September 7, 1981

Analysis of the 30 July 1977 accident involving Jennifer' Miller, a pedestrian, and a 1975 Ford Elite driven by Mr. John Graban,

Submitted to: Mr. A, James Granito
Granito & Granito
Attorneys and Counselors at Law
704 Dollar Bank Building
Youngstown, Ohio 44503

Materials and Informations,

1. State of Ohio Traffic Crash Report No. 05012

2. Xerox copies of several photographs of the accident site on Route 170.

3. Response to Requests for Admissions.

40 Several witness statements.

5. Answers to Interrogatories to Mr. John Graban.

6. Deposition of Mr. John Graban.

7. Coefficients of friction for rubber tires on dry asphalt from the "Traffic Accident Investigation Manual" by J. Stannard Baker of the Northwestern University Traffic Institute.

8. N.A.D.A. book giving the dimensions of a 1975 Ford Elite.

94 A visit to the accident scene to make measurements, direct the taking of several photographs, and to perform several experiments on the anniversary date of the accident, 30 July 1981.

Accident Description

Jennifer Miller traveled down the driveway and past the front edge of the house at #10509 State Route 170 in a trot or slow run out into the street where she was hit by a north-bound 1975 Ford Elite driven by Mr. John Graban, The Graban Ford skidded 32'2" to a stop on the dry asphalt pavement, The front of the Graban Ford was nearly even with the south edge of the drive of #10509 Route 170 when the skidmarks began,

Thus, the impact with Jennifer Miller and the onset of skidding by the Graban Ford occurred nearly simultaneously, Jennifer Miller ended up 58' north of the impact point. She was partially carried and thrown by the impact of the Graban Ford.

Experiments

The experiments were performed on 30 July 1981 with the help of Jeannie Miller who was 6 years old. She was 42" talk and weighed 38 pounds. At the time of the 30 July 1977 accident Jennifer Hiller was about 49" tall and weighed 52 pounds. As a result, visual experiments to determine distances of first sight using Jeannie Miller as the subject will yield somewhat shorter distances because of her smaller stature relative to Jennifer Miller at; the time of the accident, Thus, distances of first sight determined with Jeannie Hiller will be minimums.

Timing experiments which determine speeds for a trot or slow run will determine a range of possible speeds for Jennifer Miller at the time of the accident, Speeds of this type are affected only slightly by small size variations,

The results of the experiments are as follows:

1. The distance of first sight of a child 48' east of the east edge of Route 170 and in the center of the driveway of #10509 for a northbound car is 156' south of the driveway.

2. The distance of first sight of a child 40' east of the east edge of Route 170 (by the front edge of the house at #10509 Route 170) and in the center of the driveway of #10509 is 200' south, of the driveway,

3. The distance of first sight of a child 18' east of the east edge of Route 170 in the center of the driveway at #10509 from a car traveling from 23 to 30 mph northbound is Between 233' and 245' south of the driveway at #10509.

4. A child standing in the center of the driveway at #10509 Route 170 even with the first tree south of the driveway at #10509 Route 170 (6'6" east of the east edge of Route 170) is clearly visible to northbound traffic for at least 250' south. of the driveway at #10509.

5. Jeannie Milles ran 10 steps at a medium trot. The average distance for three trials was 23.0 ft and the average tine was 4.03 seconds. This resulted in an average speed of 5.7 ft/sec or 2.5 steps/sec. A reasonable range which would include the speed of Jennifer Miller for similar activity would by between 5 to 7 ft/sec. This speed range is consistant with rapid pedestrian movement at intersections for children up to the age of adulthood.

Don't know exact speed she was running

Objectives

1. To determine the position and the speed of the Graban vehicle at the beginning of its skid to a stop,

2, To determine the time required for Mr. Graban to bring his car to a stop in a 32'2" skid,

3. To determine the minimum distance of absolute visibility of Jennifer Miller to northhound traffic on Route 170 as she came out of the drive (#10509) on the east side of Route 170 to the point of impact,

4. To compute the time during which Jennifer Miller was absolutely visible to all traffic on Route 170 northbound prior to impact,

5. To determine the position of the Graban vehicle when Jennifer Miller became absolutely visible to all northbound traffic on Route 170.

