TRANSPORTATION POOLED FUND PROGRAM
QUARTERLY PROGRESS REPORT

Lead Agency (FHWA or State DOT):
____KansasDOT____

INSTRUCTIONS:
Project Managers and/or research project investigators should complete a quarterly progress report for each calendar quarter during which the projects are active. Please provide a project schedule status of the research activities tied to each task that is defined in the proposal; a percentage completion of each task; a concise discussion (2 or 3 sentences) of the current status, including accomplishments and problems encountered, if any. List all tasks, even if no work was done during this period.

Transportation Pooled Fund Program Project # *(i.e, SPR-2(XXX), SPR-3(XXX) or TPF-5(220)*	**Transportation Pooled Fund Program - Report Period:** ☐Quarter 1 (January 1 – March 31) ☐Quarter 2 (April 1 – June 30) ☐Quarter 3 (July 1 – September 30) X☐Quarter 4 (October 4 – December 31)

Project Title: Accommodating oversize/ overweight vehicles at roundabouts		
Project Manager: Rodney Montney, P.E., Admin, Contact Steve King, P.E., KS DOT, TAC Member	**Phone:** 785 296 0255	**E-mail:**stevenK@ksdot.org
Project Investigator: Eugene R.Russell, Sr	**Phone:** 785-539-9422	**E-mail:** geno@ksu.edu
Lead Agency Project ID: RE-0541-01	**Other Project ID (i.e., contract #):**	**Project Start Date:** January 2010
Original Project End Date: Dec 2011	**Current Project End Date:Jun2012**	**Number of Extensions: 1**

Project schedule status:

☐ On schedule ☐X On revised schedule ☐ Ahead of schedule ☐ Behind schedule

Overall Project Statistics:

Total Project Budget	Total Cost to Date for Project	Total Percentage of Work Completed
209,500	190,000	90%

Quarterly Project Statistics:

Total Project Expenses This Quarter	Total Amount of Funds Expended This Quarter	Percentage of Work Completed This Quarter
35000	35,000,	10%

Project Description: The research project will compile current practice and research by various states and countries related to the effects that oversize overweight vehicles have on roundabout location, design, and accommodation. The research will fill in information gaps with respect to to roundabout design and operations for oversize overweight vehicles. Currently there is little information available for accommodating oversize overweight vehicles in roundabout design and this project will provide information.

Progress this Quarter (includes meetings, work plan status, contract status, significant progress, etc.):

During this past quarter, it was an Internet meeting with the advisory committee. Progress was made on using the data on n seve check vehicles that were supplied by Wisconsin and developing some critical movement on prototype roundabouts that were developed using TORUS software and AutoCAD. Since the third survey that was sent to various members of the trucking industr advertises on the Internet as being OSOW carriers resulted in zero returns, the KSU research team partnered with the American research trucking Institute (ATRI) and developed a joint survey that they would send out to their membership. Is it is expected tha survey will go out in early January.

Anticipated work next quarter:

During the next quarter, the new survey – survey for – developed in partnership with ATR I, will be analyzed and summarized. Th
results will be included into the final report. Is anticipated that most if not all of the final report will be written by the end of next qu

SIGNIFICANT RESULTS:

I **AUTOTURN SIMULATIONS ON TORUS GENERATED ROUNDABOUTS**

As a next step in this study, Autoturn and Torus software was used to generate roundabouts and run OSOW vehicle simulations on the torus generated roundabouts to observe the space requirements of these huge vehicles. Autoturn and Torus were used for their ease in developing the prototypes shown for illustrative purposes and not as an endorsement by the authors that all designers should use only these tools, i.e that is a designer's choice.

