

# Appendix C

Roadway Geometric Analysis Details

Horizontal Curves from US 127 to I-64

Offtracking Analysis Calculation Sheets

Offtracking Analysis Summary

Vertical Curves from US 127 to I-64

Ball-Bank Indicator Analysis

Curve Warning Sign Inventory and Rumble  
Strip Inventory

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## **Roadway Geometry Analysis Details**

### **Horizontal Curve assumptions**

To be able to confirm that there are no horizontal curve deficiencies, would require the existing cross-slope to be compared with the existing radius. The existing cross-slope is unknown and therefore only general conclusions can be drawn. While all curves (with the exception of the curve at MP 0.1, Anderson County) meet the minimum radius for their respective design speeds, the minimum radius requires that the maximum superelevation rate (Kentucky commonly uses 8%) be applied to the curve. It is possible that the superelevation rates do not meet the current standards even though the curve radii are greater than the minimum radius. The most specific conclusion that can be drawn from this analysis is that if a highway project is intended to correct any horizontal curve deficiencies, then it could be done within the current pavement limits with superelevation modifications that will not require a horizontal alignment change.

### **Vehicle offtracking**

#### **Analysis Method**

Guidance from the “Green Book” was followed in the analysis. The “Green Book” contains the current design research and practices for highway and street geometric design. The “Green Book” has a series of formulae that calculate required curve widening based on design vehicle attributes, design speed, available pavement width, and curve radius.

#### *Design Vehicle Attributes*

The design vehicle attributes were taken from the “Green Book” Chapter 2 – Design Controls and Criteria. The WB-50 is not included in the 2011 “Green Book” so the values for the WB-40 were used and adjusted to make the wheelbase 50’ by making the trailer 10’ longer. Additionally, the 96” Wide WB-62 and WB-67 were not included in the “Green Book” but a simple adjustment of the vehicle width in the calculation allowed these vehicles to be analyzed.

#### *Design Speed*

KY 151 has a posted speed limit of 55 mph for the majority of the route. The curves at Anderson County MP 0.1, 1.2, and 1.5 are posted at 45 mph, and the curve at Anderson County MP 1.7 is posted at 35 mph. It is reasonable to assume for calculation purposes that vehicles are operating at the speed limit, and therefore the posted speed was chosen as the design speed.

#### *Available Pavement Width*

The available pavement width was determined by field measured pavement widths for all 14 analyzed curves.

#### *Curve Radius*

The approximate curve radius of each curve on this corridor was taken from archived plans. For MP 1.2 and MP 1.5 archived plans could not be located so the curve radius was estimated from aerial photography. MP 3.7 was identified in the existing plans as a horizontal deflection angle of 0°58’. Assuming a distance of 50’ to achieve this transition in the field yields a degree of curve of roughly 2°, corresponding with a radius of 2864.9’. This radius was used for offtracking calculations.

### **Vertical Curve assumptions**

An existing profile was created by drawing a horizontal alignment over an aerial image and then extracting LiDAR (a surveying technique that uses radar) elevation data along this alignment. The LiDAR data allowed a theoretical vertical alignment to be best fit to the actual ground data. This vertical alignment was then compared to current design standards in the AASHTO Green Book.

It should be noted that the approximate horizontal alignment differed by several hundred feet in length from the HIS. This means that the vertical curve locations should be seen as approximate curve locations. It also means that the speed limit changes may occur in slightly different locations thus affecting the “Current Design Standards Sight Distance” value for curves in the vicinity of a speed change. The stationing was adjusted so that the county line represents MP 0.0, so any error developed by length discrepancies in the Anderson County section is “reset” at the county line.

It should also be noted that the theoretical vertical alignment that was best fit to the LiDAR data is not an exact representation of the ground elevations along the centerline. Variations between the elevation data and the theoretical vertical alignment mandate that the existing sight distances calculated should be seen as “Approximate Sight Distances”. A substandard “Approximate Sight Distance” indicates that it is likely that the current design standards are not met, but further investigation would be required to know conclusively. Similarly, a vertical curve with an “Approximate Sight Distance” that exceeds the “Current Design Standard Sight Distance” value should be viewed as likely to meet the current design standards, but the analysis not conclusive. Sight distance is the length of roadway ahead visible to the driver, or how far a driver can see before the line of sight is blocked by a hill crest or object.

## Horizontal Curves from US 127 to I-64

	County	Beginning MP	Ending MP	Degree of Curvature	Curve Direction
1	Anderson	0	0.084	0.2	R
2		0.084	0.161	13.4	R
3		0.161	0.842	0	L
4		0.842	1.181	0.1	L
5		1.181	1.256	1.6	L
6		1.256	1.387	0	
7		1.387	1.498	3.1	L
8		1.498	1.614	0	L
9		1.614	1.728	2.9	L
10		1.728	2.045	0	
11		2.045	2.211	0.6	L
12		2.211	2.519	0	
13		2.519	2.691	2	R
14		2.691	2.855	0	R
15		2.855	3.009	3	R
16		3.009	3.729	0.1	R
17		3.729	3.985	0.5	R
18		3.985	4.278	0.1	R
19		4.278	4.463	3.5	L
20		4.463	4.587	0	
21	Franklin	0	0.323	0	
22		0.323	0.436	2.3	R
23		0.436	1.52	0	R
24		1.52	1.618	0.5	L
25		1.618	1.745	0	
26		1.745	1.896	3.8	R
27		1.896	2.15	0.1	L
28		2.15	2.225	0.1	R
29		2.225	2.284	0	
30		2.284	2.29	0	
31		2.29	2.402	4.8	L

Denotes curves that were analyzed

Degree of Curvature: the central angle formed by a chord of 100 feet

Curve Direction: the direction the roadway curves as observed when traveling in the cardinal direction (North, in the case of KY 151)

## KY 151 Offtracking Analysis - Milepoint 0.1, Anderson County

Design vehicle width, inches	Allowed Vehicles						STAA Vehicles			
	84" Wide	96" Wide					96" Wide		102" Wide	
Design vehicle	P	S-BUS-36	SU-30	SU-40	WB-40	WB-50	WB-62	WB-67	WB-62	WB-67
Width of vehicle, ft	7	8	8	8	8	8	8	8	8.5	8.5
Radius of curve, (R) ft	424.41	424.41	424.41	424.41	424.41	424.41	424.41	424.41	424.41	424.41
Design speed, (V) mph	45	45	45	45	45	45	45	45	45	45
Lateral clearance (C), ft	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Front wheelbase length of design vehicle, (L <sub>f</sub> ) ft	11	21.3	20	25	12.5	12.5	19.5	19.5	19.5	19.5
Rear wheelbase length of design vehicle, (L <sub>r</sub> ) ft					25.5	35.5	41	45.5	41	45.5
Front overhang length, (F <sub>A</sub> ) ft	3	2.5	4	4	3		4	4	4	4
Extra width allowance, (Z) ft	2.18	2.18	2.18	2.18	2.18	2.18	2.18	2.18	2.18	2.18
Track width on curve, (U) ft	7.14	8.53	8.47	8.74	8.95	9.67	10.44	10.90	10.94	11.40
Width of front overhang, (F <sub>A</sub> ) ft	0.09	0.13	0.21	0.25	0.10	0.00	0.20	0.20	0.20	0.20
Number of lanes, (N)	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Width of traveled way on curve, (W <sub>C</sub> ) ft	21.56	24.39	24.33	24.91	25.19	26.53	28.26	29.18	29.26	30.18
Existing traveled way width, ft	42.0	42.0	42.0	42.0	42.0	42.0	42.0	42.0	42.0	42.0
Curve widening, ft	-20.44	-17.61	-17.67	-17.09	-16.81	-15.47	-13.74	-12.82	-12.74	-11.82

Analysis based on AASHTO's *A Policy on Geometric Design of Highways and Streets, 2011, Chapter 3.3.9, Offtracking*

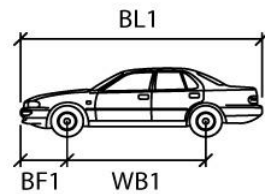
Available paved width on KY 151 is 22' or 11' per direction (including shoulder). The STAA ban has added almost a foot of effective width for the critical vehicle.