6. To determine the total stopping distance of the Graban vehicle from its pre-skid speed.

7. To determine how long Mr. Graban would have had to delay his travel to the point of impact so as to avoid hitting Jennifer Miller.

Analysis

1a) Speed determination for the Graban vehicle.

The energy of motion of the Graban vehicle was dissipated in a 32'2" skid to a stop,

Equation: $V_o^2 = 2 \mu g d$

V_o = speed at the start of the skid

$\mu = 0.60 \leftrightarrow 0.80$ (range of possible coefficients of friction for tires on dry asphalt)

$g = 32.2 \text{ ft/sec}^2$

$d = 32'2"$ (skid distance)

Result: $V_o = 24.0 \leftrightarrow 27.8$ mph

Comment: The speed of the Graban car at the start of its first skidmark of 32'2" was in the range 24.0 ↔ 27.8 mph.

b) Position determination for the Graban vehicle when its skid began,

The police report shows the final resting position of the Graban vehicle. Working backwards from the resting position to the beginning of the 32'2" skid of the left rear tire and knowing the wheel base and length of the 1975 Ford Elite allows one to determine the position of the front bumper of the Graban Ford at the start of the skid, Based on these measurements the front bumper of the Graban Ford was one or two feet south of the south edge of the driveway $ #10509 Route 170. This fact agrees with Mr, Graban's statement that he did not apply his brakes prior to hitting Jennifer Miller, In fact, the impact and the beginning of the 32'2" skid were nearly simultaneous.

2, Stopping time determination for the Graban vehicle,

Equation:: $t = a/(v_f - v_o)$

t = time to skid to a stop

$a = \mu g$ where $\mu = 0.6 \leftrightarrow 0.8$ and $g = 32.2 ft/sec^2$

$v_f = 0$

$v_i = 24.0 \leftrightarrow 27.8$ mph

Result: $t = 1.58 \leftrightarrow 1.82$ seconds

Comment: The time fron impact to *a* complete stoop **was** therefore in the range $1.58 \leftrightarrow 1.82$ seconds because the beginning of the skid and impact were nearly simultaneous. If one adds the accepted. value, 0.8 seconds, or even 1.0 second to account for driver reaction time (defined to be the length. of time from the perception of a hazard to the actual brake application) then the total stopping time is between 2.38 and 2.82 seconds for the Graban vehicle,

3. Minimum distance of absolute visibility of Jennifer Miller to traffic on Route 170 as she traversed her pre-impact path.

The first tree south of the drive of #10509 is 6'6" from the east curb. Patrolman Ricketts noted that the point of impact was near the left front headlight of the Graban vehicle (about one foot from the left edge of the vehicle). Further, the front of the Graban vehicle was 2'5" east of the double center line of Route 170. Since t'ne north-bound lane is 14' wide, the total distance is:

$$14' - 2'5" - 1' + 6'6" = 17'1"$$

As a result, the minimum distance of absolute visibility is 17'1".

In his 21 November 1980 answers to interrogatories Mr. Graban illustrates in his answer to question 12 that the point of initial contact with Jennifer Miller was about 2'6" past the edge of the passenger side of the vehicle, Thus, this distance of absolute visibility for Jennifer Miller was 2'6" less than the 17'1" based on Patrolman Ricketts statements, Thus, we have a range of possible distances of minimum visibility between 14'6" and 17'.

4. Determination of the time it took Jennifer Miller to travel the 14'6" ↔ 17' distance of absolute visibility prior to being hit by the Graban car.