This task was carried out by considering a prototype single lane roundabout and a prototype double lane roundabout. Wisconsin Department of Transportation (WisDOT) Freight Operations Section has developed inventory of 7 OSOW check vehicles for designing the roundabouts for OSOW vehicles. The 7 check vehicles (shown in Figure 4) that are considered from the WisDOT vehicle library are 55 meter wind blade NL (Vehicle Length (L)=209ft), 80' mobile home (L=112.5ft), 165' beam L (L=201.10ft), Combine (28.80ft), Wind tower section 78L (L=112.50ft), Wind tower upper mid-section (L=148.80ft), and WB-67(L=103ft). These 7 OSOW check vehicles from WisDOT vehicle library were considered to perform the vehicle path simulations on the Torus generated roundabouts and see if these vehicles can be accommodated or need any modifications.

Design Vehicle

Roundabouts are internationally designed to slow traffic, narrow curb-to-curb widths and provide tight turning radii. However, the roundabout should be designed in such a way that it can accommodate the largest vehicle that is likely to use the intersection (*f*). This vehicle is called as a design vehicle and it dictates many of the roundabouts dimensions, particularly for single lane roundabouts. WB-50 vehicles are commonly the largest vehicles along urban collectors and arterials and large trucks such as WB-67 may need to be considered at intersections on interstate freeway or state highway systems (*f*).

Single lane roundabout

To draw roundabouts using Torus software, initially an inscribed circle diameter needs to be determined for a particular location. According to NCHRP 672 (*f*), the inscribed circle diameter for a single lane roundabout is in the range 130 to 180 ft. when the design vehicle is WB 67. As the present roundabout is designed for vehicles that are larger than the WB 67 vehicle, the upper limit of the inscribed circle diameter range (180 ft.) is selected.

