02020K 312.48	US 20	312.479	ANDERSON CANAL	1	25	2675	Concrete	Frame
14555	S05110A 71.91	SH 51	071.914	BUCKAROO DITCH	1	15	525	Concrete	Frame
14695	S05510A 9.55	SH 55	009.544	NORTH CANAL	1	17	988	Concrete	Frame
14990	02010A 142.11	US 20	142.110	ARNOLD CREEK	1	22	838	Concrete	Frame
13995	03410B 27.79	SH 34	027.635	COTTONWOOD CREEK	1	28	1418	Concrete	Frame
12605	02020K 344.51	US 20	344.503	SERVICE ROAD	1	25	2843	Concrete	Frame
12980	S02210A 39.26	SH 22	039.273	BIRCH CREEK;HYDRO PROJ	1	17	954	Concrete	Frame
13635	03020L 219.65	US 30	219.617	PERRINE COULEE CANAL	1	26	5737	Concrete	Frame
14985	02010A 141.84	US 20	141.840	HOT CREEK	1	22	838	Concrete	Frame
13100	S02620A 139.79	US 26	139.820	CANAL	1	14	768	Concrete	Frame
12375	02020K 311.75	US 20	311.750	WILLOW CREEK	1	22	4825	Concrete	Frame
12425	S02020K 320.34	US 20 EBL & WBL	320.344	ALLIANCE CANAL	1	15	3179	Concrete	Frame
13110	S02620A 146.43	US 26	146.430	S.GOODING MAIN CANAL	1	13	449	Concrete	Frame
12975	S03310A 16.32	SH 33	016.314	LITTLE LOST RIVER	1	18	614	Concrete	Frame
13610	S03020K 202.73	US 30	202.724	LATERAL	1	16	650	Concrete	Frame
15285	07810A 54.21	SH 78	054.220	BIRCH CREEK	1	26	829	Concrete	Frame
12455	02020K 322.84	US 20 EBL & WBL	322.837	PARKS LEWISVILLE CANAL	1	33	4937	Concrete	Frame
13940	03310A 106.75	SH 33	106.748	ENTERPRIZE CANAL	1	21	1176	Concrete	Frame
13202	02020F 270.84	US 20	270.840	INL CENTRAL CONNECTOR	1	29	1516	Concrete	Frame
14315	S04510A 25.46	SH 45	025.459	WILSON DRAIN	1	13	1214	Concrete	Frame
14045	03410C 76.81	SH 34	076.810	LITTLE BLACKFOOT RIVER	1	32	1310	Concrete	Frame
15000	S02010A 144.68	US 20	144.678	W.BRANCH CORRAL CREEK	1	20	840	Concrete	Frame
13615	S03020K 204.61	US 30	204.182	CANAL	1	16	650	Concrete	Frame
14970	S02010A 139.53	US 20	139.533	CHICKEN CREEK	1	16	686	Concrete	Frame
Count:	101								
15015	02010A 147.41	US 20	147.407	THREE MILE CREEK	2	16	1389	Concrete Continuous	Slab
15005	02010A 145.36	US 20	145.357	CORRAL CREEK	2	16	1389	Concrete Continuous	Slab