Jennifer Miller was 7 years old at the time of this accident, One witness says that she did "a sort of walking-run out the driveway[sp], Another states that she "came trotting down the driveway". The speed range of Jennifer Miller for this activity *is* between 5 and 7 ft/sec. This range is based on experiments with Jeannie Miller, other experiments which I have performed and data on pedestrian studies, As a result, the time for absolute visibility for Jennifer Miller for the 14'6" ↔ 17' travel distance before impact is in the range 2.1 ↔ 3.4 seconds.

5. The speed of the Graban vehicle at the start of its skid was in the range of 24.0 ↔ 27.8 mph. At a time 2.1 ↔ 3.4 seconds prior to the onset of the skid and the nearly simultaneous impact, its position south of the impact can by calculated as follows:

Equation: $d_1 = v_0 t$

d_1 = position of Graban vehicle south of impact

$v_0 = 24.0 \leftrightarrow 27.8$ mph

$t = 2.1 \leftrightarrow 3.4$ seconds

Result: $d_1 = 73.9' \leftrightarrow 138.6'$

6. The maximum total stopping distance for the Graban vehicle includes the 32'2" skid-to-a-stop distance and the distance traveled in a normal to long reaction time range of 0.8 ↔ 1.0 seconds from a possible speed range of 24.0 ↔ 27.8 mph, This latter distance is between 28'2" and 40'10". As a result, the total stopping distance of the Graban vehicle was within a distance range of 60.3' and 73'.

7. Determination of the delay time required for the Graban vehicle so as to avoid impact with Jennifer Miller.

To avoid impact, Jennifer Miller would have had to travel an extra 2' to 4' towards the west curb of Route 170. At a speed range of 5 ↔ 7 ft/sec Jennifer Miller would have traveled the required distance of 2' to 4' in a possible time range of 0.29 ↔ 0.80 seconds, As a result, if the Graban vehicle had delayed its travel to impact by at least 0.8 seconds the accident would have been avoided,

Conclusions

1. The pre-skid speed of the Graban vehicle was in the range of 24.0 ↔ 27.8 mph and the total time to stop the vehicle from this speed range is 2.38 ↔ 2.82 seconds.

2. Mr. Graban's application of his brakes was nearly simultaneous with the impact.

3. Jennifer Miller was absolutely visible for at least 2.1 — 3.4 seconds before impact, As a result, the Graban vehicle was at least in the range of 73.9' ↔ 138.6' south of the impact point when Jennifer Miller was first absolutely visible to northbound traffic. Since the maximum stopping distance for a vehicle traveling on dry asphalt at 24.0 ↔ 27.8 mph is in the range 60.3' ↔ 73' there is no question that Mr. Graban could have avoided the accident by bringing his vehicle to a complete step south of the impact point,

4. If the Graban Ford's travel prior to impact had been delayed by a maximum of 0.8 seconds the accident would not have occurred. In this instance, the Graban vehicle would not even have had to stop prior to the impact point.

