National Transportation Safety Board
Office of Research and Engineering
Washington, DC 20594

HWY23FH012

VIDEO STUDY

Specialist's Study

March 12, 2023

TABLE OF CONTENTS

A. CRASH

Location:	Excelsior TWP, Wisconsin
Date:	May 12, 2023
Time:	07:20 AM Central Daylight Time (CDT)
Vehicle1:	2010 Ford F-150 Pickup Truck
Vehicle2:	School Bus

B. VIDEO STUDYSPECIALIST

Specialist Shane K. Lack
NTSB
Washington, DC

C. SUMMARY

Please refer to the *Crash Summary Report* which is available in the docket for this crash.

D. DETAILS OF THE ANALYSIS

1.0 Overview

In this crash a Ford F-150 pickup truck approached a stopped school bus from behind on a 2-lane rural highway near Excelsior, Wisconsin. As it approached the stopped school bus, the pickup swerved to the right, struck the right rear corner of the bus, went off the shoulder of the road and struck a pedestrian that was waiting to board the bus at a rural farm driveway (see Figure 1). The posted speed limit at the crash location is 55 mph. For the purposes of this report the bus is referred to as "bus" or "school bus". The Ford F150 is referred to as "the pickup" or "the pickup truck". The goal of this study is to estimate the speed of the pickup truck as it approached the bus and then swerved to the right. The video analysis is based on footage obtained from a Digital BUS-WATCH SD40 camera. This camera showed an interior view of the bus (see Figure 2). The camera was part of a larger system of cameras on the bus that captured video. Data used in this study was provided to the NTSB in the form of 4514 video frames in the MP4 format. The video resolution was 352 x 240. The average frame rate of the video was 14.9848 fps.

State Highway 23/33 where the crash occurred is an undivided highway with two travel lanes, one in the westbound direction and one in the eastbound direction. Both the school bus and the Ford pickup were traveling in the westbound lane prior to the collision (see Figure 1).

The portion of the video evaluated in the study begins approximately 1 second prior to the pickup truck swerving to the right. As indicated by Figure 2, it was daylight when the crash occurred.