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13150	09320C 167.54	US 93	167.538	MILNER GOODING CANAL	2	37	3003	Concrete Continuous	Slab
Count:	3								
13160	09320C 182.82	US 93	182.820	JIMMY BYRNES SLOUGH	3	10	2077	Concrete Continuous	Culvert
Count:	1								
14350	04610A 112.89	SH 46	112.893	BIG WOOD RIVER	3	72	4155	Concrete Continuous	Tee Beam
13650	03020L 231.92	US 30	231.904	UPRR;BICKEL OVERPASS	3	58	4725	Concrete Continuous	Tee Beam
Count:	2								
14320	04610A 100.04	SH 46	100.038	I 84 EB-WB;S.WENDELL IC	2	111	19939	Concrete Continuous	Single/Spread Box
Count:	1								
12995	02410B 5.55	SH 24	005.545	'B' CANAL	3	34	5985	Concrete Continuous	Frame
Count:	1								
15069	S02010A 172.86	US 20	172.860	ROCK CREEK	1	11	1808	Steel	Culvert
12615	02020K 347.02	US 20 EBL & WBL	347.022	SALEM UNION CANAL	1	38	6707	Steel	Culvert
15263	S07810A 6.87	SH 78	006.820	SQUAW CREEK	1	13	598	Steel	Culvert
12295	02020J 302.76	US 20	302.758	OAKLAND WASTE DITCH	1	22	4553	Steel	Culvert
18040	09520A 26.79	US 95	026.787	'B' LINE CANAL	1	24	3960	Steel	Culvert
15264	07810A 16.41	SH 78	016.410	REYNOLDS CREEK	1	30	1378	Steel	Culvert
15109	02010B 195.11	US 20	195.106	DRY CREEK	2	24	9149	Steel	Culvert
15288	S07810A 60.83	SH 78	060.833	MUTUAL CANAL	1	16	1056	Steel	Culvert
13735	S03020P 404.35	US 30	404.514	SODA CREEK	2	6	1604	Steel	Culvert
34510	S03020N 365.19	US 30	365.186	PORTNEUF RIVER OVERFLOW	1	13	3172	Steel	Culvert
15291	S07810A 66.48	SH 78	066.480	BYBEE CANAL	1	13	1053	Steel	Culvert
34500	S03020N 365.17	US 30	365.171	PORTNEUF RIVER	1	13	3614	Steel	Culvert
15068	S02010A 168.05	US 20	168.050	CAMP CREEK	1	10	1440	Steel	Culvert
34505	S03020N 365.18	US 30	365.181	PORTNEUF RIVER OVERFLOW	1	13	3354	Steel	Culvert
15067	S02010A 164.55	US 20	164.550	WILLOW CREEK	1	14	2820	Steel	Culvert
15066	S02010A 160.00	US 20	160.000	ELK CREEK	1	12	1216	Steel	Culvert
Count:	16								
13550	03020K 177.44	US 30	177.471	MALAD R.;N.HAGERMAN BR.	3	114	12239	Steel	Stringer/Girder
13704	03020N 364.59	US 30	364.589	PORTNEUF RIVER	1	197	16154	Steel	Stringer/Girder
17570	09320A 37.57	US 93	037.495	HIGH LINE CANAL	1	75	2842	Steel	Stringer/Girder
15220	07410A 2.44	SH 74	002.439	LOW LINE CANAL	1	75	2863	Steel	Stringer/Girder
13500	08400B 59.17	I 84B	059.168	INDIAN CREEK	1	25	1970	Steel	Stringer/Girder
14260	04410A 0.04	SH 44	000.039	I 84 EB-WB;MIDDLETON IC	5	49	7610	Steel	Stringer/Girder