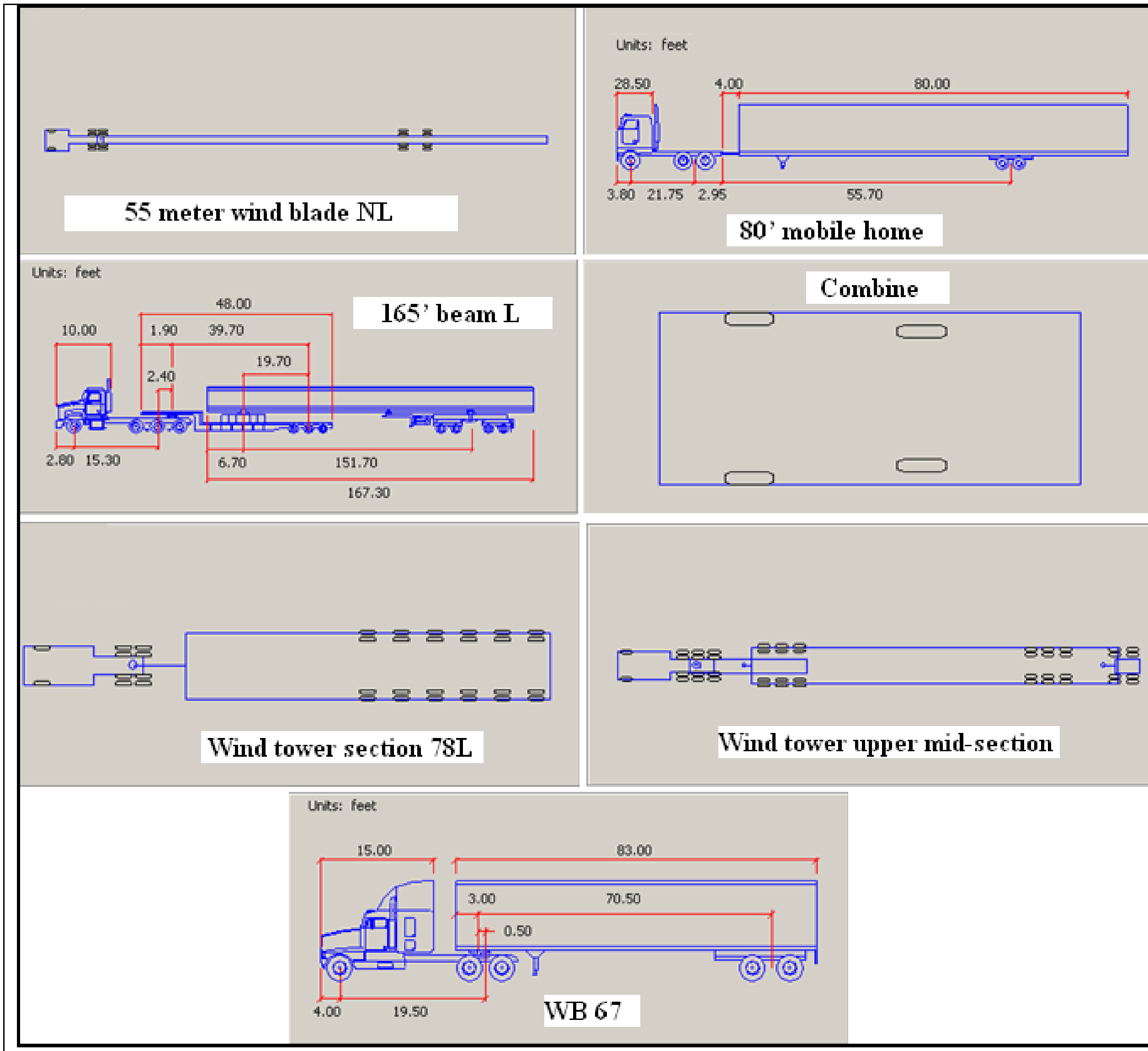

Figure 4: 7 OSOW check vehicles from the Wisconsin DOT vehicle library (Source: E-mail from Patrick Fleming, Wisconsin DOT)

The Torus generated single lane roundabout has a default designed center island truck apron width of 10 ft. This truck apron width is not sufficient for the design vehicle (WB 67) to traverse a left turn (usually the most critical movement). Therefore, a central island truck apron width of 15 ft. is initially assumed which accommodates the left turn movement of a WB 67. Each approach was designed in such a way that the approach has a 15 ft. (randomly selected) left offset to the center of the roundabout. Figure 5 shows the roundabout designed with Torus software with the specifications mentioned above. Torus uses the guidelines from “Roundabouts: An Informational Guide (FHWA-RD-00-067) (*g*)” for designing its roundabouts. However, this study designs the roundabouts based on the guidelines provided from the latest roundabout guide (*f*). As the design specifications from the latest roundabout guide are different from the initial version, the Torus software detects some errors while generating the roundabouts which can be ignored. It was assumed that OSOW trucks are considered to be able to go over the splitter island at the approach and exit to safely traverse a roundabout. It was also assumed that the drivers can enter from any lane and change into any lane at any point for the purpose of maneuvering through the roundabout. Right turn maneuvers, through maneuvers, and left turn maneuvers of the 7 check vehicles will be considered for checking and redesigning the geometry of the roundabout as necessary. Figure 6 shows an example right-turn simulation of a ‘Wind tower section 78L’ traversing a right turn (enters from approach 3 and exit into approach 4). From Figure 6, the three parallel red lines in the path of the vehicle are the front tire tracks and the blue lines are the rear tire tracks as the vehicle traverses a right turn. The yellow hashed area represents the swept area of the load.

Therefore, when OSOW vehicles are expected at the roundabout from two opposite approaches (approach 1 and approach 3), the modified design of the center island is in oval shape as shown in Figure 7. In this oval shaped truck apron and roundabout design, the maximum size of the truck apron width is 30 ft. and the minimum width of the truck apron is 15 ft. However, if we assume that the OSOW loads are entering from all the four directions, then the center island shape will need to be modified again to a circular shape and with a center island truck apron width as 30 ft. as shown in Figure 8. For the above two cases, a 15ft external truck apron should be provided in between two consecutive legs of the roundabout as shown in Figures 7 and 8.