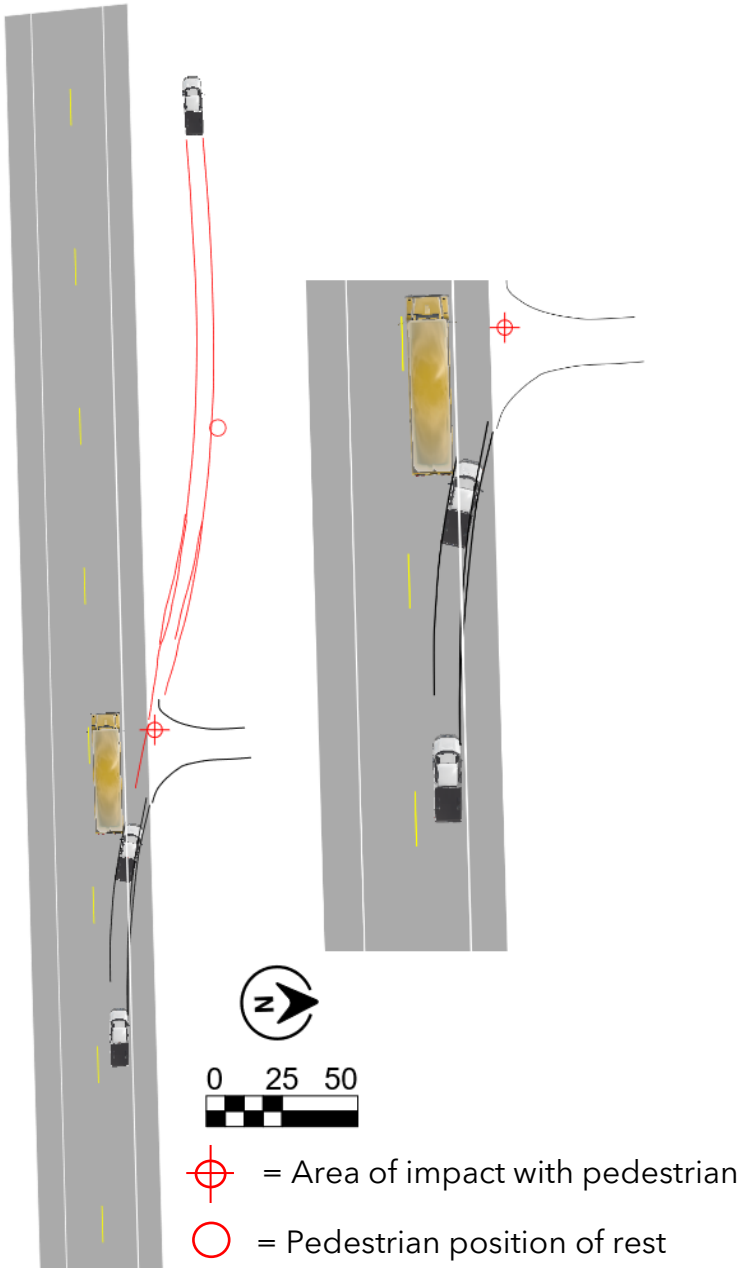

Figure 1. Diagram of the crash site. North is to the right.