P=Passenger car

S=School Bus

SU=Single Unit Truck, defined by total length

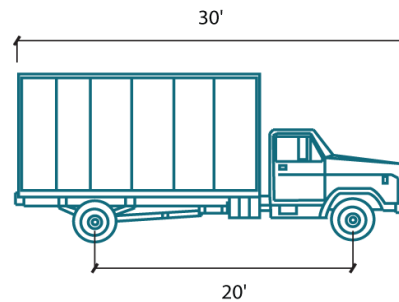
WB=Wheel base truck, defined by the length of wheel base



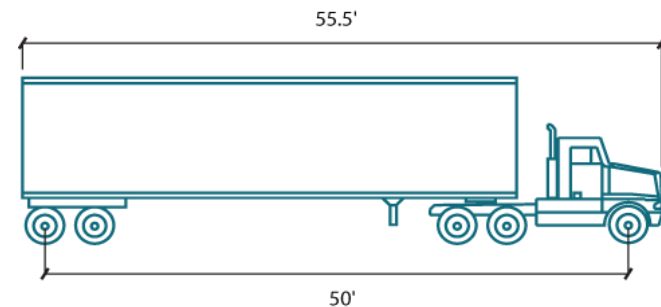
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S-BUS-36



SU-30



WB-50

# KY 151 Offtracking Analysis - Milepoint 1.2, Anderson County

Design vehicle width, inches	Allowed Vehicles						STAA Vehicles			
	84" Wide	96" Wide					96" Wide		102" Wide	
Design vehicle	P	S-BUS-36	SU-30	SU-40	WB-40	WB-50	WB-62	WB-67	WB-62	WB-67
Width of vehicle, ft	7	8	8	8	8	8	8	8	8.5	8.5
Radius of curve, (R) ft (estimated from aerial)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Design speed, (V) mph	45	45	45	45	45	45	45	45	45	45
Lateral clearance (C), ft	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Front wheelbase length of design vehicle, (L <sub>f</sub> ) ft	11	21.3	20	25	12.5	12.5	19.5	19.5	19.5	19.5
Rear wheelbase length of design vehicle, (L <sub>r</sub> ) ft					25.5	35.5	41	45.5	41	45.5
Front overhang length, (F <sub>A</sub> ) ft	3	2.5	4	4	3		4	4	4	4
Extra width allowance, (Z) ft	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01
Track width on curve, (U) ft	7.03	8.11	8.10	8.16	8.20	8.35	8.52	8.61	9.02	9.11
Width of front overhang, (F <sub>A</sub> ) ft	0.02	0.03	0.04	0.05	0.02	0.00	0.04	0.04	0.04	0.04
Number of lanes, (N)	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Width of traveled way on curve, (W <sub>C</sub> ) ft	20.09	22.26	22.25	22.37	22.43	22.71	23.08	23.27	24.08	24.27
Existing traveled way width, ft	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0
Curve widening, ft	-4.91	-2.74	-2.75	-2.63	-2.57	-2.29	-1.92	-1.73	-0.92	-0.73

Analysis based on AASHTO's *A Policy on Geometric Design of Highways and Streets*, 2011, Chapter 3.3.9, Offtracking

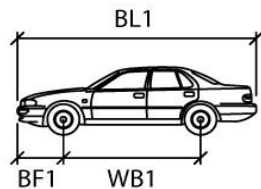
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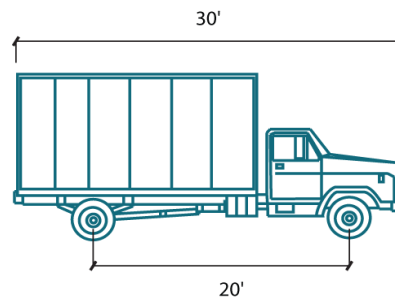
WB=Wheel base truck, defined by the length of wheel base



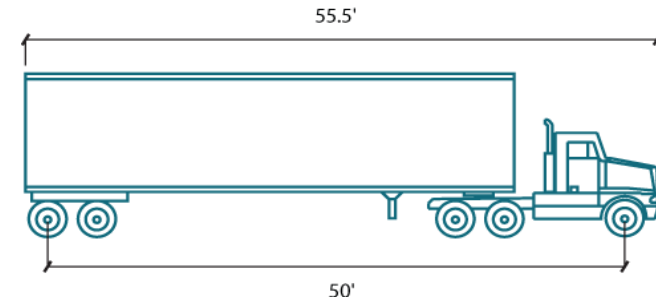
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S-BUS-36



SU-30



WB-50

## KY 151 Offtracking Analysis - Milepoint 1.5, Anderson County

Design vehicle width, inches	Allowed Vehicles						STAA Vehicles			
	84" Wide	96" Wide					96" Wide		102" Wide	
Design vehicle	P	S-BUS-36	SU-30	SU-40	WB-40	WB-50	WB-62	WB-67	WB-62	WB-67
Width of vehicle, ft	7	8	8	8	8	8	8	8	8.5	8.5
Radius of curve, (R) ft	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500
Design speed, (V) mph	45	45	45	45	45	45	45	45	45	45
Lateral clearance ( C), ft	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Front wheelbase length of design vehicle, (L <sub>i</sub> ) ft	11	21.3	20	25	12.5	12.5	19.5	19.5	19.5	19.5
Rear wheelbase length of design vehicle, (L <sub>i</sub> ) ft					25.5	35.5	41	45.5	41	45.5
Front overhang length, (F <sub>A</sub> ) ft	3	2.5	4	4	3		4	4	4	4
Extra width allowance, (Z) ft	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16	1.16
Track width on curve, (U) ft	7.04	8.15	8.13	8.21	8.27	8.47	8.69	8.82	9.19	9.32
Width of front overhang, (F <sub>A</sub> ) ft	0.02	0.04	0.06	0.07	0.03	0.00	0.06	0.06	0.06	0.06
Number of lanes, (N)	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Width of traveled way on curve, (W <sub>C</sub> ) ft	20.27	22.50	22.49	22.65	22.73	23.11	23.59	23.85	24.59	24.85
Existing traveled way width, ft	25.4	25.4	25.4	25.4	25.4	25.4	25.4	25.4	25.4	25.4
Curve widening, ft	-5.13	-2.90	-2.91	-2.75	-2.67	-2.29	-1.81	-1.55	-0.81	-0.55

Analysis based on AASHTO's *A Policy on Geometric Design of Highways and Streets, 2011, Chapter 3.3.9, Offtracking*