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12220	02020B 22.06	US 20	022.062	I 84 EB-WB;PARMA IC	4	64	6606	Steel	Stringer/Girder
Count: 7									
12565	02020K 334.45	US 20 EBL	334.350	S.FK.TETON RIVER	3	59	7868	Steel Continuous	Stringer/Girder
14670	05510A 2.61	SH 55	002.605	SNAKE RIVER(MARSING BR)	12	64	29407	Steel Continuous	Stringer/Girder
19391	09320B 45.66	US 93	045.658	ROCK CREEK	3	164	39143	Steel Continuous	Stringer/Girder
12671	02020L 363.37	US 20	363.370	HENRY'S FK. SNAKE RIVER	3	212	34810	Steel Continuous	Stringer/Girder
13706	03020N 365.25	US 30	365.246	UPRR & CANAL; TOPAZ OP	3	320	50266	Steel Continuous	Stringer/Girder
12560	02020K 334.44	US 20 WBL	334.349	S.FK.TETON RIVER	3	59	7868	Steel Continuous	Stringer/Girder
18050	09520A 34.71	US 95	034.710	SNAKE RIVER;HOMEDALE BR.	5	185	28395	Steel Continuous	Stringer/Girder
14410	04612A 0.41	SH 46 SPUR	000.041	I 84 EB-WB;W.WENDELL IC	2	150	13493	Steel Continuous	Stringer/Girder
13946	03310A 115.51	SH 33	115.508	CANYON CREEK	3	212	15960	Steel Continuous	Stringer/Girder
12676	02020L 379.15	US 20	379.144	HENRY'S FK. SNAKE RIVER	2	125	10538	Steel Continuous	Stringer/Girder
14520	05010A 3.88	SH 50	003.887	SNAKE RIVER;HANSEN BR.	4	258	26006	Steel Continuous	Stringer/Girder
12440	02020K 321.32	US 20 EB-WB	321.320	SH 48;RIGBY GS	3	105	13184	Steel Continuous	Stringer/Girder
16641	03310A 58.84	SH 33	058.838	I 15 NB-SB;SAGE JCT IC	4	93	15758	Steel Continuous	Stringer/Girder
Count: 13									
14360	S04610A 116.09	SH 46	116.092	N. GOODING LATERAL 1465	1	18	1227	Prestressed Concrete	Slab
Count: 1									
12690	02020L 398.76	US 20	398.756	HENRY'S LAKE OUTLET	1	57	2756	Prestressed Concrete	Stringer/Girder
12685	02020L 392.77	US 20	392.764	HENRY'S FK. SNAKE RIVER	3	59	10818	Prestressed Concrete	Stringer/Girder
14040	03410C 70.46	SH 34	070.458	BLACKFOOT RIVER	1	94	3821	Prestressed Concrete	Stringer/Girder
13702	03020N 364.20	US 30	364.200	PORTNEUF RIVER	3	123	28126	Prestressed Concrete	Stringer/Girder
13730	03020P 375.67	US 30	375.588	DEER CROSSING	1	75	4994	Prestressed Concrete	Stringer/Girder
12520	02020K 328.08	US 20 WBL	328.068	TEXAS SLOUGH	1	61	2796	Prestressed Concrete	Stringer/Girder
12370	02020K 310.18	US 20 WBL	310.173	IDAHO CANAL	1	80	3541	Prestressed Concrete	Stringer/Girder
12585	02020K 339.41	US 20 WBL	339.405	N.FK.TETON RIVER	1	99	4413	Prestressed Concrete	Stringer/Girder
14300	04510A 10.43	SH 45	010.428	SNAKE R.(WALTERS FERRY)	10	67	27190	Prestressed Concrete	Stringer/Girder
13950	03310A 128.51	SH 33	128.410	TETON RIVER	2	79	6394	Prestressed Concrete	Stringer/Girder
12465	02020K 323.59	US 20 EBL	323.565	SNAKE RIVER DRY BED CNL	1	71	3089	Prestressed Concrete	Stringer/Girder
13715	03020P 371.89	US 30	371.782	PORTNEUF RIVER	3	122	13638	Prestressed Concrete	Stringer/Girder
14724	05510A 16.47	SH 55	016.465	INDIAN CREEK	3	118	21749	Prestressed Concrete	Stringer/Girder
15226	07410A 7.23	SH 74	007.225	ROCK CREEK	4	105	33960	Prestressed Concrete	Stringer/Girder
13618	03020K 208.91	US 30	208.914	CEDAR CREEK DRAW	1	77	3360	Prestressed Concrete	Stringer/Girder
18075	09520A 45.21	US 95	045.205	US 20;UPRR;US 20-95 IC	6	69	10560	Prestressed Concrete	Stringer/Girder
16645	03310A 73.44	SH 33	073.436	HENRY'S FK.SNAKE RIVER	4	79	14768	Prestressed Concrete	Stringer/Girder
12654	02020K 352.07	US 20 EBL	352.067	FALL RIVER CANAL	1	31	1432	Prestressed Concrete	Stringer/Girder
12413	02020K 317.90	US 20 EBL	317.899	COUNTY LINE ROAD IC	1	122	5457	Prestressed Concrete	Stringer/Girder
13725	03020P 373.22	US 30	373.123	DEER CROSSING	1	75	4026	Prestressed Concrete	Stringer/Girder

