



# Safety Evaluation of 2+1 Roadway Design

Report Number: KTC-24-18

DOI: <https://doi.org/10.13023/ktc.rr.2024.18>





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**Research Report**

KTC-24-18

**Safety Evaluation of 2+1 Roadway Design**

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January 2024

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## 1. Introduction

KYTC has built several 2+1 roads since their introduction in 2013. Once each 2 + 1 segment opened to traffic, KYTC and KTC began monitoring their performance, paying special attention to highway safety statistics. Table 1 lists 2 + 1 roads that have been constructed and key characteristics of each (county, route, mile point, dates opened to traffic). So far, about 36 miles of 2 + 1 roads have been constructed along KY 55 and US 68 in Adair, Taylor, Marion, and Washington counties. These roads extend from Columbia north to Springfield. After construction on KY 555 north of Springfield is complete, a nearly 60-mile corridor with the 2 + 1 configuration will be in place from the Cumberland Parkway to the Bluegrass Parkway.

**Table 1** Location of Existing 2+1 Roadways in Kentucky

County (Item #)	Route	Mile Point Range	Date Opened as a 2+1 Roadway
Adair (8-8851)	KY 55	<ul style="list-style-type: none"> <li>• 15 to 20.0</li> <li>• 20.9-21.3</li> </ul>	<ul style="list-style-type: none"> <li>• September 14, 2016</li> <li>• December 4, 2020</li> </ul>
Taylor (4-8920)	KY 55	0.0 to 7.8	<ul style="list-style-type: none"> <li>• December 4, 2020</li> </ul>
Marion (4-8916.10)	KY 55	1.8 to 4.7	<ul style="list-style-type: none"> <li>• June 13, 2019</li> </ul>
Washington (4-8916.20)	KY 55	<ul style="list-style-type: none"> <li>• 0-0.15</li> <li>• 0.15-4.55</li> </ul>	<ul style="list-style-type: none"> <li>• June 13, 2019</li> <li>• October 18, 2021</li> </ul>
Taylor (4-8917)	US 68	7.404-13.531	<ul style="list-style-type: none"> <li>• August 15, 2022</li> </ul>
Marion (4-8917)	US 68	Marion 0 to 9.339	<ul style="list-style-type: none"> <li>• August 15, 2022</li> </ul>

## 2. Safety Analysis

We compared the number of crashes that occurred on each segment before and after implementation of the 2 + 1 design. Table 2 lists the evaluation periods for each route. For all segments, the analysis compared equal number of days. Except for KY 55 in Adair County, the *After 2 + 1* analysis period ended on June 30, 2023. We modified the analysis period for this route because crash data from before 2011 is inconsistent. Evaluation periods ranged in length from 319 to 1,769 days.

**Table 2** Date Ranges for Safety Evaluations Before and After 2 + 1 Implementation

Project Information			Evaluation Period		
County	Route	Mile Point	Before 2 + 1	After 2 + 1	Days
Adair (8-8851)	KY 55	15-20.9	1/1/11 – 11/5/15	9/14/16 – 6/22/21	1,769
Taylor Adair (4-8920)	KY 55 KY 55	0.0-7.8 20.9-21.3	1/27/17 - 8/23/19	12/4/20 – 6/30/23	938
Marion Washington (181047)	KY 55 KY 55	1.8-4.7 0.0-0.15	2/4/15 – 2/21/19	6/13/19 – 6/30/23	1,477
Washington (201316)	KY 55	0.15-4.55	3/9/19 – 12/2/20	10/18/21 – 6/30/23	620

Project Information			Evaluation Period		
County	Route	Mile Point	Before 2 + 1	After 2 + 1	Days
Marion	US 68	0-9.339	7/5/20 – 5/20/21	8/15/22 – 6/30/23	319
Taylor (4-8917)	US 68	7.404-13.531			

We examined data for each crash to verify it occurred during the specified date ranges and along the indicated road segment. Analysis excluded crashes involving a collision with an animal as well as crashes in parking lots. Because most of the road segments are in rural areas, we identified several vehicle-animal collisions (typically involving deer). Table 3 summarizes crash data for each segment during the periods before and after the 2 + 1 configuration opened to traffic. It includes the total number of crashes as well as the number of injury and fatal crashes. Combining all projects, crash data are very similar prior to and after implementation of 2 + 1 designs.

**Table 3** Crash Data Before and After 2 + 1 Implementation

			Crashes (Excluding Animal/Parking Lots)					
Project Information			Before 2 + 1			After 2 + 1		
County	Route	Mile Point	Total	Injury	Fatal	Total	Injury	Fatal
Adair (8-8851)	KY 55	15-20.9	61	16	1	82	21	1
Taylor	KY 55	0.0-7.8	60	10	1	36	7	1
Adair (4-8920)	KY 55	20.9-21.3	1	1	0	4	0	0
Marion	KY 55	1.8-4.7	26	3	0	37	9	2
Washington (181047)	KY 55	0.0-0.15	2	0	0	2	1	1
Washington (201316)	KY 55	0.15-4.55	28	6	2	15	5	0
Marion	US 68	0-9.339	14	7	0	19	4	1
Taylor (4-8917)	US 68	7.404-13.531	13	3	0	6	2	0
<b>All Projects</b>			<b>205</b>	<b>46</b>	<b>4</b>	<b>201</b>	<b>49</b>	<b>6</b>

We compared the manner of collision for crashes recorded before and after implementation of 2 + 1 designs (Table 4). Percentages for all crash types were similar in each period. The percentages of head-on and sideswipe/opposite direction collisions did not increase following 2 + 1 adoption. Opposing left turn crashes had the greatest percentage change, increasing from 3.4 percent to 6.5 percent.