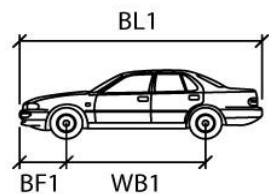
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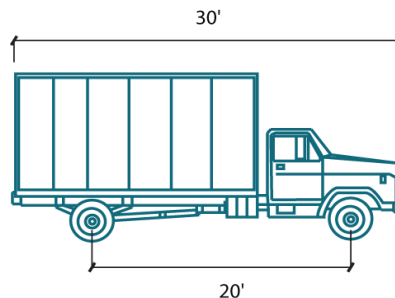
WB=Wheel base truck, defined by the length of wheel base



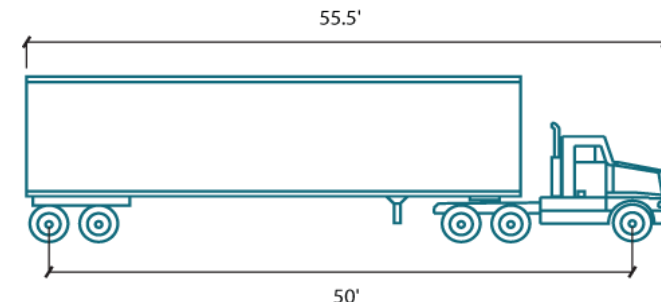
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**S-BUS-36**



**SU-30**



**WB-50**

# KY 151 Offtracking Analysis - Milepoint 1.7, Anderson County

Design vehicle width, inches	Allowed Vehicles						STAA Vehicles			
	84" Wide	96" Wide					96" Wide		102" Wide	
Design vehicle	P	S-BUS-36	SU-30	SU-40	WB-40	WB-50	WB-62	WB-67	WB-62	WB-67
Width of vehicle, ft	7	8	8	8	8	8	8	8	8.5	8.5
Radius of curve, (R) ft	1432.7	1432.7	1432.7	1432.7	1432.7	1432.7	1432.7	1432.7	1432.7	1432.7
Design speed, (V) mph	35	35	35	35	35	35	35	35	35	35
Lateral clearance (C), ft	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Front wheelbase length of design vehicle, (L <sub>f</sub> ) ft	11	21.3	20	25	12.5	12.5	19.5	19.5	19.5	19.5
Rear wheelbase length of design vehicle, (L <sub>r</sub> ) ft					25.5	35.5	41	45.5	41	45.5
Front overhang length, (F <sub>A</sub> ) ft	3	2.5	4	4	3		4	4	4	4
Extra width allowance, (Z) ft	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Track width on curve, (U) ft	7.04	8.16	8.14	8.22	8.28	8.49	8.72	8.86	9.22	9.36
Width of front overhang, (F <sub>A</sub> ) ft	0.03	0.04	0.06	0.08	0.03	0.00	0.06	0.06	0.06	0.06
Number of lanes, (N)	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Width of traveled way on curve, (W <sub>C</sub> ) ft	20.04	22.28	22.27	22.44	22.52	22.91	23.42	23.70	24.42	24.70
Existing traveled way width, ft	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5
Curve widening, ft	-5.46	-3.22	-3.23	-3.06	-2.98	-2.59	-2.08	-1.80	-1.08	-0.80

Analysis based on AASHTO's *A Policy on Geometric Design of Highways and Streets*, 2011, Chapter 3.3.9, Offtracking

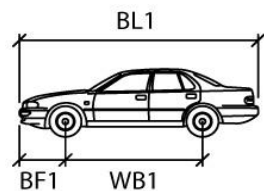
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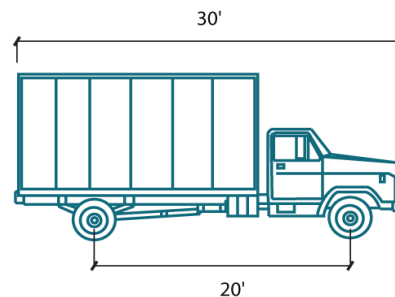
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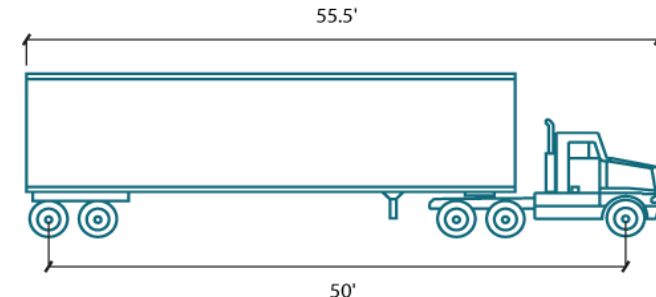
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S-BUS-36



SU-30



WB-50



## KY 151 Offtracking Analysis - Milepoint 2.1, Anderson County

Design vehicle width, inches	Allowed Vehicles						STAA Vehicles			
	84" Wide	96" Wide					96" Wide		102" Wide	
Design vehicle	P	S-BUS-36	SU-30	SU-40	WB-40	WB-50	WB-62	WB-67	WB-62	WB-67
Width of vehicle, ft	7	8	8	8	8	8	8	8	8.5	8.5
Radius of curve, (R) ft	2864.9	2864.9	2864.9	2864.9	2864.9	2864.9	2864.9	2864.9	2864.9	2864.9
Design speed, (V) mph	55	55	55	55	55	55	55	55	55	55
Lateral clearance (C), ft	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Front wheelbase length of design vehicle, (L <sub>f</sub> ) ft	11	21.3	20	25	12.5	12.5	19.5	19.5	19.5	19.5
Rear wheelbase length of design vehicle, (L <sub>r</sub> ) ft					25.5	35.5	41	45.5	41	45.5
Front overhang length, (F <sub>A</sub> ) ft	3	2.5	4	4	3		4	4	4	4
Extra width allowance, (Z) ft	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03
Track width on curve, (U) ft	7.02	8.08	8.07	8.11	8.14	8.25	8.36	8.43	8.86	8.93
Width of front overhang, (F <sub>A</sub> ) ft	0.01	0.02	0.03	0.04	0.01	0.00	0.03	0.03	0.03	0.03
Number of lanes, (N)	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Width of traveled way on curve, (W <sub>C</sub> ) ft	20.08	22.21	22.20	22.28	22.32	22.52	22.78	22.91	23.78	23.91
Existing traveled way width, ft	24.1	24.1	24.1	24.1	24.1	24.1	24.1	24.1	24.1	24.1
Curve widening, ft	-4.02	-1.89	-1.90	-1.82	-1.78	-1.58	-1.32	-1.19	-0.32	-0.19

Analysis based on AASHTO's *A Policy on Geometric Design of Highways and Streets*, 2011, Chapter 3.3.9, Offtracking

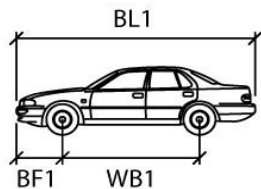
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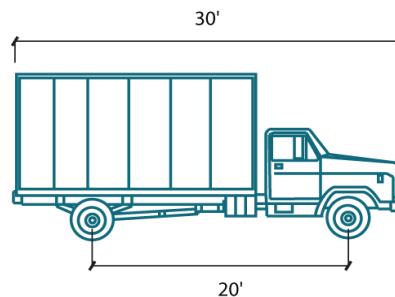
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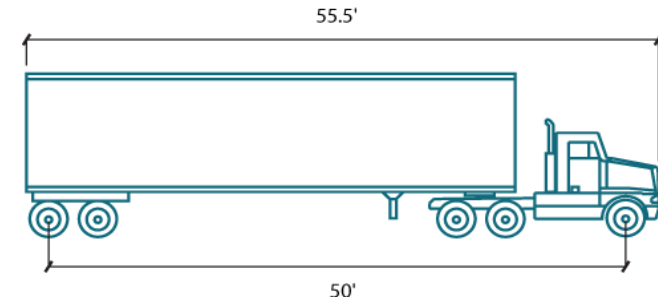
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S-BUS-36