Idaho Transportation Department
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BrKey	Structure No.	Route	Milepost	Features	# Spans	Span Lgth	Sq.Ft.	Material Type	Structure Type
17600	09320B 61.70	US 93	061.714	'M' CANAL	1	46	1991	Prestressed Concrete	Stringer/Girder
13200	02020F 265.04	US 20	265.043	BIG LOST RIVER	1	58	2422	Prestressed Concrete	Stringer/Girder
12015	03020N 359.65	US 30	359.645	PORTNEUF RIVER;MCCAMMON	3	69	15726	Prestressed Concrete	Stringer/Girder
12485	02020K 325.04	US 20 WBL	325.020	MENAN CANAL	1	43	1916	Prestressed Concrete	Stringer/Girder
12680	02020L 387.03	US 20	387.030	BUFFALO RIVER;PONDS BR.	3	59	10818	Prestressed Concrete	Stringer/Girder
12500	02020K 326.23	US 20 WBL	326.201	SNAKE RIVER;LORENZO BR.	6	107	28654	Prestressed Concrete	Stringer/Girder
18095	09520A 60.82	US 95	060.815	I 84 EB-WB;US 95 IC	5	73	18557	Prestressed Concrete	Stringer/Girder
12470	02020K 323.60	US 20 WBL	323.575	SNAKE RIVER DRY BED CNL	1	71	3089	Prestressed Concrete	Stringer/Girder
14690	05510A 8.10	SH 55	008.098	LOW LINE CANAL	2	35	3892	Prestressed Concrete	Stringer/Girder
14035	03410C 57.91	SH 34	057.912	UPRR;SODA'S 3RD E.ST OP	1	77	6209	Prestressed Concrete	Stringer/Girder
13740	03020P 406.67	US 30	406.711	UPRR; SODA SPRINGS OP	1	111	5188	Prestressed Concrete	Stringer/Girder
12373	02020K 311.33	US 20 EBL	311.338	STC 6708; ST LEON RD	1	111	4806	Prestressed Concrete	Stringer/Girder
14525	05010A 4.68	SH 50	004.700	I 84 EB-WB;KIMBERLY IC	3	50	15500	Prestressed Concrete	Stringer/Girder
15105	02010B 191.36	US 20	191.356	SILVER CREEK	1	61	2497	Prestressed Concrete	Stringer/Girder
13720	03020P 372.52	US 30	372.434	DEER CROSSING	1	75	4026	Prestressed Concrete	Stringer/Girder
17610	09320B 62.66	US 93	062.682	'R' CANAL	1	54	2336	Prestressed Concrete	Stringer/Girder
12645	02020K 350.71	US 20 WBL & EBL	350.701	S.FK.FALL RIVER CANAL	2	37	8719	Prestressed Concrete	Stringer/Girder
12435	02020K 320.85	US 20	320.851	BURGESS CANAL	1	88	8224	Prestressed Concrete	Stringer/Girder
12384	02020K 313.45	US 20 WBL	313.448	STC 6706; HITT RD	1	116	5023	Prestressed Concrete	Stringer/Girder
12489	02020K 325.58	US 20	325.574	MENAN-LORENZO RD.	1	97	4488	Prestressed Concrete	Stringer/Girder
17456	09120A 1.86	US 91	001.846	CUB RIVER	1	72	5291	Prestressed Concrete	Stringer/Girder
15300	07810B 94.61	SH 78	094.608	SNAKE R.;INDIAN COVE BR.	8	68	17642	Prestressed Concrete	Stringer/Girder
16625	08112A 0.27	SH 81B SPUR	000.263	I 84;MALTA-YALE RD IC	3	49	7223	Prestressed Concrete	Stringer/Girder
12480	02020K 325.03	US 20 EBL	325.019	MENAN CANAL	1	43	1916	Prestressed Concrete	Stringer/Girder
12665	02020K 354.05	US 20	354.049	FALL RIVER	2	55	4779	Prestressed Concrete	Stringer/Girder
12650	02020K 352.06	US 20 WBL	352.066	FALL RIVER CANAL	1	31	1410	Prestressed Concrete	Stringer/Girder
13656	03020L 236.42	US 30	236.417	TWIN FALLS MAIN CANAL	2	74	5426	Prestressed Concrete	Stringer/Girder
13711	03020N 369.05	US 30	369.047	PORTNEUF RIVER	2	105	14842	Prestressed Concrete	Stringer/Girder
12590	02020K 339.42	US 20 EBL	339.406	N.FK.TETON RIVER	1	99	4413	Prestressed Concrete	Stringer/Girder
12515	02020K 328.06	US 20 EBL	328.067	TEXAS SLOUGH	1	61	2796	Prestressed Concrete	Stringer/Girder
12400	02020K 315.23	US 20 EBL	315.226	SH 43;WEST BELT BRIDGE	4	63	10223	Prestressed Concrete	Stringer/Girder
12020	03020N 359.60	US 30	359.597	UPRR;N.MCCAMMON OP	3	67	14133	Prestressed Concrete	Stringer/Girder
15070	02010A 176.04	US 20	176.038	BIG WOOD RIVER	3	76	7772	Prestressed Concrete	Stringer/Girder
14722	05510A 16.37	SH 55	016.369	UPRR	1	93	8630	Prestressed Concrete	Stringer/Girder
12487	02020K 325.57	US 20	325.572	MENAN-LORENZO RD.	1	97	4488	Prestressed Concrete	Stringer/Girder
12495	02020K 326.22	US 20 EBL	326.200	SNAKE RIVER;LORENZO BR.	6	107	28514	Prestressed Concrete	Stringer/Girder
12405	02020K 315.24	US 20 WBL	315.227	SH 43;WEST BELT BRIDGE	4	73	10289	Prestressed Concrete	Stringer/Girder
14729	05510A 16.59	SH 55	016.588	I 84;KARCHER IC	2	104	16382	Prestressed Concrete	Stringer/Girder
14020	03410B 46.08	SH 34	046.084	BEAR RIVER;GRACE BRIDGE	7	75	27868	Prestressed Concrete	Stringer/Girder
12383	02020K 313.44	US 20 EBL	313.447	STC 6706; HITT RD	1	116	5023	Prestressed Concrete	Stringer/Girder