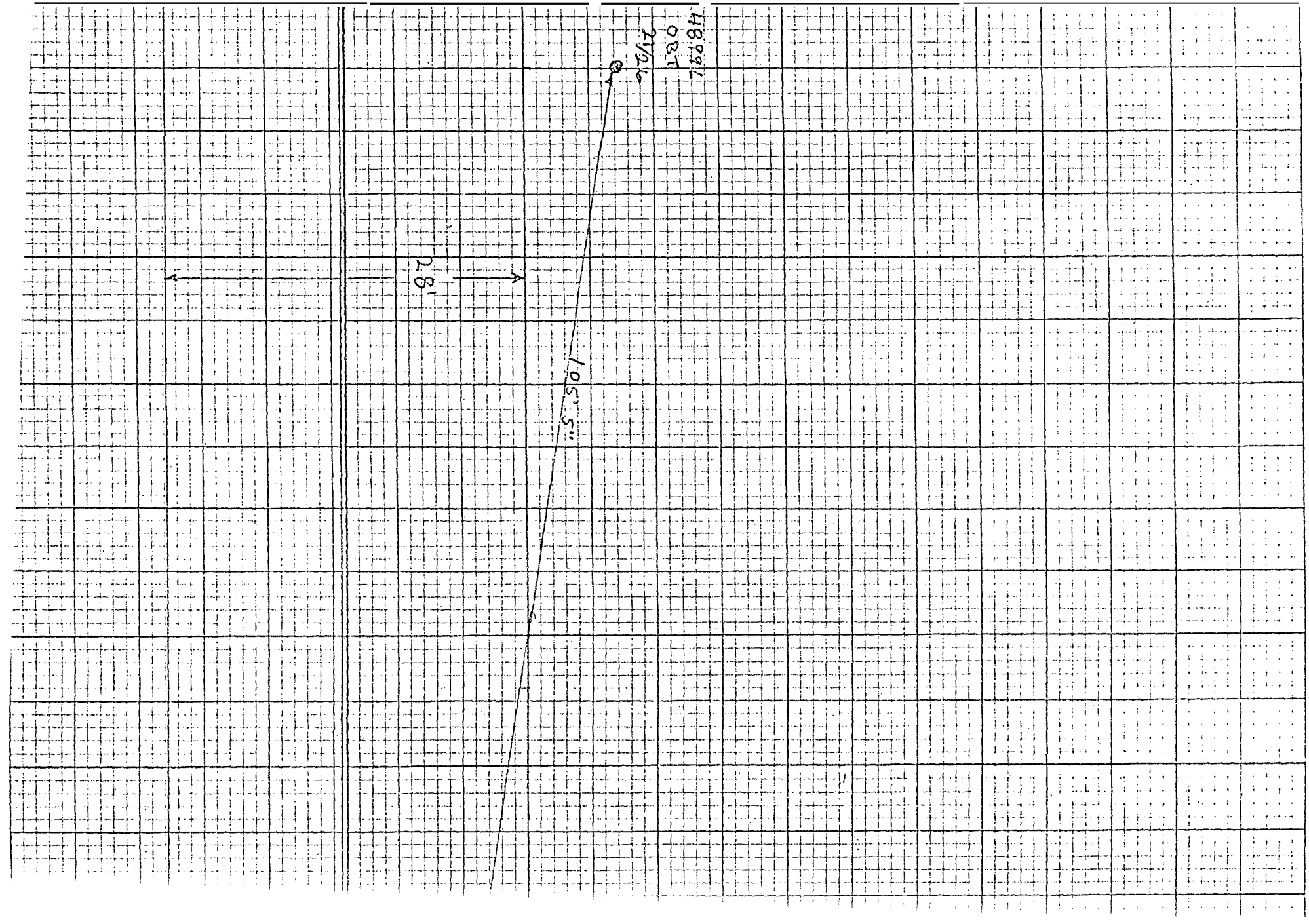
5. It is clear that even before reaching the point of absolute visibility, Jennifer Miller would have been visible to northbound traffic for portions of her 40' travel down the driveway from the house of #10509 Route 170 to the first point of absolute visibility,