There are some locations where we can expect the OSOW entering the roundabout from two opposite directions and they might use only the through movements. In such cases, providing a special through movement through the center island would make it easier for OSOW vehicles to traverse through the roundabout. Figure 9 shows the design generated in the single lane roundabout when only OSOW through movements are expected from approach 1 and 3. Gates should be provided for the through paths so that only permitted OSOW trucks can legally have access to these paths and avoid regular traffic using them.

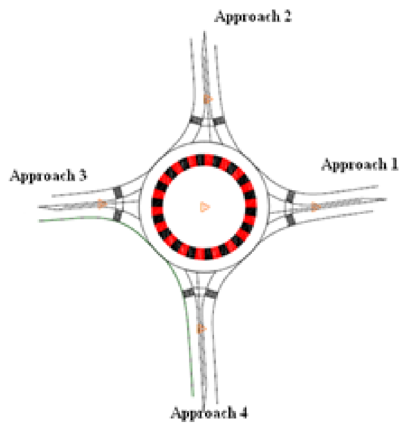

Figure 5: Figure shows a Torus generated single lane roundabout with180ft inscribed circle diameter, 15ft truck apron, and 15ft left offset for each approach.

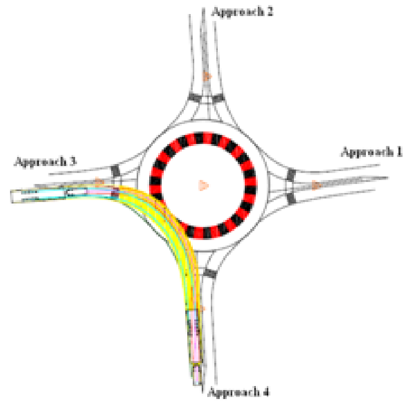

Figure 6: Right turn maneuver of 'Wind tower section 78L'

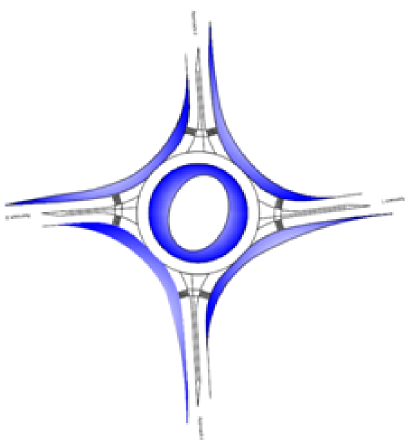

Figure 7: Final design of a roundabout when OSOW vehicles are expected from approach 1 and approach 3.

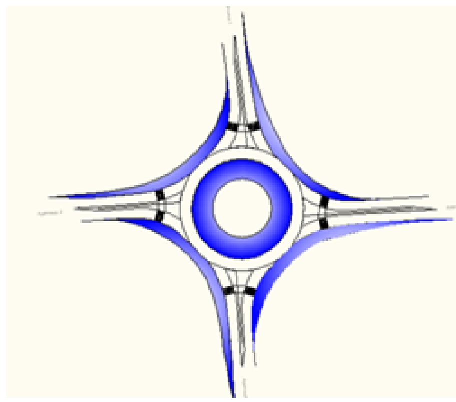

Figure 8: Final design of a roundabout when OSOW vehicles are expected from all approaches.

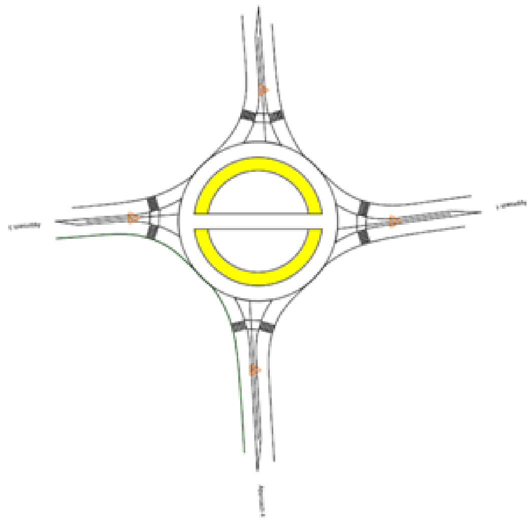

Figure 9: Redesigned roundabout with straight passage through the center island (Assuming trucks are able to go over the splitter island).