**Table 4** Comparison of Crash Types Before and After 2 + 1 Implementation

Crash Type	Percentage of Total Crashes	
	Before 2 + 1	After 2 + 1
Angle	14.1	11.7
Backing	1.0	0.9
Head-On	4.4	3.5
Opposing Left Turn	3.4	6.5
Rear End	39.0	35.9

Crash Type	Percentage of Total Crashes	
	Before 2 + 1	After 2 + 1
Sideswipe/Opposite Direction	4.4	4.3
Sideswipe/Same Direction	7.3	9.5
Single Vehicle	26.3	27.7

We identified 49 injury crashes and 6 fatal crashes following 2 + 1 implementation. Crash reports for each incident were reviewed. Police report classify injuries as:

- A Incapacitating injury
- B Non-incapacitating injury
- C Possible injury

Based on police report codes, we classified each injury crash based on the most serious injury. Of the 49 injury crashes that took place after a 2 + 1 configuration opened, 8 were an A-injury crash, 20 a B-injury crash, and 21 a C-injury crash. Short descriptions of the 8 A-injury crashes are provided below.

- Adair County; KY 55; mile-point 16.4; November 2, 2017  
A rear end crash when a vehicle stopped to turn into a business lot.
- Taylor County; KY 55; mile-point 4.0; September 25, 2022  
A “sideswipe/opposite direction” crash involving drug use.
- Taylor County; KY 55; mile-point 5.0; April 20, 2023  
A truck driver stated he choked on food and lost control of his vehicle.
- Marion County; KY 55; mile-point 1.9; January 11, 2020  
Angle collision at KY 2154 intersection (traffic signal not working).
- Marion County; KY 55; mile-point 2.0; March 1, 2023  
Angle collision at Radio Station Road intersection.
- Marion County; KY 55; mile-point 2.0; February 19, 2023  
Angle collision at Five Star entrance.
- Marion County; KY 55; mile-point 4.0; November 6, 2021  
Sideswipe/opposite direction collision when northbound vehicle crossed centerline.
- Taylor County; US 68; mile-point 7.9; September 17, 2022  
Head-on collision when eastbound vehicle crossed centerline.

We also reviewed the locations where fatal crashes occurred. No fatal crashes occurred at locations where the 2+1 design would have been a factor in the incident. The one head-on fatal crash was recorded on a section that has two lanes in one direction and one lane in the other direction. Short descriptions of fatal crashes are provided below.

- Marion County; US 68; mile-point 4.9; October 6, 2022  
A westbound driver crossed the centerline resulting in a head-on collision.
- Marion County; KY 55; mile-point 2.0; April 24, 2022  
A single vehicle crash when a northbound motorcycle crossed the road and collided with a guardrail and bridge barrier.
- Taylor County; KY 55; mile-point 3.3; August 9, 2021  
A single vehicle crash when a northbound vehicle hydroplaned due to heavy rain.



- Marion County; KY 55; mile-point 2.0; September 27, 2022  
A northbound driver turned left into the path of a southbound vehicle at the entrance to Five Star.
- Washington County; KY 55; mile-point 0.1; February 4, 2020  
Rear end crash during heavy rain with lack of visibility (lost control while passing).
- Adair County; KY 55; mile-point 15.2; March 26, 2017  
Single vehicle crash (during rain) involving impact with a guardrail (alcohol involved).

Eight head-on crashes took place after 2 + 1 implementation. Several involved a driver turning into the path of another vehicle and were not a typical head-on crash. Three crashes occurred when a vehicle crossed the centerline into the opposing lane, with one being the fatal head-on crash noted above. A fatal crash on KY 55 in Taylor County near mile point 4.0 occurred on a three-lane section and involved a vehicle colliding with a trailer pulled by a pickup. The other head-on crash was on US 68 in Taylor County near mile point 7.9 on a three-lane section and involved a driver losing control of their vehicle.

Ten sideswipe/opposite direction crashes occurred after 2 + 1 implementation. Only one crash involved a vehicle crossing the centerline into the opposing lane. This incident happened on KY 55 in Marion County near mile point 4.0 and involved a driver that was reported swerving in and out of their lane.

### **3. Conclusion**

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Crash types and numbers did not change appreciably following 2 + 1 implementation. But our review of crash reports **did not uncover** incidents where the 2+1 configuration was a contributing factor. KYTC should continue to monitor and analyze the safety performance of 2+1 roads.