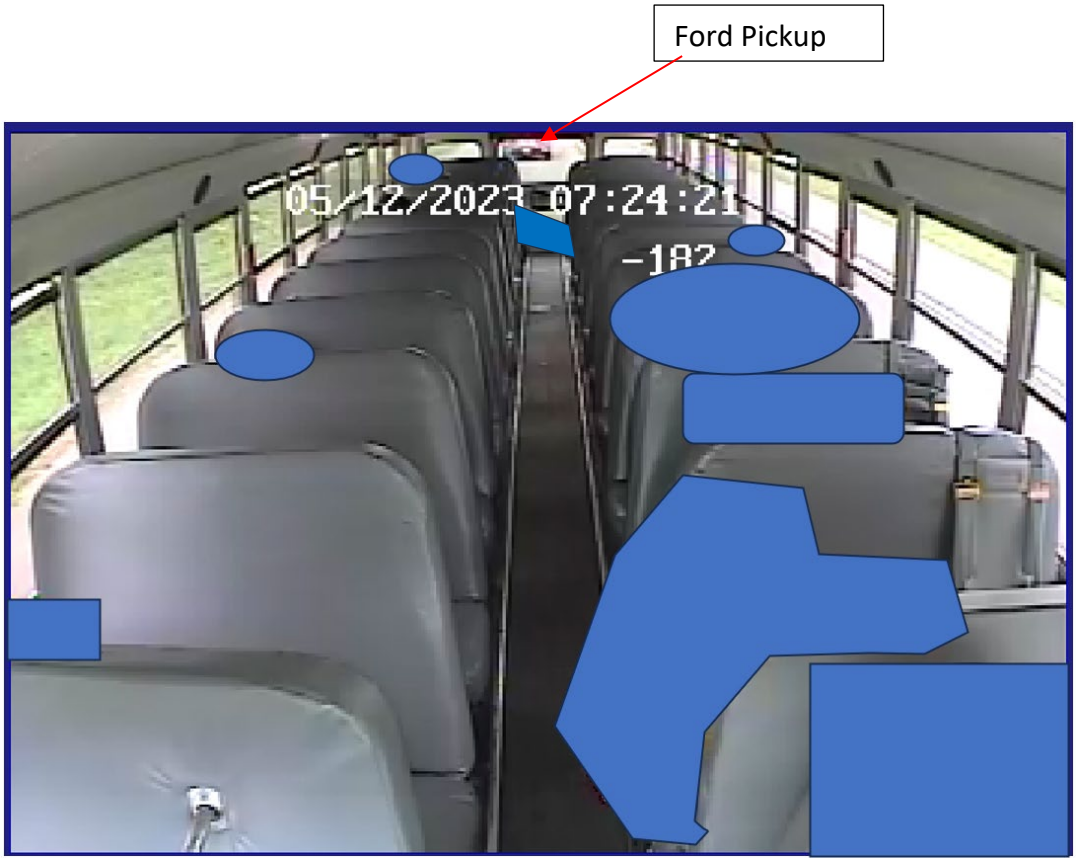

Figure 2. Still image from the video camera showing the camera view. The pickup truck is visible in the rear emergency door window of the bus as it approaches the bus. (Blue shapes obscure bus occupants.)

2.0 Video Analysis

2.1.1 Brief Description of the Video

The video was from a rear facing interior camera that was located at the front of the bus. In the video the pickup is visible in the rear windows of the bus as it approaches the back of the bus and then swerves to the right. After swerving to the right, the pickup is visible in the right-side passenger windows of the bus as it passes by the bus. The collision between the pickup and the bus, and the collision with the pedestrian are not shown in this video. When the pickup truck first becomes visible in the video, the bus is still moving but has stopped by the time the pickup truck strikes the bus.

2.1.2 Estimating the Speed of the Pickup

The speed of the pickup truck was measured by triangulating the position of the pickup as its left front tire crossed the top and bottom edges of the upper window of the rear emergency door in the video (see Figures 3, 4 and 5). The triangulated positions of the pickup truck and the associated video times (see Figures 4 and 5) were then used to estimate the average speed just prior to the pickup truck swerving. In the video the pickup truck began to swerve to the right shortly after the left front tire crossed the lower portion of the top window of the rear emergency exit (see Figure 3). The speeds estimated in the report are the average speeds over about one second prior to the pickup swerving.

The details of the triangulation (of the pickup truck's position) and the video timing information used in the study are described in Figures 4 and 5. Measurements of the bus used in the study (the camera height above ground, the height of the upper rear emergency door window glass above the ground, etc.) were obtained from the Sauk County, Wisconsin Sheriff's Office. The uncertainty associated with each measurement is ±1/2 inch. The effects of the uncertainties on the speed estimates were evaluated by iteratively adjusting the bus measurements used in the triangulation over the range of the uncertainties to determine the upper and lower bounds of the speed range. The resulting speed estimates were adjusted by + 2 mph to account for the fact that the bus was still moving when the pickup first became visible in the video but had stopped prior to the pickup truck swerving to the right. (This speed adjustment was determined using a video tracking software, Syntheyes (SynthEyes - Boris FX, Inc. (ssontech.com), and tracking fixed points along the road.)

The results of the speed study indicate the average speed of the pickup truck over the last second prior to swerving was 54±4 mph.