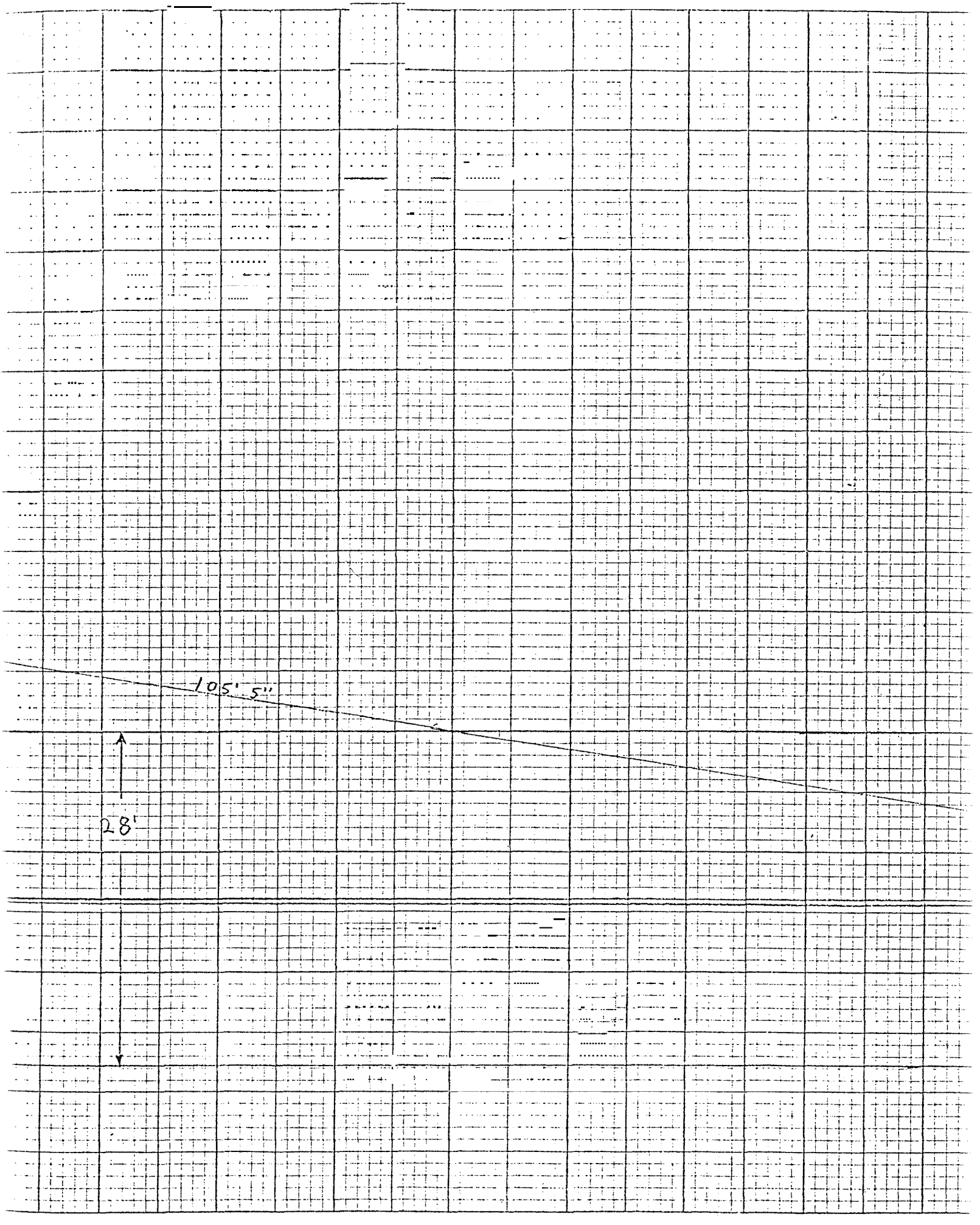
Submitted by: David L Uhrich

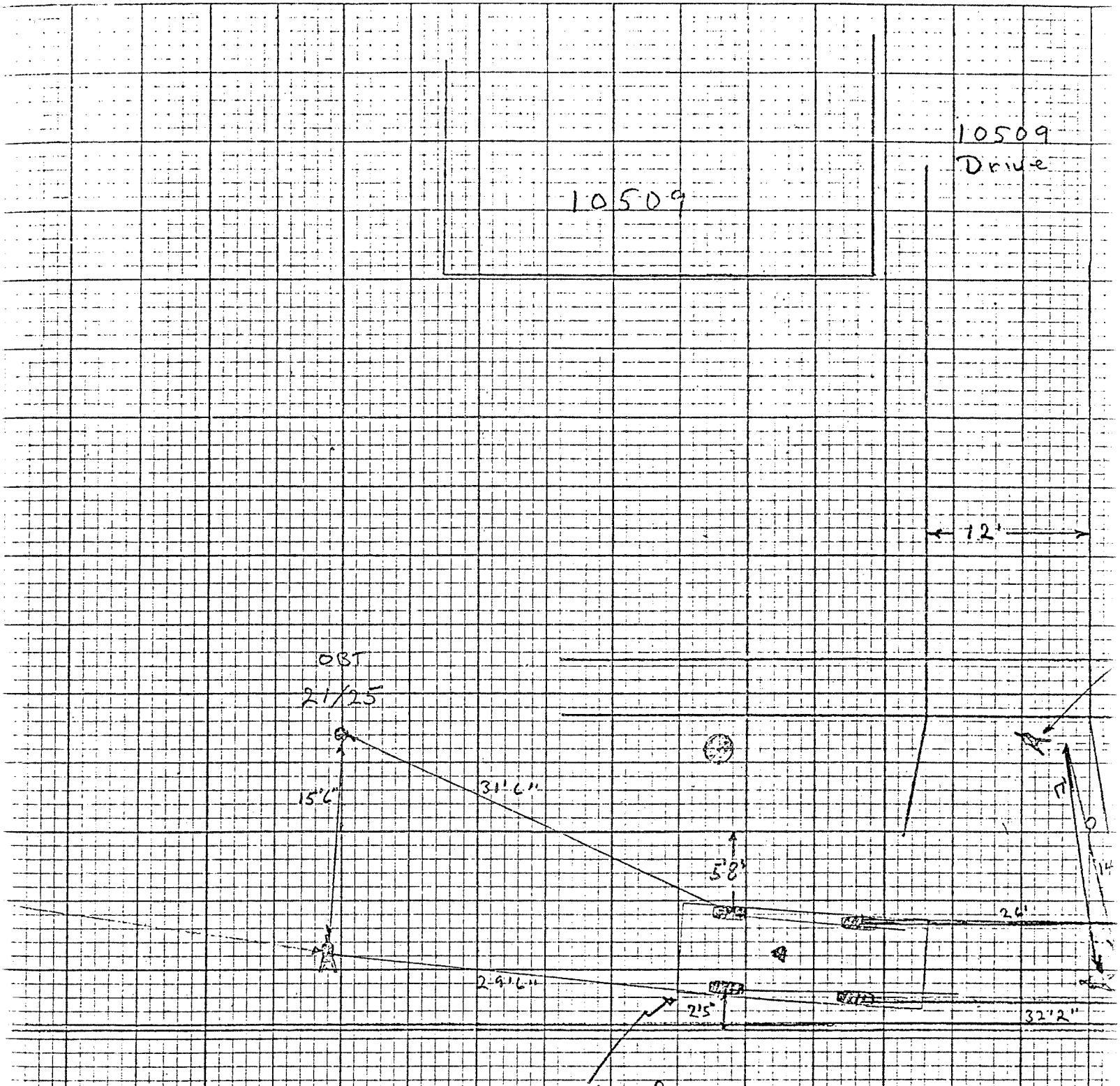
David L. Uhrich, Ph.D.
Professor of Physics
(Kent State University)
707 Berkeley Dr.
Kent, Ohio 44240

RECORDING CHARTS
GRAPHIC CONTROLS CORPORATION
BUFFALO, NEW YORK
PRINTED IN U.S.A.