Idaho Transportation Department
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BrKey	Structure No.	Route	Milepost	Features	# Spans	Span Lgth	Sq.Ft.	Material Type	Structure Type
12414	02020K 317.89	US 20 WBL	317.893	COUNTY LINE ROAD IC	1	122	5457	Prestressed Concrete	Stringer/Girder
19850	16710A 0.80	SH 167	000.793	SNAKE RIVER;GRANDVIEW BR	6	102	23121	Prestressed Concrete	Stringer/Girder
13646	03020L 230.13	US 30	230.126	TWIN FALLS MAIN CANAL	3	48	4905	Prestressed Concrete	Stringer/Girder
12374	02020K 311.34	US 20 WBL	311.339	STC 6708; ST LEON RD	1	111	4806	Prestressed Concrete	Stringer/Girder
Count: 64									
13000	02410B 7.99	SH 24	007.994	'B-2' CANAL	1	30	1023	Prestressed Concrete	Tee Beam
17827	08710A 0.06	SH 87	000.060	HOWARD CREEK	1	38	1722	Prestressed Concrete	Tee Beam
17829	08710A 1.14	SH 87	001.140	TARGHEE CREEK	1	80	3486	Prestressed Concrete	Tee Beam
Count: 3									
16611	08110A 25.08	SH 81	025.076	'H' CANAL	1	48	2278	Prestressed Concrete	Multiple Box Beam
18045	09520A 30.37	US 95	030.370	JUMP CREEK	1	47	1902	Prestressed Concrete	Multiple Box Beam
15100	02010B 187.15	US 20	187.147	SILVER CREEK	3	35	4123	Prestressed Concrete	Multiple Box Beam
13175	09320C 200.06	US 93	200.060	LITTLE WOOD RIVER	1	62	2605	Prestressed Concrete	Multiple Box Beam
12620	02020K 347.04	US 20 EBL & WBL	347.038	TWIN GROVES CANAL	1	28	4413	Prestressed Concrete	Multiple Box Beam
14365	04610A 117.90	SH 46	117.903	NRTH GOODING MAIN CNL	1	24	936	Prestressed Concrete	Multiple Box Beam
12625	02020K 347.35	US 20 EBL & WBL	347.349	FARMERS FRIEND CANAL	1	33	5210	Prestressed Concrete	Multiple Box Beam
14030	03410B 47.26	SH 34	047.305	NORTH EXTENSION CANAL	1	34	2240	Prestressed Concrete	Multiple Box Beam
19393	09320B 48.66	US 93	048.659	PERRINE COULEE;BIKE PATH	1	36	5460	Prestressed Concrete	Multiple Box Beam
16606	08110A 23.61	SH 81	023.613	'J' CANAL	1	55	2540	Prestressed Concrete	Multiple Box Beam
17566	09320A 25.08	US 93	025.019	LATERAL NO. 1	1	62	4864	Prestressed Concrete	Multiple Box Beam
13190	09320C 204.55	US 93	204.553	LITTLE WOOD RIVER	1	49	2992	Prestressed Concrete	Multiple Box Beam
13185	09320C 204.38	US 93	204.382	LITTLE WOOD RIVER	1	39	2400	Prestressed Concrete	Multiple Box Beam
13180	09320C 200.90	US 93	200.900	LITTLE WOOD RIVER	1	38	1647	Prestressed Concrete	Multiple Box Beam
13165	09320C 198.27	US 93	198.266	SILVER CREEK	1	46	1873	Prestressed Concrete	Multiple Box Beam
13155	09320C 177.63	US 93	177.638	LITTLE WOOD RIVER	1	53	2164	Prestressed Concrete	Multiple Box Beam
13170	09320C 199.28	US 93	199.280	LITTLE WOOD RIVER	1	68	2842	Prestressed Concrete	Multiple Box Beam
Count: 17									
12535	02020K 331.93	US 20 WBL	331.924	STP 7726;S.REXBURG IC	3	98	6868	Prestressed Concrete	Single/Spread Box
12550	02020K 333.41	US 20 EBL	333.420	SH 33;REXBURG IC	3	98	6867	Prestressed Concrete	Single/Spread Box
12530	02020K 331.92	US 20 EBL	331.923	STP 7726;S.REXBURG IC	3	98	6868	Prestressed Concrete	Single/Spread Box
12555	02020K 333.42	US 20 WBL	333.421	SH 33;REXBURG IC	3	98	6867	Prestressed Concrete	Single/Spread Box
Count: 4									
14297	04410C 16.86	SH 44	016.864	DRY CREEK	3	30	6881	P/S Conc Continuous	Slab
Count: 1									
12583	03310A 99.42	SH 33 SPUR	099.400	US 20;SH 33 SPUR IC	2	118	13810	P/S Conc Continuous	Stringer/Girder