Double Lane Roundabout

According to NCHRP 672 report (*2*), the inscribed circle diameter for a double lane roundabout is in the range 165 to 220 ft. when the design vehicle is WB 67. As the current roundabout is designed for vehicles that are larger than the WB 67 vehicle, the upper limit of the inscribed circle diameter range 220 ft. is selected for this design.

The Torus generated double lane roundabout has a center island truck apron width of 20 ft. and this width is kept the same for this design of 2 lane roundabout. Each approach is designed in such a way that the approach has a 40 ft. (randomly assumed) left offset to the center of the roundabout. Figure 10 shows the roundabout designed with Torus software with the specifications mentioned above. It was assumed that OSOW trucks are considered to go over the splitter island at the approach and exit to safely traverse a roundabout. It was also assumed that the drivers can enter from any lane and change into any lane at any point for the purpose of maneuvering the roundabout. Right turn maneuvers, through maneuvers, and left turn maneuvers of the 7 check vehicles will be considered for redesigning the geometry of the roundabout.

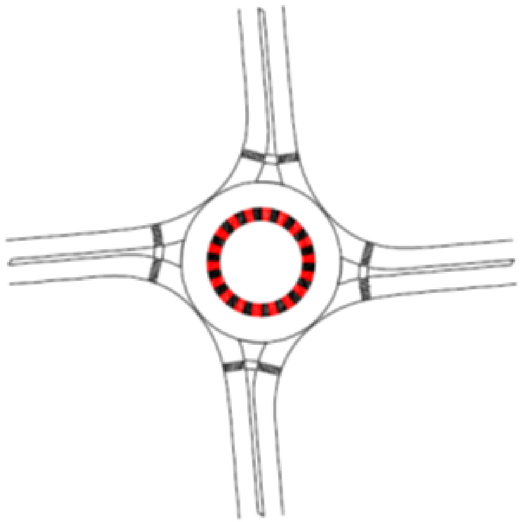

Figure 10: Figure shows a Torus generated double lane roundabout with220ft inscribed circle diameter, 20ft truck apron, and 40ft left offset for each approach.

SUMMARY AND CONCLUSIONS

Though roundabouts have several safety and operational advantages over signalized and stop controlled intersection alternatives, including, lower delays, shorter queues, better management of speed and opportunities for community enhancement features, the potential use of roundabouts with all their benefits may be greatly diminished on certain routes because they may not accommodate OSOW vehicles. This study has gathered information from 50 U.S. States regarding problems accommodating OSOW vehicles at roundabouts by conducting two surveys. Then with the use of TORUS software, prototype roundabouts and seven typical OSOW loads illustrated the types of design changes that needed to be made in a roundabout to accommodate the OSOW.

The first survey was conducted to find information on permits that are required for different states to transport OSOW vehicles and to determine the bottlenecks for OSOW vehicles. The bottlenecks were: bridges, curbs, interchanges, intersections, overhead structures, overhead wires, rail- highway grade crossings, raised channelization, roundabouts, signs and signals, and utilities.