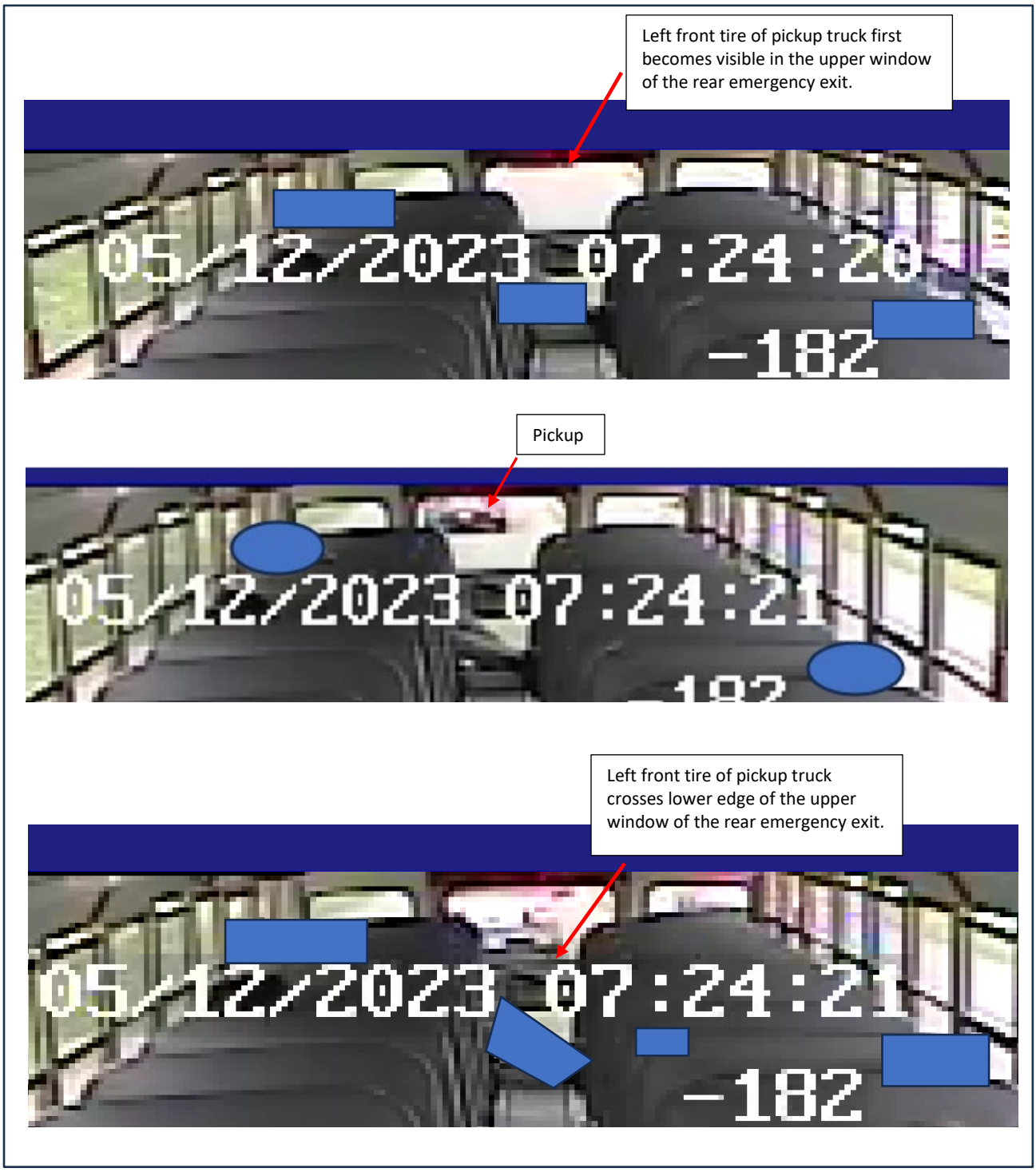

Figure 3. Video images showing the pickup as it approaches the back of the bus in the video. The top and bottom images were used to triangulate the position of the pickup as the left front tire crossed the upper and lower portions of the upper rear emergency door window in the video.