Idaho Transportation Department
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BrKey	Structure No.	Route	Milepost	Features	# Spans	Span Lgth	Sq.Ft.	Material Type	Structure Type
17605	09320B 61.94	US 93	061.952	'U' CANAL	3	52	6749	P/S Conc Continuous	Stringer/Girder
Count: 2									
13095	02620A 138.82	US 26	138.836	I 84 EB-WB;E.BLISS IC	2	179	23002	P/S Conc Continuous	Single/Spread Box
13608	03020K 212.06	US 30	212.057	US 30/US 93 INTERCHANGE	1	150	11259	P/S Conc Continuous	Single/Spread Box
Count: 2									

Count: 321

the Right Truck for Idaho

Right for Idaho's Economy
Right for Idaho's Road Safety
Right for Idaho's Environment

Idaho Transportation Department
3311 W. State St.
P.O. Box 7129
Boise ID 83707-1129

May 31, 2016

Mr. Ramon Hobdey-Sanchez,

Thank you again for the opportunity to provide comment on the permitting and safety requirements for vehicles and loads over 80,000 pounds in Idaho.

In reviewing comments submitted to-date, we observe that comments fall into one of two categories. The first, from the overwhelming majority, describe why the system in place today is working and has worked for decades. The second, are those comments from a small minority that suggest changes are necessary for reasons that are largely out of scope of this particular rules process or already covered under existing state and federal rules.

The record clearly illustrates the successes of the current system. For over two decades the Idaho Department of Transportation (ITD) has successfully implemented and managed vehicle loads from 80,000 pounds and higher on Idaho roads. Comments from users across the state indicate trucks over 80,000 pounds have made hundreds of thousands of trips safely and within compliance of existing state law and rules.

User voices provide invaluable data and on-the-ground detail about the safety and function of current practices. This information is far more valuable than hypothetical or national data; it shows the Idaho experience. What we see in the record is that everyone is committed to driver and equipment safety. We see that companies are greatly reducing truck traffic but increasing regional commerce. We see that a cohesive and state-wide system works while also providing a voice for local input and consideration.

The Department outlined that this rulemaking should evaluate the permitting process and safety requirements of all weights over 80,000 pounds. Whether or not 129,000 pound loads are right for Idaho is not up for debate in this process. After a decade of study and implementation experience, the Idaho Legislature and the Department found 129,000 pound loads safe and efficient for Idaho. As indicated in letters from Idaho companies, 129,000 pound loads are greatly reducing overall truck traffic and are held to the same, if not higher, performance and safety standards.