The second survey was conducted with all 50 U.S States responding to obtain further detailed information specifically regarding their roundabouts and their issues with OSOW loads. Clearance issues, both vertical and horizontal, were among the most observed concerns from the responding states about the roundabout from the companies that deal with vehicles requiring a permit. Additional concerns that were mentioned are roundabouts with tight radii, oversize loads riding up on the exterior curb, narrow lanes, lack of understanding of the drivers that truck aprons are designed to be mounted and driven on by big trucks, objects in the center island hindering horizontal clearance, trucks required to stay in lane on approaches (required by law in some states), and concerns from farming and emergency response vehicles. The mitigation strategies from the study "Accommodating Trucks in Single and Multilane Roundabouts (*d*)" such as fully traversable center islands (similar to mini-roundabouts), widened entry and exit lanes, right turn bypass lanes, partially traversable central island truck aprons, gated pass-through lanes, lane striping, and others can be adopted to overcome these concerns. However, each of these methods carry design trade-offs in terms of speed control of passenger cars and small trucks which affects safety which decreases with increased speed, i.e. large roundabouts with wide lanes and large radii would help OSOW but decrease the safety benefits for all vehicles so each roundabout should be considered for site specific conditions.

The 7 OSOW check vehicles obtained from a Wisconsin DOT study were used to illustrate the necessary types of changes that a designer must make in a prototype single lane roundabout and also a prototype double lane roundabout. It is concluded that an external truck apron and wide central island truck apron should provide clear passage of the seven OSOW check vehicles for the single lane roundabout and an altered central island shape providing an increased central island truck apron should provide clear passage of the seven OSOW check vehicles for the double lane roundabout. These features can be incorporated in such a way as to not increase speed and decrease safety for all vehicles. That is the challenge for designers. However, states should always be in communication with their state trucking needs and should some OSOW vehicles larger than the seven check vehicles need to traverse a route, the dimensions and configuration and turning characteristics of the vehicle need to be determined and with the use of design and checking tools, similar but more extensive design modifications may have to be made.

Following is the survey that was developed

Survey 4

Survey 4: Survey to OSOW haulers conducted jointly by the American Transportation Resear State University (KSU)

Survey Description:
The American Transportation Research Institute (ATRI) is asking for your help on a very important research initiative focused on th Roundabouts can offer several advantages over signalized and stop-sign controlled intersections, including better overall safety pe and better management of speed. The potential use of roundabouts, however, may be greatly diminished due to a potential inability step, ATRI is working in coordination with Kansas State University to gather industry feedback on how to accommodate large truck the safety and operational efficiency of the roundabout. To take the survey, please follow the instructions below. Responses will be

Opening Instructions:
To start, please proceed to the next page. Once you feel that you have answered all the questions to the best of your knowledge, p of the page to automatically submit your responses to the secure Kansas State University automated survey system. If you have ar mail ranjitg@ksu.edu.We will keep the individual responses confidential. We will not name any particular responder in our summary responders. We thank you for your input and help in this important study.

Best Regards,
Dan Murray Vice President, Research

American Transportation Research Institute

Eugene R (Gene) Russell, Sr., P.E., PhD,
Civil Engineering Professor Emeritus, Kansas State University

Page 1

Question 1

Which sector of the trucking industry do you operate in?

- ○ For-hire
- ○ Private Fleet
- ○ Mail/Parcel
- ○ Other (Please specify below)

Further comments about your response:

Question 2

Which carrier type **best** describes your company? (Please select only one)

- ○ Truckload
- ○ Less-Than-Truckload
- ○ Private Fleet / Shipper
- ○ Specialized (Flatbed)
- ○ Specialized (Tanker)
- ○ Express / Parcel
- ○ Other (please specify below)

Further comments about your response:

Question 3

Do you carry hazardous materials (hazmat)?

Yes

No

Further comments about your response:

The next 7 Questions (Question 4 to 10) are about your current fleet size and approximate number of trucks l

Question 4

What is the approximate number of trucks (or %) you have for the vehicle type "Straight Trucks" ?

Characters Remaining: 50

Question 5

What is the approximate number of trucks (or %) you have for the vehicle type "5-Axle Tractor/Semitrailer" ?

Characters Remaining: 50

Question 6

What is the approximate number of trucks (or %) you have for the vehicle type "6-Axle Tractor/Semitrailer" ?