SU-30



WB-50

## KY 151 Offtracking Analysis - Milepoint 2.6, Anderson County

Design vehicle width, inches	Allowed Vehicles						STAA Vehicles			
	84" Wide	96" Wide					96" Wide		102" Wide	
Design vehicle	P	S-BUS-36	SU-30	SU-40	WB-40	WB-50	WB-62	WB-67	WB-62	WB-67
Width of vehicle, ft	7	8	8	8	8	8	8	8	8.5	8.5
Radius of curve, (R) ft	1146.3	1146.3	1146.3	1146.3	1146.3	1146.3	1146.3	1146.3	1146.3	1146.3
Design speed, (V) mph	55	55	55	55	55	55	55	55	55	55
Lateral clearance (C), ft	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Front wheelbase length of design vehicle, (L <sub>f</sub> ) ft	11	21.3	20	25	12.5	12.5	19.5	19.5	19.5	19.5
Rear wheelbase length of design vehicle, (L <sub>r</sub> ) ft					25.5	35.5	41	45.5	41	45.5
Front overhang length, (F <sub>A</sub> ) ft	3	2.5	4	4	3		4	4	4	4
Extra width allowance, (Z) ft	1.62	1.62	1.62	1.62	1.62	1.62	1.62	1.62	1.62	1.62
Track width on curve, (U) ft	7.05	8.20	8.17	8.27	8.35	8.62	8.90	9.07	9.40	9.57
Width of front overhang, (F <sub>A</sub> ) ft	0.03	0.05	0.08	0.09	0.04	0.00	0.08	0.08	0.08	0.08
Number of lanes, (N)	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Width of traveled way on curve, (W <sub>C</sub> ) ft	20.76	23.07	23.05	23.26	23.36	23.86	24.50	24.84	25.50	25.84
Existing traveled way width, ft	24.8	24.8	24.8	24.8	24.8	24.8	24.8	24.8	24.8	24.8
Curve widening, ft	-4.04	-1.73	-1.75	-1.54	-1.44	-0.94	-0.30	0.04	0.70	1.04

Analysis based on AASHTO's *A Policy on Geometric Design of Highways and Streets, 2011, Chapter 3.3.9, Offtracking*

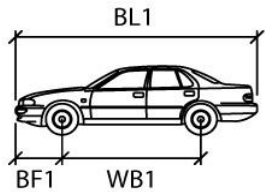
Available paved width on KY 151 is 22' or 11' per direction (including shoulder). The STAA ban has added almost a foot of effective width for the critical vehicle.

P=Passenger car

S=School Bus

SU=Single Unit Truck, defined by total length

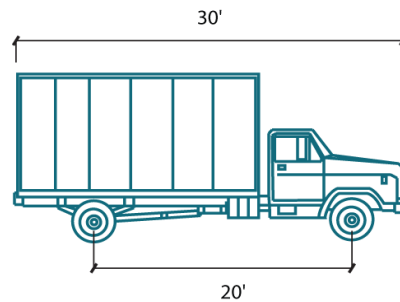
WB=Wheel base truck, defined by the length of wheel base



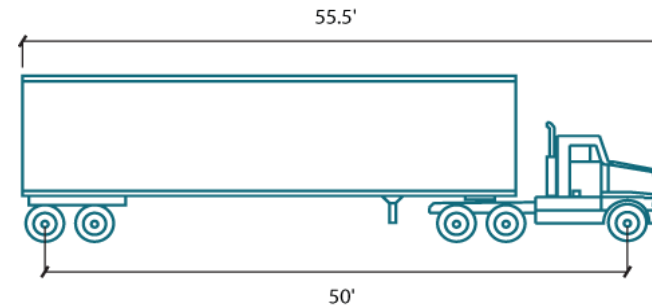
P



S-BUS-36



SU-30



WB-50

# KY 151 Offtracking Analysis - Milepoint 3.0, Anderson County

Design vehicle width, inches	Allowed Vehicles						STAA Vehicles			
	84" Wide	96" Wide					96" Wide		102" Wide	
Design vehicle	P	S-BUS-36	SU-30	SU-40	WB-40	WB-50	WB-62	WB-67	WB-62	WB-67
Width of vehicle, ft	7	8	8	8	8	8	8	8	8.5	8.5
Radius of curve, (R) ft	1146.3	1146.3	1146.3	1146.3	1146.3	1146.3	1146.3	1146.3	1146.3	1146.3
Design speed, (V) mph	55	55	55	55	55	55	55	55	55	55
Lateral clearance (C), ft	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Front wheelbase length of design vehicle, (L <sub>f</sub> ) ft	11	21.3	20	25	12.5	12.5	19.5	19.5	19.5	19.5
Rear wheelbase length of design vehicle, (L <sub>r</sub> ) ft					25.5	35.5	41	45.5	41	45.5
Front overhang length, (F <sub>A</sub> ) ft	3	2.5	4	4	3		4	4	4	4
Extra width allowance, (Z) ft	1.62	1.62	1.62	1.62	1.62	1.62	1.62	1.62	1.62	1.62
Track width on curve, (U) ft	7.05	8.20	8.17	8.27	8.35	8.62	8.90	9.07	9.40	9.57
Width of front overhang, (F <sub>A</sub> ) ft	0.03	0.05	0.08	0.09	0.04	0.00	0.08	0.08	0.08	0.08
Number of lanes, (N)	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Width of traveled way on curve, (W <sub>C</sub> ) ft	20.76	23.07	23.05	23.26	23.36	23.86	24.50	24.84	25.50	25.84
Existing traveled way width, ft	24.1	24.1	24.1	24.1	24.1	24.1	24.1	24.1	24.1	24.1
Curve widening, ft	-3.34	-1.03	-1.05	-0.84	-0.74	-0.24	0.40	0.74	1.40	1.74

Analysis based on AASHTO's *A Policy on Geometric Design of Highways and Streets*, 2011, Chapter 3.3.9, Offtracking

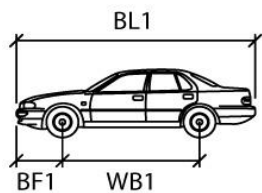
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SU=Single Unit Truck, defined by total length

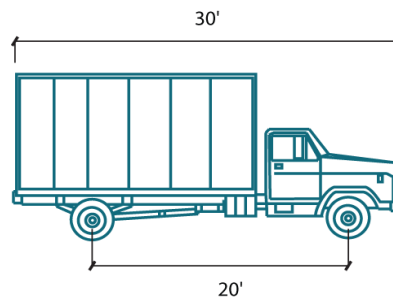
WB=Wheel base truck, defined by the length of wheel base



