The determination of the velocity of the vehicle according to the slide marks of vehicle while moving through a curve

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Abstract: During the movement of the vehicle through a curve whilst surpassing critical slide velocity there appears not only sliding, but also the uncontrolled movement of the vehicle. In this process, aside from the usual parameters which influence the critical slide velocity of the vehicle in a curve there is also importance to the driver's actions. In the occasions where the vehicle slides and slide marks appear we have the problem of determining the speed of the vehicle at the point where the driver lost control.

Index Terms: movement, velocity, slide marks, curve, control, critical slide velocity, safety

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1 INTRODUCTION

"Slide marks" are an action of the vehicle centered on the mass of the vehicle, this action is a sliding sideways motion and is usually caused by vehicles traveling around the turn when the rear part wants to leave and looks like it wants to move in the other direction that the vehicle is driven. Slide marks start when the rear wheels start sliding more than the front wheels and develop when the rear wheels deviate from their normal line and surpass the lines of the front wheels. Many accidents are caused by the driver attempting to take a turn with high velocity but the radius of the curve and the bend and the suction factor exists a speed undoubtedly critical after which the vehicle cannot take the turn in a safe way and begins to slide. When the vehicle spins in a curve it is often that the critical slide velocity was surpassed. We can find the critical velocity through the use of the laws of physics and the appropriate formulas.

2 THE EXPRESSION FOR CALCULATING VELOCITY

During the analysis of cases when the vehicle slides during movement in the curve, the velocity of the vehicle in the moment when sliding began can be determined by the formula:

The formula for the calculation of velocity via slide marks:

$$V = 11.27\sqrt{R(f \pm e)}$$

R- radius of slide marks,
f- braking coefficient,
m- the slope of the road,
e- the sideways slope of the road,
+- when the vehicle slides on a slope,
-- when the vehicle slides on a slope (down).

In the conditions where we do not have the tools to measure the velocity of the vehicle, we use this formula.

3 MEASUREMENT OF SLIDE MARKS

In order to determine velocity from slide marks, we must measure the curve radius of slide marks. To make this measurement, we need these values:

a- The length of the cord(C)
b- The length of the middle coordinate(M)

While the vehicle is in a sliding motion the slide marks appear in a variety of different forms but the arch-radius has a certain form which allows the measurement of the needed elements.
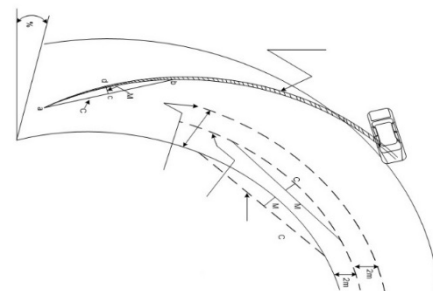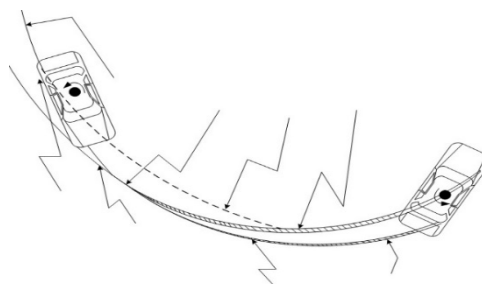
Fig.1. Slide marks. Elements of slide marks

Both figures 2 and 3 show the mark of the front wheel in sliding motion. Of all the other tires are excluded to simplify the explanation of the slide marks and the measure of the vehicle's trail. The investigator must try to find where the marks of

the rear wheel supersede those of the front wheel and use that as the starting point for measuring the length of the slide marks' chord, in every case the investigator must be sure that their measurement begins in the aforementioned point. At that point (Figure 2) the zero, the end of the ribbon is placed at either end (side) of the mark which presents the deformation of clarity, the ribbon is then pulled on a straight line towards the same side of the mark (b). In the straight measurement with the ribbon there is the chord (c). Use the first 1/3 of the mark to measure the chord. Divide the length of the chord by two from the end, measure the chord horizontally find the middle point, which we shall name c. On the right corner of the ribbon, at the c chord and measure it up to the opposite point in the slide marks, and this we named. The distance from **c** to **d** is the middle ordinate.(M).

Fig.2.Slide marks- main points of trajectory

Fig.3.Measured elements of slide marks

During the accomplished analyses in a real case we have:

The vehicle had slide marks of a distance of 10.56 meters, and during the measurement of the radius of the of the slide marks turned out to be 0.24 meters. The radius is found in the measurement of slide marks from the distance of 11.00 meters, so from the moment where the two slide marks overlapped on one side, the measuring meter is stretched to 11.00 meters, the slope of the road is measured with a level of length by 0.80 meters, and the distance between the road and the level was 0.5 meters.
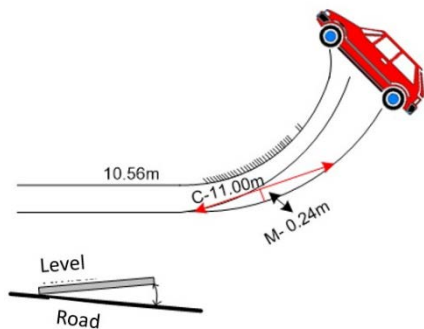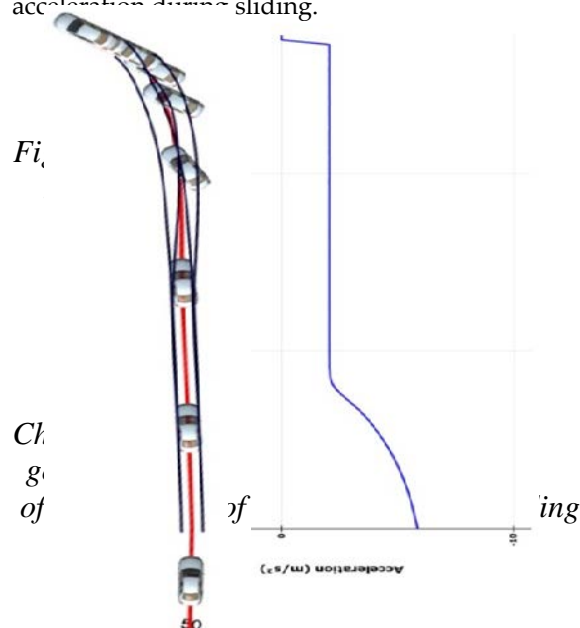
5 CONCLUSION

Based on the expression for the calculation of velocity of a vehicle based on its slide marks, the methodology of measuring aforementioned slide marks and the results we can conclude that:

-This method is simple and quickly applicable
-Can be used by investigators and experts,
-A vehicle's slide can appear for values lower than the critical sliding velocity,
-In this form of accident- the deviation of the vehicle from the trajectory of motion is mostly caused by the driver's actions.

Fig.4. Real case slide marks situation

4 THE DIFFERENCE IN THE VEHICLE'S ACCELERATION DURING SLIDES

For the purpose of knowing the change in acceleration of the vehicle during slides, we have used a software to simulate the movement of a vehicle while sliding. According to the displayed results, a vehicle's acceleration first suffers a decline and after a short period of time becomes constant and ultimately arrives at zero when the vehicle stops.
Further, there are displayed the situation of the simulation and the diagram of the difference in acceleration during sliding.

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