Characters Remaining: 50

Question 7

What is the approximate number of trucks (or %) you have for the vehicle type "Standard Double" ?

Characters Remaining: 50

Question 8

What is the approximate number of trucks (or %) you have for the vehicle type "Rocky Mountain Double" ?

Characters Remaining: 50

Question 9

What is the approximate number of trucks (or %) you have for the vehicle type "Turnpike Double" ?

Characters Remaining: 50

Question 10

What is the approximate number of trucks (or %) you have for the vehicle type "Triple Trailer" ?

Characters Remaining: 50

Question 11

What type of commodity do your drivers or contractors typically haul? (check one)

- Consumer/Retail Products
- Truck/Auto Transport
- Heavy Machinery/Equipment
- General Freight/Less-than-Truckload
- Mine Ores
- Agricultural Products/Livestock
- General Freight/Truckload
- Household Goods
- Modular/Mobile Homes
- US Mail/Parcel
- Petroleum Products
- Forest Products/Building Materials
- Processes Foods
- Other (Please specify below):

Further comments about your response:

Question 12

What are the primary road types on which your trucks typically travel? (check all that apply)

- ☐ Urban Interstate, Highways and Freeways
- ☐ Urban Major Highways
- ☐ Urban Local Roads
- ☐ Rural Interstate, Highways and Freeways
- ☐ Rural Major Highways
- ☐ Rural Local Roads

Question 13

Please provide your contact information: name, organization, e-mail and phone so we may contact you for further discussion.

Characters Remaining: 500

Question 14

Are roundabouts any more of a problem compared with other intersections?

- ○ Yes
- ○ No

Further comments about your response:

Question 15

Are roundabouts any more of a problem than other Highway features which may be a concern to oversize overweight loads such a so forth?

- ○ Yes
- ○ No

Further comments about your response:

Question 16

Do you have any unique problems with roundabouts, and if so, please explain?

- Yes
- No

Further comments about your response:

Question 17

If the answer to question 15 and/or 16 is “yes”, what possible solutions do you think might mitigate the problem(s) without comprom
vehicles, or requiring excessive right of way and cost?

Characters Remaining: 1000

Question 18

What is your fleet's experience with these particular aspects of a roundabout:

a. the approach,
b. the circulating roadway and
c. the departure.

Click on 1, 2, or 3 and then explain problems you experience in Question 19

1 - Serious problem exists | 2 - Problem exists but not so serious

3 - No Problem

18.1 The approach	
18.2 The circulatory roadway	
18.3 The departure	

Question 19

If you checked a 1 and/or 2 on question 18, what specific experience led you to do so?

Characters Remaining: 1000

Question 20

How beneficial would it be if loads could go straight through a roundabout, if a removable barrier is in place to prevent other vehicle

- Not Beneficial
- Somewhat Beneficial
- Very Beneficial

Further comments about your response:

Question 21

How beneficial would it be if loads could go straight through a roundabout, if the pathway would be offset so the entrance would lin
would have to move to the left lane on the approach) ?

- Not Beneficial

Somewhat Beneficial

Very Beneficial

Further comments about your response:

Question 22

Do you feel there is a need for you to provide more input to roundabout designers, and if so, about what topics?

Characters Remaining: 500

Questions 23-28: What are your views on the roundabout concerns below:

Question 23

What are your views on the roundabout concern "Low boy(low clearance) vehicles have problems with curbs over 4 inches in heigh

Characters Remaining: 200

Question 24

What are your views on the roundabout concern "There are issues with OSOW riding up on the curb on the exterior of the roundab

Characters Remaining: 200

Question 25

What are your views on the roundabout concern "OSOW vehicles don't like hauling their long loads through roundabouts with tight

Characters Remaining: 200

Question 26

What are your views on the roundabout concern "Fixed objects within the center of the roundabout cause problems"

Characters Remaining: 200

Question 27

What are your views on the roundabout concern "Slopes of circular roadway and/truck apron cause fear of overturning"

Characters Remaining: 200

Question 28

What are your views on the roundabout concern "Drivers do not understand what the truck apron is for and need education"

Characters Remaining: 200

Question 29

Please add any additional concerns you have about roundabouts that were not mentioned in Questions 23 to 28:

Characters Remaining: 200

Question 30

Do you use OSOW permits?