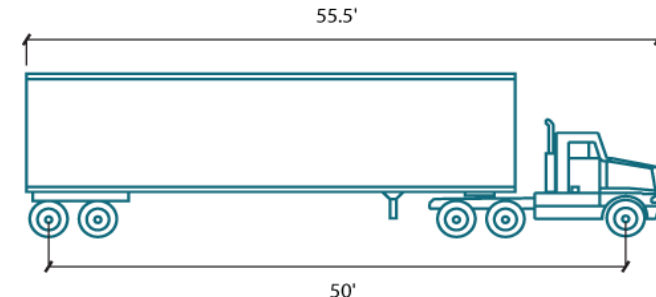
P



S-BUS-36



SU-30



WB-50

# KY 151 Offtracking Analysis - Milepoint 3.5, Anderson County

Design vehicle width, inches	Allowed Vehicles						STAA Vehicles			
	84" Wide	96" Wide					96" Wide		102" Wide	
Design vehicle	P	S-BUS-36	SU-30	SU-40	WB-40	WB-50	WB-62	WB-67	WB-62	WB-67
Width of vehicle, ft	7	8	8	8	8	8	8	8	8.5	8.5
Radius of curve, (R) ft	5729.6	5729.6	5729.6	5729.6	5729.6	5729.6	5729.6	5729.6	5729.6	5729.6
Design speed, (V) mph	55	55	55	55	55	55	55	55	55	55
Lateral clearance (C), ft	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Front wheelbase length of design vehicle, (L <sub>f</sub> ) ft	11	21.3	20	25	12.5	12.5	19.5	19.5	19.5	19.5
Rear wheelbase length of design vehicle, (L <sub>r</sub> ) ft					25.5	35.5	41	45.5	41	45.5
Front overhang length, (F <sub>A</sub> ) ft	3	2.5	4	4	3		4	4	4	4
Extra width allowance, (Z) ft	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73
Track width on curve, (U) ft	7.01	8.04	8.03	8.05	8.07	8.12	8.18	8.21	8.68	8.71
Width of front overhang, (F <sub>A</sub> ) ft	0.01	0.01	0.02	0.02	0.01	0.00	0.02	0.02	0.02	0.02
Number of lanes, (N)	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Width of traveled way on curve, (W <sub>C</sub> ) ft	19.75	21.82	21.81	21.85	21.87	21.97	22.10	22.17	23.10	23.17
Existing traveled way width, ft	25.2	25.2	25.2	25.2	25.2	25.2	25.2	25.2	25.2	25.2
Curve widening, ft	-5.45	-3.38	-3.39	-3.35	-3.33	-3.23	-3.10	-3.03	-2.10	-2.03

Analysis based on AASHTO's *A Policy on Geometric Design of Highways and Streets*, 2011, Chapter 3.3.9, Offtracking

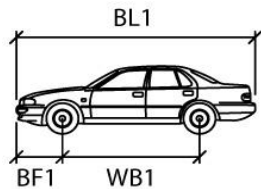
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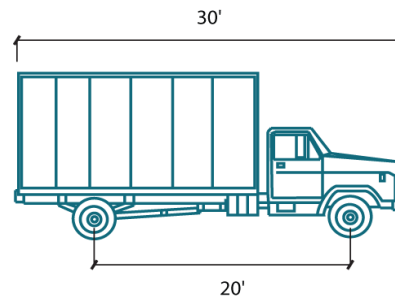
WB=Wheel base truck, defined by the length of wheel base



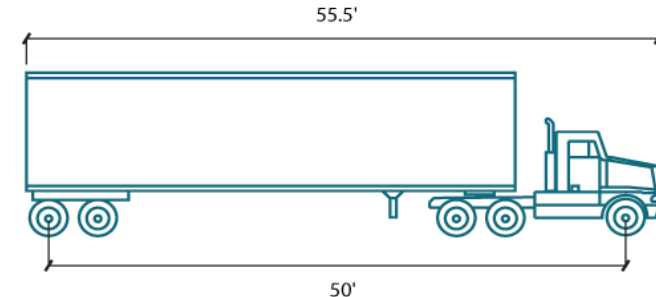
P



S-BUS-36



SU-30



WB-50

## KY 151 Offtracking Analysis - Milepoint 3.7, Anderson County

Design vehicle width, inches	Allowed Vehicles						STAA Vehicles			
	84" Wide	96" Wide					96" Wide		102" Wide	
Design vehicle	P	S-BUS-36	SU-30	SU-40	WB-40	WB-50	WB-62	WB-67	WB-62	WB-67
Width of vehicle, ft	7	8	8	8	8	8	8	8	8.5	8.5
Radius of curve, (R) ft	2864.9	2864.9	2864.9	2864.9	2864.9	2864.9	2864.9	2864.9	2864.9	2864.9
Design speed, (V) mph	55	55	55	55	55	55	55	55	55	55
Lateral clearance (C), ft	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Front wheelbase length of design vehicle, (L <sub>i</sub> ) ft	11	21.3	20	25	12.5	12.5	19.5	19.5	19.5	19.5
Rear wheelbase length of design vehicle, (L <sub>i</sub> ) ft					25.5	35.5	41	45.5	41	45.5
Front overhang length, (F <sub>A</sub> ) ft	3	2.5	4	4	3		4	4	4	4
Extra width allowance, (Z) ft	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03
Track width on curve, (U) ft	7.02	8.08	8.07	8.11	8.14	8.25	8.36	8.43	8.86	8.93
Width of front overhang, (F <sub>A</sub> ) ft	0.01	0.02	0.03	0.04	0.01	0.00	0.03	0.03	0.03	0.03
Number of lanes, (N)	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Width of traveled way on curve, (W <sub>C</sub> ) ft	20.08	22.21	22.20	22.28	22.32	22.52	22.78	22.91	23.78	23.91
Existing traveled way width, ft	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0
Curve widening, ft	-4.92	-2.79	-2.80	-2.72	-2.68	-2.48	-2.22	-2.09	-1.22	-1.09

Analysis based on AASHTO's *A Policy on Geometric Design of Highways and Streets, 2011, Chapter 3.3.9, Offtracking*

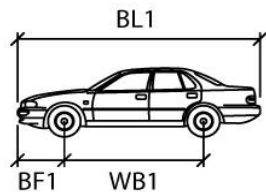
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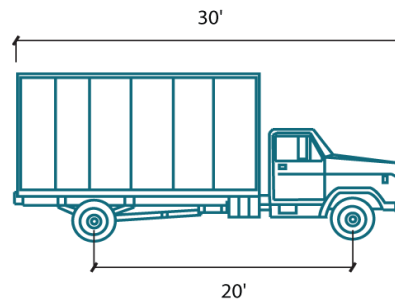
WB=Wheel base truck, defined by the length of wheel base