Select comments spoke to route selection concerning the physical characteristics of roads and highways that should be authorized for over legal trucks. Senate Bill 1117 enacted in 2013 specifically authorized the Idaho Department of Transportation Board to approve routes "utilizing criteria established by the Board based upon road and bridge structural integrity engineering standards, as well as public safety

engineering standards." Subsequently the ITD Board established by rule (39.03.22-1302) a process for qualified experts to review individual route requests and current engineering standards to qualify routes for over-legal truck traffic and sets a process for public comment on those evaluations. This established process is working very well and is the proper venue for review of physical characteristics of state highways as they apply to authorized truck traffic. The Department pays close attention to, and updates regularly, current engineering standards for roads, bridges, and vehicles which is, and should remain, the source of these route reviews. The process of route selection is measured, thoughtful and brings in local needs and voices.

Issues associated with current engineering standards and highway standards are well beyond the scope of this proposed rule which is defined as "potential improvements to the permitting process and safety requirements for vehicles and loads" (5/4/16 Idaho Administrative Bulletin). Additionally, we note that some submitted comments urge the Department to adopt provisions that would apply to specific geographic regions of the state, but not others. Doing so would be disruptive. Commercial trucking rules in Idaho should be applied uniformly and consistently across the entire state, not selectively to various regions or other geo-political boundaries.

It is important to note that the Department does not need to create new rules for the implementation of Senate Bill 1229. Instead, Idaho's existing rules govern 129,000 pound trucks on Idaho roads and Federal Motor Carriers Safety Administration rules govern the vehicles as they travel on interstates in Idaho and throughout the region. All carriers electing to use the interstate in Idaho will follow the federal rules regulating everything from driver training to equipment and configuration standards. These rules help ensure that travel between states is safe, efficient and seamless.

The existing regulations that govern truck traffic, both federal and state, create a safe and reliable system in Idaho. There are no compelling reasons for change. As the Department continues to review the current rules and the comments from this process, we look forward to providing additional input and feedback.

Thank you,

THE RIGHT TRUCK FOR IDAHO COALITION

Arlo G Lott Trucking
Milk Producers of Idaho
Idaho Trucking Association
Food Producers of Idaho
Idaho Forest Group
Transystems LLC
Glanbia Foods
Idaho Sugar Beet Growers Association

Associated Food Stores
Idaho Grower Shippers Association
Idaho Farm Bureau Federation
Winco
The Amalgamated Sugar Company
NW Dairy Association
Darigold
Idaho Cattle Association

Monsanto
US Ecology Inc.
Scoular Company
Idaho Grain Producers
Idaho Oregon Fruit and Vegetable Association
Northwest Grocery Association
Idaho Dairymen's Association

IDAHO FOREST
— GROUP —

4447 EAST CHILCO ROAD ATHOL, ID 83801 IDAHOFORESTGROUP.COM 208.762.2917

May 24, 2016

Idaho Transportation Department
3311 W. State St.
P.O. Box 7129
Boise ID 83707-1129

In re: Comments on Dockett # 39-0300-160 Notice of Intent to Promulgate Rules Regarding Potential Improvements to the Permitting Process and Safety Requirements for Vehicles and Loads that are Required to Operate Under an Over-legal Permit

Dear Mr. Ramon Hobdey-Sanchez:

These are the initial comments of IFG on the notice of intent to initiate a negotiated rulemaking on Idaho truck and driver safety regulations.

Idaho Forest Group (IFG) is the largest lumber manufacturing company in Idaho with manufacturing facitilites at Grangeville, Lewiston, Chilco, Laclede, and Moyie Springs, Idaho. Trucking is essential to our business. Nearly all of our 600,000 mbf of logs required by our facilities are delivered by trucks, and 40% of the 950 million bd ft of lumber we manufacture are shipped by trucks.

IFG does not operate any company owned trucking fleets, but relies almost exclusively on contracting with Idaho's professional trucking companies to operate our business.

Safety is a priority at IFG, as evidenced by the excellent, award winning, safety records in all of our operations. We also make safety a priority for our contactors thru contractual clauses and have a "continuous improvement" policy with all safety aspects of our business.