- Yes (if "Yes", please continue)
- No (if "No", please scroll to the end of the survey and press "Done" to automatically submit the survey to us.

Further comments about your response:

Questions Specific to OSOW Routing within your Fleet:

Mitigation Strategies:
Listed below are some suggested roundabout mitigation strategies for large trucks from another state study. I
indicate if you feel implementation of the strategy would benefit OSOW trucks:

1. Wide Truck Aprons (12 feet or more) with minimum slope and mountable curb
2. Custom Center island to address known left turns
3. Tapered center-island to support through movements
4. Paved area behind curb (right side for off tracking)
5. Installing removable signs and set-backs for permanent fixtures (light poles)
6. Allow trucks to cross over median (stamped, depressed, or corrugated) in counter flow direction before rou
opposing lane and then cross back over after the turn
7. Right turn lanes (sometimes gated)

Below in questions 31 to 37, please provide your views about each mitigation strategy.

Question 31

Mitigation Strategy: "Wide Truck Aprons (12 feet or more) with minimum slope and mountable curb".

Characters Remaining: 200

Question 32

Mitigation Strategy: "Custom Center island to address known left turns".

Characters Remaining: 200

Question 33

Mitigation Strategy: "Tapered center-island to support through movements".

Characters Remaining: 200

Question 34

Mitigation Strategy: "Paved area behind curb (right side for off tracking)".

Characters Remaining: 200

Question 35

Mitigation Strategy: "Installing removable signs and set-backs for permanent fixtures (light poles)".

Characters Remaining: 200

Question 36

Mitigation Strategy: "Allow trucks to cross over median (stamped, depressed, or corrugated) in counter flow direction before roun
lane and then cross back over after the turn".

Characters Remaining: 200

Question 37

Mitigation Strategy: "Right turn lanes (sometimes gated)".

Characters Remaining: 200

Question 38

In Kansas, the highest priority is given to bridge loading. Do you make adjustments to routes if their routing contains an intersectio
you report the adjustment? **(Please select any two)**

- ☐ Make adjustments
- ☐ Do not make adjustments
- ☐ Report adjustment
- ☐ Do not report adjestment

Further comments about your response:

Question 39

How do you handle the case where a state indicates a route leaving the state, and then puts you on a route way in which you cann

Characters Remaining: 500

Question 40

Do you use your own escort or do you use a certified escort service?

- Own escort
- Certified escort service

Further comments about your response:

Question 41

If you use a certified escort service, does your escort service provide traffic control when traffic is interrupted or are police required

- Escort service provide traffic control when traffic is interrupted
- Police required

Further comments about your response:

Question 42

If police are required, who pays?

Characters Remaining: 200

Question 43

Do you remove and replace highway signs, or any other highway feature you consider an obstacle and replace them after passing?

- Yes
- No

Further comments about your response:

Question 44

Do you pay the government agency to replace signs or repair damaged fixtures?

- Yes
- No

Further comments about your response:

Question 45

Are there places where you are permitted to hold traffic and travel in the wrong direction to continue toward your destination?

- Yes
- No

Further comments about your response:

Question 46

Do you report problems negotiating a given route to the permitting agency?

- Yes
- No

Further comments about your response:

Question 47

What are your views on typical state permitting and routing policies and procedures?

Characters Remaining: 1000

'If you feel you have answered most of the questions to the best of your knowledge, Please click the 'Done' b
submitted automatically.'

Circumstance affecting project or budget. (Please describe any challenges encountered or anticipated that might affect th scope and fiscal constraints set forth in the agreement, along with recommended solutions to those problems).

None at this time