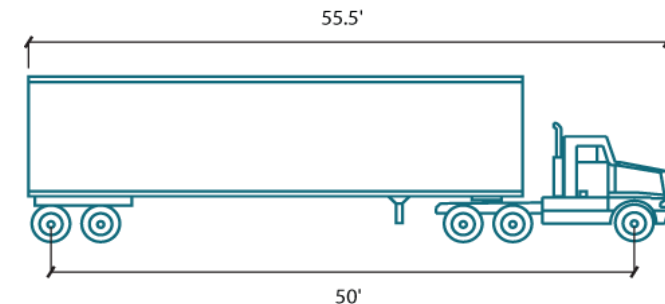
**P**



**S-BUS-36**



**SU-30**



**WB-50**

# KY 151 Offtracking Analysis - Milepoint 4.0, Anderson County

	Allowed Vehicles						STAA Vehicles			
Design vehicle width, inches	84" Wide	96" Wide					96" Wide		102" Wide	
Design vehicle	P	S-BUS-36	SU-30	SU-40	WB-40	WB-50	WB-62	WB-67	WB-62	WB-67
Width of vehicle, ft	7	8	8	8	8	8	8	8	8.5	8.5
Radius of curve, (R) ft	2864.9	2864.9	2864.9	2864.9	2864.9	2864.9	2864.9	2864.9	2864.9	2864.9
Design speed, (V) mph	55	55	55	55	55	55	55	55	55	55
Lateral clearance ( C ), ft	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Front wheelbase length of design vehicle, (L <sub>i</sub> ) ft	11	21.3	20	25	12.5	12.5	19.5	19.5	19.5	19.5
Rear wheelbase length of design vehicle, (L <sub>i</sub> ) ft					25.5	35.5	41	45.5	41	45.5
Front overhang length, (F <sub>A</sub> ) ft	3	2.5	4	4	3		4	4	4	4
Extra width allowance, (Z) ft	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03
Track width on curve, (U) ft	7.02	8.08	8.07	8.11	8.14	8.25	8.36	8.43	8.86	8.93
Width of front overhang, (F <sub>A</sub> ) ft	0.01	0.02	0.03	0.04	0.01	0.00	0.03	0.03	0.03	0.03
Number of lanes, (N)	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Width of traveled way on curve, (W <sub>C</sub> ) ft	20.08	22.21	22.20	22.28	22.32	22.52	22.78	22.91	23.78	23.91
Existing traveled way width, ft	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0
Curve widening, ft	-4.92	-2.79	-2.80	-2.72	-2.68	-2.48	-2.22	-2.09	-1.22	-1.09

Analysis based on AASHTO's *A Policy on Geometric Design of Highways and Streets, 2011, Chapter 3.3.9, Offtracking*

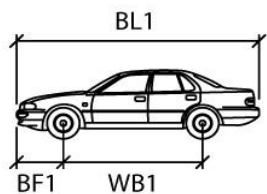
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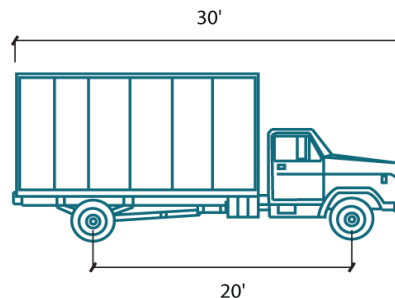
WB=Wheel base truck, defined by the length of wheel base



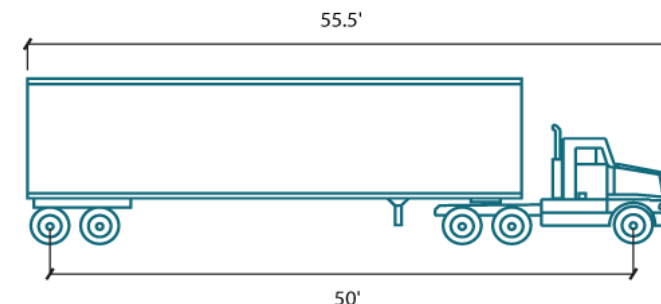
**P**



**S-BUS-36**



**SU-30**



**WB-50**

## KY 151 Offtracking Analysis - Milepoint 4.4, Anderson County

Design vehicle width, inches	Allowed Vehicles						STAA Vehicles			
	84" Wide	96" Wide					96" Wide		102" Wide	
Design vehicle	P	S-BUS-36	SU-30	SU-40	WB-40	WB-50	WB-62	WB-67	WB-62	WB-67
Width of vehicle, ft	7	8	8	8	8	8	8	8	8.5	8.5
Radius of curve, (R) ft	1432.4	1432.4	1432.4	1432.4	1432.4	1432.4	1432.4	1432.4	1432.4	1432.4
Design speed, (V) mph	55	55	55	55	55	55	55	55	55	55
Lateral clearance (C), ft	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Front wheelbase length of design vehicle, (L <sub>f</sub> ) ft	11	21.3	20	25	12.5	12.5	19.5	19.5	19.5	19.5
Rear wheelbase length of design vehicle, (L <sub>r</sub> ) ft					25.5	35.5	41	45.5	41	45.5
Front overhang length, (F <sub>A</sub> ) ft	3	2.5	4	4	3		4	4	4	4
Extra width allowance, (Z) ft	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45
Track width on curve, (U) ft	7.04	8.16	8.14	8.22	8.28	8.49	8.72	8.86	9.22	9.36
Width of front overhang, (F <sub>A</sub> ) ft	0.03	0.04	0.06	0.08	0.03	0.00	0.06	0.06	0.06	0.06
Number of lanes, (N)	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Width of traveled way on curve, (W <sub>C</sub> ) ft	20.56	22.81	22.79	22.96	23.05	23.44	23.95	24.22	24.95	25.22
Existing traveled way width, ft	42.0	42.0	42.0	42.0	42.0	42.0	42.0	42.0	42.0	42.0
Curve widening, ft	-21.44	-19.19	-19.21	-19.04	-18.95	-18.56	-18.05	-17.78	-17.05	-16.78

Analysis based on AASHTO's *A Policy on Geometric Design of Highways and Streets, 2011, Chapter 3.3.9, Offtracking*

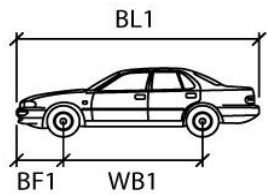
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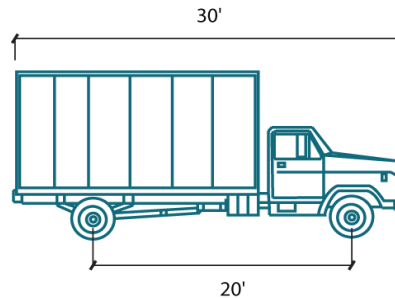
WB=Wheel base truck, defined by the length of wheel base



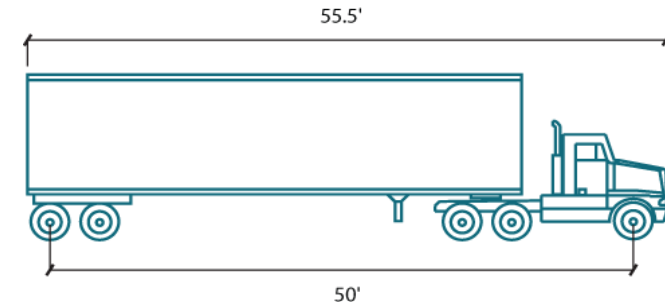
**P**



**S-BUS-36**



**SU-30**



**WB-50**



## KY 151 Offtracking Analysis - Milepoint 0.4, Franklin County

Design vehicle width, inches	Allowed Vehicles						STAA Vehicles			
	84" Wide	96" Wide					96" Wide		102" Wide	
Design vehicle	P	S-BUS-36	SU-30	SU-40	WB-40	WB-50	WB-62	WB-67	WB-62	WB-67
Width of vehicle, ft	7	8	8	8	8	8	8	8	8.5	8.5
Radius of curve, (R) ft	1432.4	1432.4	1432.4	1432.4	1432.4	1432.4	1432.4	1432.4	1432.4	1432.4
Design speed, (V) mph	55	55	55	55	55	55	55	55	55	55
Lateral clearance (C), ft	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Front wheelbase length of design vehicle, (L <sub>f</sub> ) ft	11	21.3	20	25	12.5	12.5	19.5	19.5	19.5	19.5
Rear wheelbase length of design vehicle, (L <sub>r</sub> ) ft					25.5	35.5	41	45.5	41	45.5
Front overhang length, (F <sub>A</sub> ) ft	3	2.5	4	4	3		4	4	4	4
Extra width allowance, (Z) ft	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45
Track width on curve, (U) ft	7.04	8.16	8.14	8.22	8.28	8.49	8.72	8.86	9.22	9.36
Width of front overhang, (F <sub>A</sub> ) ft	0.03	0.04	0.06	0.08	0.03	0.00	0.06	0.06	0.06	0.06
Number of lanes, (N)	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Width of traveled way on curve, (W <sub>C</sub> ) ft	20.56	22.81	22.79	22.96	23.05	23.44	23.95	24.22	24.95	25.22
Existing traveled way width, ft	29.00	29.00	29.00	29.00	29.00	29.00	29.00	29.00	29.00	29.00
Curve widening, ft	-8.44	-6.19	-6.21	-6.04	-5.95	-5.56	-5.05	-4.78	-4.05	-3.78