IFG's business success depends on effective and efficient trucking to remain competitive with our peer manufactures in adjacent states and Canada. We have consistently supported investments in Idaho's road and bridge infrastructure and the expanded opportunities for higher capacity trucks. Most recently IFG partnered with local trucking experts in north Idaho to implement trucking up to 129,000 lbs on US Highway 95 between Grangeville and Lewiston, Idaho.

IFG appreciates the interests of the Idaho Transportation Department to examine truck and driver safety requirements in Idaho. It is appropriate for the state to monitor and periodically update safety standards when needed. Also, to compare our record, requirements and success with adjoining states & provinces. Increasing use of Idaho's highways, evolving truck design and braking technology, and data from monitoring studies invite periodic consideration of safety programs. What we know overall is that truck safety is very good in Idaho and improving.

Informed by our considerable experience at Idaho Forest Group operations, we anticipate ITD will find, as we have, that trucking in Idaho is being accomplished at a very safe level. IFG carefully monitors and regularly communicates with our trucking contractors about all safety matters. Of particular mention are the relatively new 129,000 lb trucking operations of our freight on US 95. The 129,000 lb trucks have been operating since 10/8/2014 on this section of Idaho highway without a single safety incident. See attached picture. Our trucking contractor, Baker Trucking, has an excellent safety program. Their Safety Director, Lori Webb-Remacle can provide any details about the trucks and drivers, but the record speaks for itself.

IFG stands ready to participate in the negotiated rulemaking to examine and respectfully engage other stakeholders that have concerns about Idaho truck safety standards. We do request, however, that the ITD exercise its customary care and due diligence to only move forward new safety regulation issues in this rule making if they are supported by sound data or engineering studies, not speculation or unfounded assertions. ITD should remain very cognizant about the positive truck safety record in Idaho. A possible and legitimate outcome of this rule-making process may well be to conclude that no additional regulations on truck safety are warranted or required because highly safety goals are being accomplished by the current regulations.

Sincerely,

Bob Boeh
VP Government Affairs/Strategic Outreach
Idaho Forest Group

129,000 lb lumber truck configuration

Arlo G. Lott
TRUCKING INC
Jerome Idaho

May 24, 2016

Steve Bywater
Consultant to Idaho Transportation Department

and

Ramón Hobdey-Sánchez, Program Specialist
Government Affairs
Idaho Transportation Department
P.O. Box 7129
Boise, ID 83707-1129

RE: Negotiated Rulemaking on Over-legal Permitting on the Interstate, Senate Bill 1229

Dear Mr. Bywater and Mr. Hobdey-Sánchez,

Arlo G. Lott Trucking, Inc. is an Idaho based carrier operating in excess of 27,000,000 miles per year with 14,400,000 of those miles functioning at 105,500 GVW and 3,200,000 miles at 129,000 GVW. Our Fleet has proven within our internal matrix that Longer Combination Vehicles (LCV) have 70% less per million miles for the following; out of service violations, driver influenced events and catastrophic accidents in comparison to 5 axle, 80,000 GVW vehicles. We have done our own internal audit due to the fact that all the statistics do not separate LCV incidents from tractor trailer, doubles, and triples, thus skewing the data. Our safety record will show that we take safety serious and we have invested in tested and proven instruments to maintain and constantly improve what we do. For example; roll over protection devices, electronic logs, drive cams, lane departure, and safety rewards to name a few.

We have participated in the Pilot Program with excellent ITD data, proving the system works well. We also operate in other 129,000 GVW States with metropolitan populations and mountainous terrain following the safety guidelines, permits, and regulations that are set forth for 80,000 GVW trucks that has proven itself to be effective and safe.

As an Idaho Business we see our surrounding 129,000 GVW States at an advantage over Idaho with the efficiencies they possess of hauling more with less and out performing us in the market place. Our agriculture and States natural resources will benefit from this Bill far greater than we realize.

In conclusion, history has shown that improving our transportation has benefited the populace and entire economies through change and educated proven decisions that we feel have been accomplished with the pilot program and the surrounding states success at 129,000 GVW.

We express our gratitude for your time and the opportunity to comment on the Negotiated Rulemaking. If further communications is required feel free to contact me at 208-324-5053 or e-mail andy.lott @agltrucking.com

Kind Regards,

Andrew Lott
President

PO Box 110 Jerome, ID 83338 (208) 324-5053