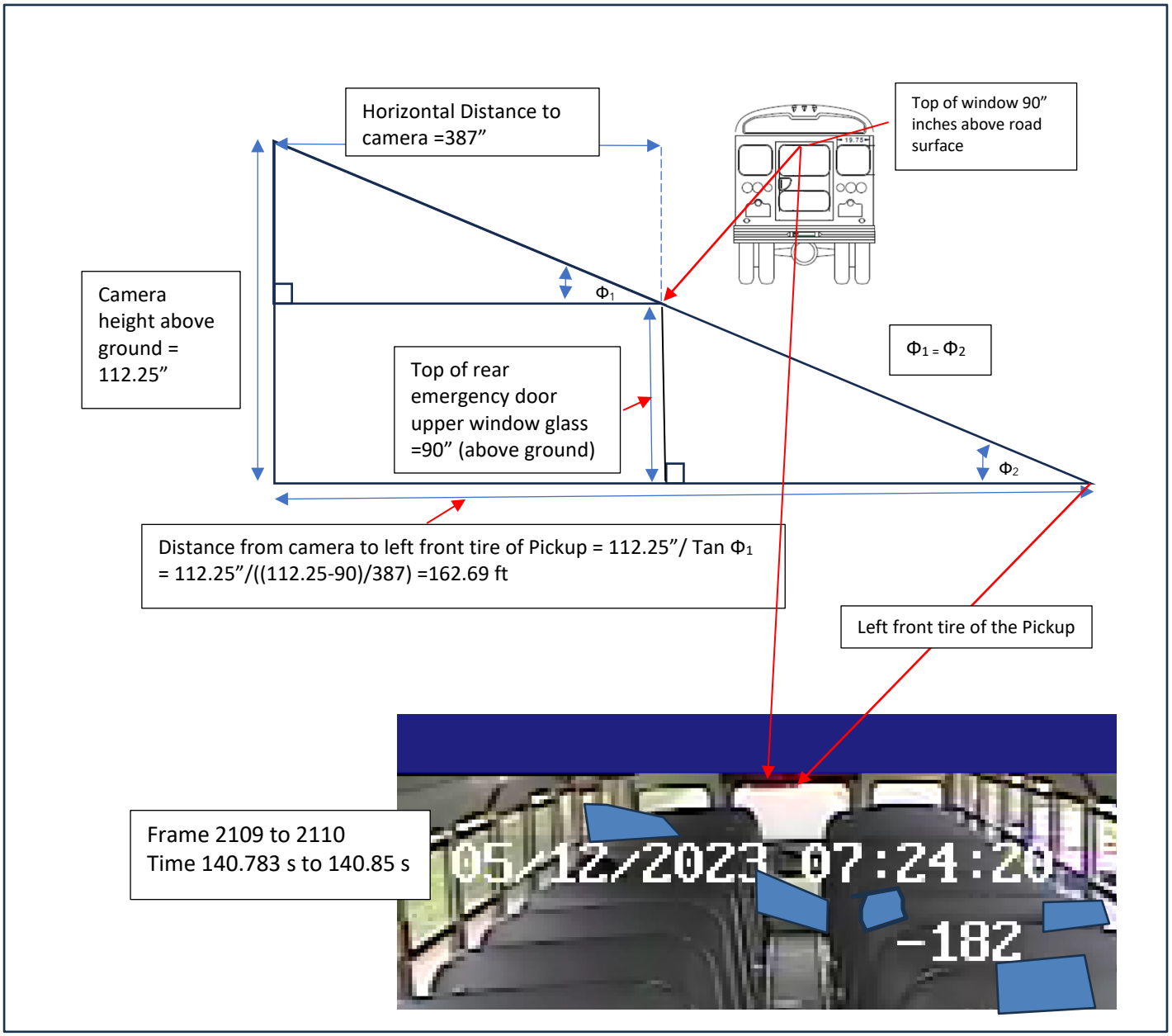

Figure 4. Details of the triangulation of the pickup’s position as the left front tire crosses the upper portion of the rear emergency door window.