Analysis based on AASHTO's *A Policy on Geometric Design of Highways and Streets*, 2011, Chapter 3.3.9, Offtracking

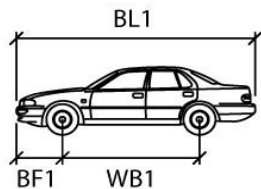
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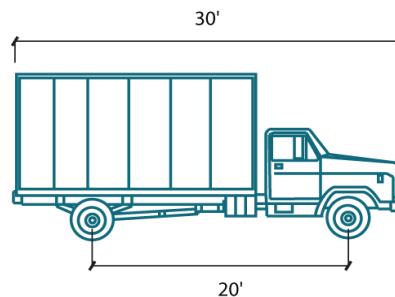
WB=Wheel base truck, defined by the length of wheel base



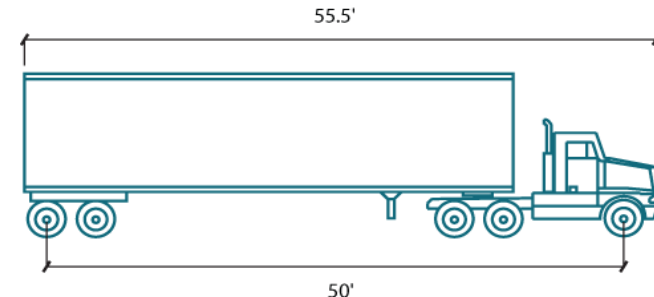
P



S-BUS-36



SU-30



WB-50



# KY 151 Offtracking Analysis - Milepoint 1.5, Franklin County

Design vehicle width, inches	Allowed Vehicles						STAA Vehicles			
	84" Wide	96" Wide					96" Wide		102" Wide	
Design vehicle	P	S-BUS-36	SU-30	SU-40	WB-40	WB-50	WB-62	WB-67	WB-62	WB-67
Width of vehicle, ft	7	8	8	8	8	8	8	8	8.5	8.5
Radius of curve, (R) ft	11459.16	11459.16	11459.16	11459.16	11459.16	11459.16	11459.16	11459.16	11459.16	11459.16
Design speed, (V) mph	55	55	55	55	55	55	55	55	55	55
Lateral clearance (C), ft	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Front wheelbase length of design vehicle, (L <sub>f</sub> ) ft	11	21.3	20	25	12.5	12.5	19.5	19.5	19.5	19.5
Rear wheelbase length of design vehicle, (L <sub>r</sub> ) ft					25.5	35.5	41	45.5	41	45.5
Front overhang length, (F <sub>A</sub> ) ft	3	2.5	4	4	3		4	4	4	4
Extra width allowance, (Z) ft	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51
Track width on curve, (U) ft	7.01	8.02	8.02	8.03	8.04	8.06	8.09	8.11	8.59	8.61
Width of front overhang, (F <sub>A</sub> ) ft	0.00	0.00	0.01	0.01	0.00	0.00	0.01	0.01	0.01	0.01
Number of lanes, (N)	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Width of traveled way on curve, (W <sub>C</sub> ) ft	19.53	21.56	21.56	21.58	21.59	21.64	21.70	21.74	22.70	22.74
Existing traveled way width, ft	34.00	34.00	34.00	34.00	34.00	34.00	34.00	34.00	34.00	34.00
Curve widening, ft	-14.47	-12.44	-12.44	-12.42	-12.41	-12.36	-12.30	-12.26	-11.30	-11.26

Analysis based on AASHTO's *A Policy on Geometric Design of Highways and Streets*, 2011, Chapter 3.3.9, Offtracking

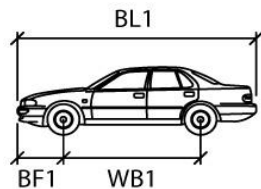
Available paved width on KY 151 is 22' or 11' per direction (including shoulder). The STAA ban has added almost a foot of effective width for the critical vehicle.

P=Passenger car

S=School Bus

SU=Single Unit Truck, defined by total length

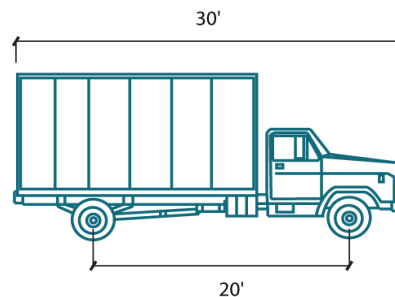
WB=Wheel base truck, defined by the length of wheel base



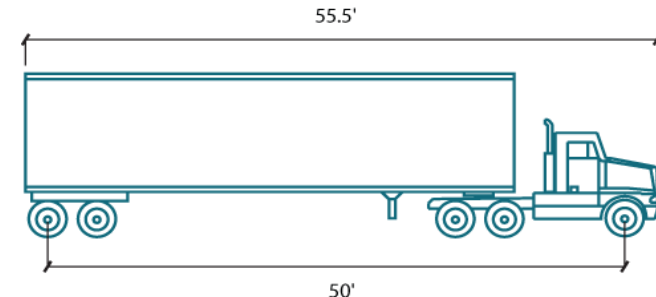
P



S-BUS-36



SU-30



WB-50

# KY 151 Offtracking Analysis - Milepoint 1.8, Franklin County

Design vehicle width, inches	Allowed Vehicles						STAA Vehicles			
	84" Wide	96" Wide					96" Wide		102" Wide	
Design vehicle	P	S-BUS-36	SU-30	SU-40	WB-40	WB-50	WB-62	WB-67	WB-62	WB-67
Width of vehicle, ft	7	8	8	8	8	8	8	8	8.5	8.5
Radius of curve, (R) ft	1432.4	1432.4	1432.4	1432.4	1432.4	1432.4	1432.4	1432.4	1432.4	1432.4
Design speed, (V) mph	55	55	55	55	55	55	55	55	55	55
Lateral clearance (C), ft	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Front wheelbase length of design vehicle, (L <sub>f</sub> ) ft	11	21.3	20	25	12.5	12.5	19.5	19.5	19.5	19.5
Rear wheelbase length of design vehicle, (L <sub>r</sub> ) ft					25.5	35.5	41	45.5	41	45.5
Front overhang length, (F <sub>A</sub> ) ft	3	2.5	4	4	3		4	4	4	4
Extra width allowance, (Z) ft	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45
Track width on curve, (U) ft	7.04	8.16	8.14	8.22	8.28	8.49	8.72	8.86	9.22	9.36
Width of front overhang, (F <sub>A</sub> ) ft	0.03	0.04	0.06	0.08	0.03	0.00	0.06	0.06	0.06	0.06
Number of lanes, (N)	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Width of traveled way on curve, (W <sub>C</sub> ) ft	20.56	22.81	22.79	22.96	23.05	23.44	23.95	24.22	24.95	25.22
Existing traveled way width, ft	34.00	34.00	34.00	34.00	34.00	34.00	34.00	34.00	34.00	34.00
Curve widening, ft	-13.44	-11.19	-11.21	-11.04	-10.95	-10.56	-10.05	-9.78	-9.05	-8.78