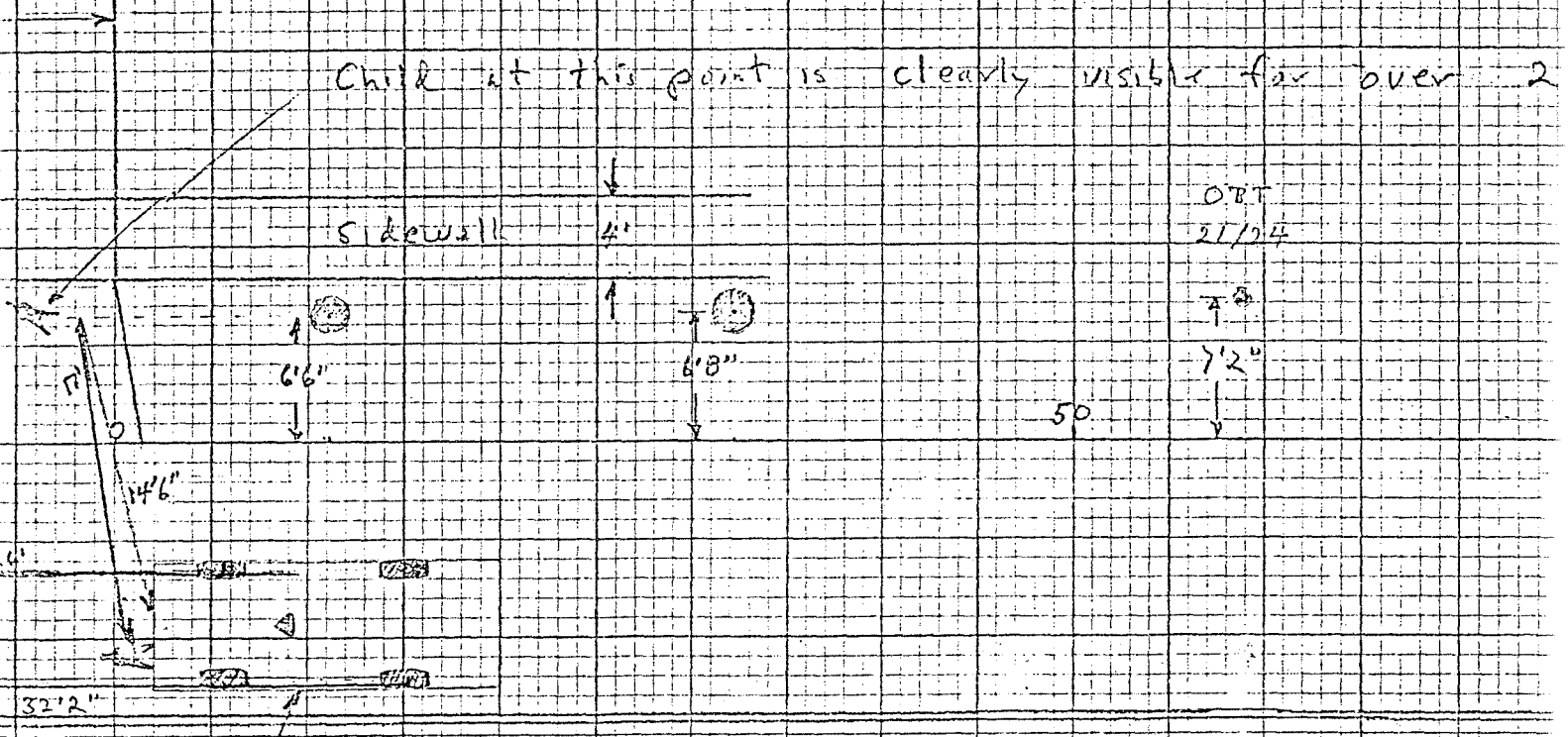
No. XY 1101-SP5




105' 5"
28'

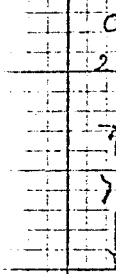


Ford Elite stopped
at the end of its
32'2" skid



Position of Ford Elite
at Impact

sible for over 250' South of the Driveway



OBT
21/23

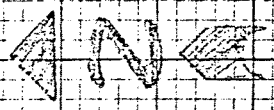
150

200

10550

10550
House

Drive



Scale
1" = 10'

200

250

David L Wheeler

August 4, 1981

OHIO STATE ROUTE 170

NEW MIDDLETOWN ELEMENTARY SCHOOL