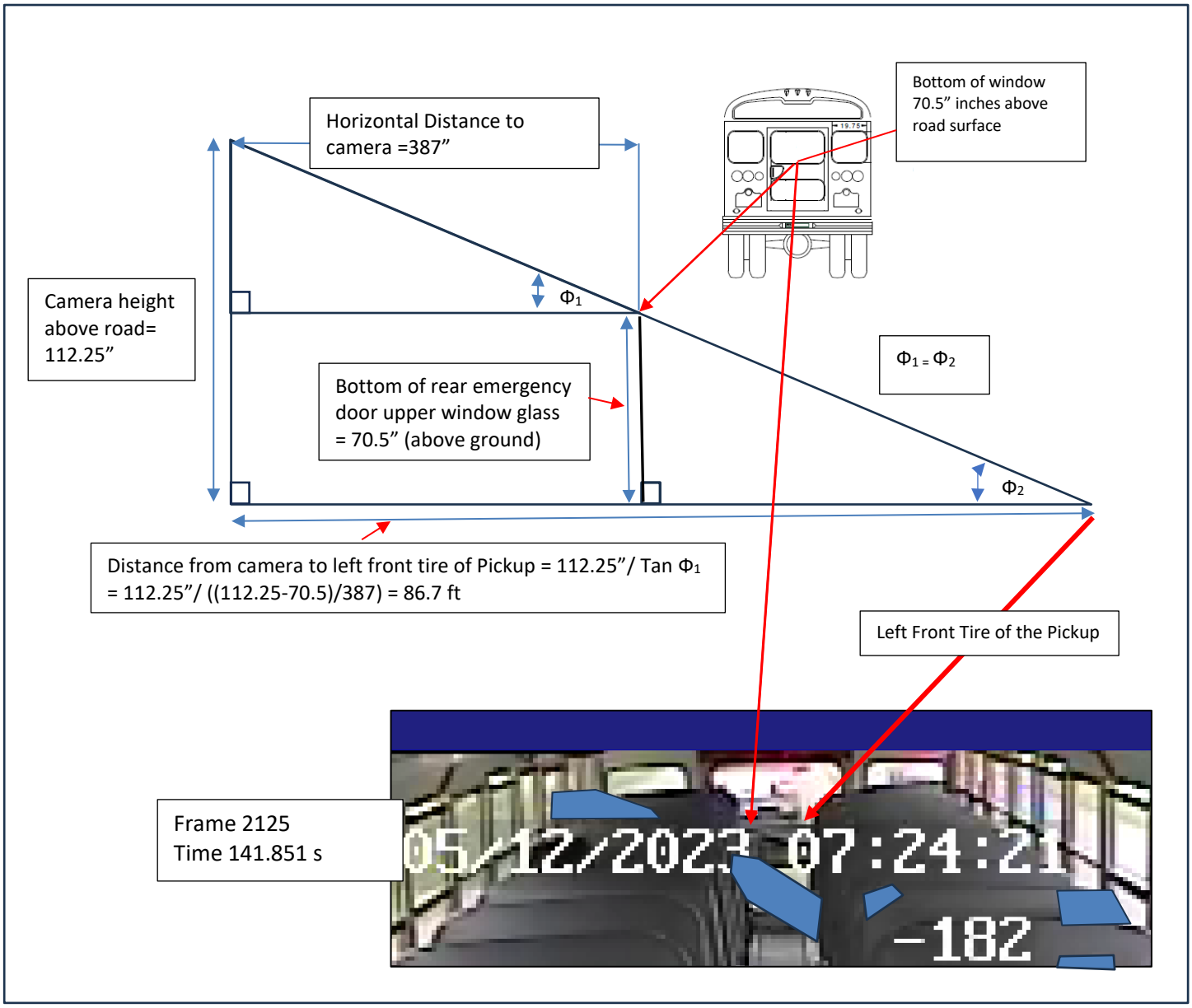

Figure 5. Details of the triangulation of the pickup's position as the left front tire crosses the lower portion of the upper rear emergency door window.

March 12, 2024

E. SUMMARY OF FINDINGS

In this crash a Ford F-150 pickup truck approached a stopped school bus from behind on a 2-lane rural highway. As it approached the stopped school bus, the pickup swerved to the right, struck the right rear corner of the bus, traveled onto the shoulder of the road, and then struck a pedestrian that was waiting to board the bus at a rural farm driveway (see Figure 1). This report describes a video study that was performed to determine the speed of the pickup truck prior to the collision. The results of the study indicate the average speed of the pickup truck over the last second prior to swerving to the right to avoid the school bus was 54±4 mph. The posted speed limit at the crash location is 55 mph.

Submitted by:

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