Analysis based on AASHTO's *A Policy on Geometric Design of Highways and Streets*, 2011, Chapter 3.3.9, Offtracking

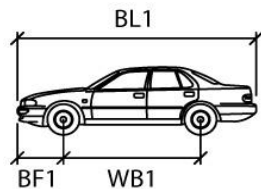
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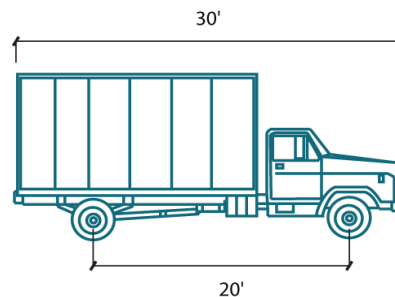
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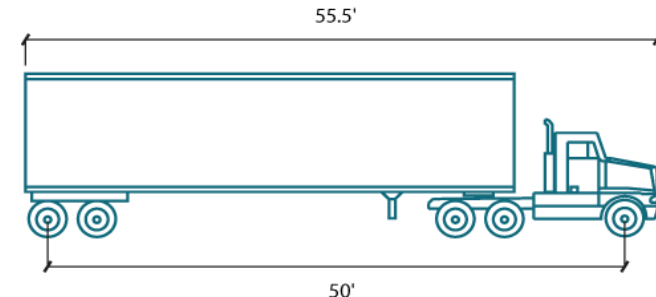
P



S-BUS-36



SU-30



WB-50

## KY 151 Offtracking Analysis Summary

		Required Pavement widening (feet)									
		Allowed Vehicles						STAA Vehicles			
		84" Wide	96" Wide					96" Wide		102" Wide	
County	Milepoint	P	S-BUS-36	SU-30	SU-40	WB-40	WB-50	WB-62	WB-67	WB-62	WB-67
Anderson	0.1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	1.2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	1.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	1.7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2.1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2.6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.70	1.04
	3.0	0.00	0.00	0.00	0.00	0.00	0.00	0.40	0.74	1.40	1.74
	3.7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4.4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Franklin	0.4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	1.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	1.8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

*Red highlighted numbers indicate curves that may require additional widening to be able to accommodate the currently prohibited STAA vehicles*

## Vertical Curves from US 127 to I-64

	County	Beginning MP	Ending MP	Crest or Sag	Approximate Existing Sight Distance (ft)	Sight Distance (ft) Current Design Guidelines
1	Anderson	0.00	0.12	Crest	452	360
2		0.16	0.19	Sag	292	360
3		0.26	0.36	Sag	1625	360
4		0.49	0.55	Crest	1915	360
5		0.57	0.68	Sag	713	360
6		0.73	0.79	Crest	1006	360
7		0.94	1.01	Crest	437	360
8		1.07	1.14	Sag	451	360
9		1.22	1.34	Crest	621	360
10		1.38	1.45	Sag	376	360
11		1.50	1.54	Crest	405	250
12		1.62	1.64	Crest	2485	250
13		1.65	1.69	Sag	892	250
14		1.71	1.75	Crest	521	250
15		1.77	1.81	Sag	726	250
16		1.86	1.90	Sag	2689	250
17		1.93	1.95	Crest	466	250
18		1.97	2.03	Sag	293	495
19		2.04	2.09	Crest	415	495
20		2.13	2.19	Crest	363	495
21		2.21	2.29	Sag	215	495
22		2.31	2.37	Crest	309	495
23		2.39	2.42	Sag	331	495
24		2.51	2.57	Crest	362	495
25		2.59	2.63	Sag	1153	495
26		2.68	2.70	Crest	1499	495
27		2.73	2.81	Sag	387	495
28		2.99	3.04	Crest	285	495
29		3.15	3.28	Sag	432	495
30		3.31	3.33	Crest	867	495
31		3.35	3.38	Sag	440	495
32		3.41	3.42	Crest	789	495
33		3.47	3.54	Crest	309	495
34		3.61	3.67	Sag	227	495
35		3.68	3.72	Crest	427	495
36		3.72	3.80	Sag	418	495
37		3.96	4.01	Crest	350	495
38		4.12	4.15	Crest	1140	495
39		4.22	4.37	Sag	867	495
40		4.56	4.59	Crest	637	495
41	Franklin	0.24	0.30	Sag	13930	495
42		0.46	0.55	Sag	475	495
43		0.92	1.07	Crest	593	495
44		1.21	1.24	Crest	804	495
45		1.73	1.83	Sag	435	495
46		1.86	1.99	Crest	458	495

Denotes curves that were analyzed

# Ball-Bank Indicator Analysis

Observers: KYTC HSIP

Date: 8/8/2016

County: Anderson

Route: KY 151







Posted Speed: 55/45/35 mph

Travel Direction: (see below)

Ball-Bank Indicator Readings (degrees)											
Curve ID Milepoint	Curve Milepoint (rounded)	Travel Direction	Speed on Curve (mph)							Advisory Speed (mph)	Remarks
			55	50	45	40	35	30	25		
0.126 to 0.019	0.1	South	-	20.50	15.20	12.38	8.93	-	-	35	45 mph zone – no curve sign but US 127 intersection is near
1.485 to 1.380	1.5	South	15.60	12.40	10.80					45	45 mph zone – borderline reading, could be 50 mph advisory with tube ball-bank or different vehicle
1.652 to 1.585	1.7	South	10.80	-						50	35 mph zone
2.608 to 2.508	2.6	South	9.20	9.00						55	
2.935 to 2.865	3.0	South	8.60	8.00						55	
4.421 to 4.265	4.4	South	7.40	5.20						55	
0.126 to 0.019	0.1	North	-	-	-	-	-	-	-	-	Intersection
1.485 to 1.380	1.5	North	9.10	7.10						55	45 mph zone
1.652 to 1.585	1.7	North	9.98	9.72						55	35 mph zone
2.608 to 2.508	2.6	North	12.30	7.40						55	
2.935 to 2.865	3.0	North	9.30	7.00						55	
4.421 to 4.265	4.4	North	5.85	4.00						55	

Note: An alarm sounds when the ball-bank indicator reaches the following readings:

1. 16 degrees of ball-bank for speeds of 20 mph or less
2. 14 degrees of ball-bank for speeds of 25 to 30 mph
3. 12 degrees of ball-bank for speeds of 35 mph and higher

Curve Warning Sign Inventory				
County	Posted Speed (mph)	Milepoint	Northbound	Southbound
Anderson	45	1.4		
		1.5		
	55	2.4		
	55	2.8		
		2.8		
	55	4.2		

Rumble Strip Inventory				
County	Posted Speed (mph)	Rumble Strip	Begin MP	End MP
Anderson	45	No rumble strip	0.00	1.473
	35 to 45 (Alton)	Rumble strip on roadway edges and centerline	1.473	1.990
	55	Rumble strip on roadway edges and centerline	1.990	4.587
Franklin	55	Rumble strip on roadway edges and centerline	0.00	2.30