**Technical Report Documentation Page**

| 1. Report No. | 2. Government Accession No. | 3. Recipient's Catalog No. |
|---|---|---|
| FHWA/TX-84/ 52 +343-2 | | |

| 4. Title and Subtitle | 5. Report Date |
|---|---|
| TEST AND EVALUATION OF NEIGHBORHOOD MAILBOX | March 1984 |
| | 6. Performing Organization Code |
| | 8. Performing Organization Report No. |
| 7. Author(s) | Research Report 343-2 |
| Wanda L. Campise and Hayes E. Ross, Jr. | |
| 9. Performing Organization Name and Address | 10. Work Unit No. (TRAIS) |
| Texas Transportation Institute<br>Texas A&M University<br>College Station, TX 77843 | 11. Contract or Grant No.<br>Study 2-18-83-343 |
| | 13. Type of Report and Period Covered |
| 12. Sponsoring Agency Name and Address | Final Report<br>August 1983 - March 1984 |
| Texas State Department of Highways and Public Transportation; Transportation Planning Division<br>P. O. Box 5051<br>Austin, TX 78763 | 14. Sponsoring Agency Code |

15. Supplementary Notes

Research performed in cooperation with DOT, FHWA.
Research Title: Improved Design of Lightpoles, Guardrails, and Other Appurtenances

16. Abstract

To expedite mail delivery and to reduce cost, the U.S. Postal Service is installing "neighborhood" mailboxes. Typically, twelve to sixteen boxes are housed in a metal framework and supported by a single vertical post. The vertical post is typically attached to a concrete footing.

There are several n eighborhood mailbox designs in use. The designs vary in terms of structural configuration and height. There is apparently no standard concrete footing in use.

Some of these neighborhood mailboxes have been installed along the shoulders of Texas roadways. Recent crash test studies have demonstrated the hazard of certain mailbox installations. In view of these studies, it was concluded that a typical neighborhood mailbox should be crash tested and evaluated in terms of recommended impact performance standards set forth in NCHRP Report 230.

A typical neighborhood mailbox was subjected to a test with a 1978 Honda at 60 mph. The vehicle exhibited violent rollover which is an unacceptable interaction according to NCHRP Report 230. Further testing and evaluation is recommended to establish safe and acceptable operating conditions for this installation.

| 17. Key Words | 18. Distribution Statement |
|---|---|
| Mailbox(es), Safety, Roadside, Test | No restrictions. This document is available to the public through the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161 |

| 19. Security Classif. (of this report) | 20. Security Classif. (of this page) | 21. No. of Pages | 22. Price |
|---|---|---|---|
| Unclassified | Unclassified | 21 | |

Form DOT F 1700.7 (8-72) Reproduction of completed page authorized

# TEST AND EVALUATION OF NEIGHBORHOOD MAILBOX

by

Wanda L. Campise
Research Associate

and

Hayes E. Ross, Jr.
Research Engineer and Principal Investigator

Research Report No. 343-2

Improved Design of Lightpoles, Guardrails, and Other Appurtenances

Research Study Number 2-18-83-343

Sponsored by

State Department of Highways and Public Transportation
in Cooperation with the
U. S. Department of Transportation
Federal Highway Administration

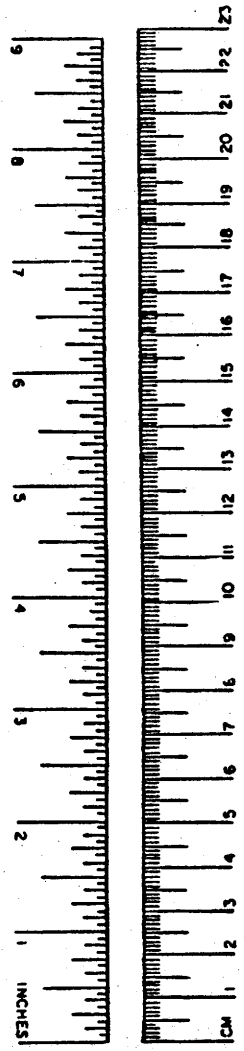
March 1984

TEXAS TRANSPORTATION INSTITUTE
The Texas A&M University System
College Station, Texas 77843

# METRIC CONVERSION FACTORS

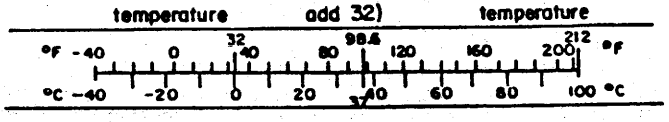
## APPROXIMATE CONVERSIONS FROM METRIC MEASURES

| SYMBOL | WHEN YOU KNOW | MULTIPLY BY | TO FIND | SYMBOL |
|---|---|---|---|---|
| **LENGTH** | | | | |
| in | inches | 2.5 | centimeters | cm |
| ft | feet | 30 | centimeters | cm |
| yd | yards | 0.9 | meters | m |
| mi | miles | 1.6 | kilometers | km |
| **AREA** | | | | |
| $in^2$ | square inches | 6.5 | square centimeters | $cm^2$ |
| $ft^2$ | square feet | 0.09 | square meters | $m^2$ |
| $yd^2$ | square yards | 0.6 | square meters | $m^2$ |
| $mi^2$ | square miles | 2.6 | square kilometers | $km^2$ |
| | acres | 0.4 | hectares | ha |
| **MASS (weight)** | | | | |
| oz | ounces | 28 | grams | g |
| lb | pounds | 0.45 | kilograms | kg |
| | short tons(2000 lb) | 0.9 | tonnes | t |
| **VOLUME** | | | | |
| tsp | teaspoons | 5 | milliliters | ml |
| tbsp | tablespoons | 15 | milliliters | ml |
| fl oz | fluid ounces | 30 | milliliters | ml |
| c | cups | 0.24 | liters | l |
| pt | pints | 0.47 | liters | l |
| qt | quarts | 0.95 | liters | l |
| gal | gallons | 3.8 | liters | l |
| $ft^3$ | cubic feet | 0.03 | cubic meters | $m^3$ |
| $yd^3$ | cubic yards | 0.76 | cubic meters | $m^3$ |
| **TEMPERATURE (exact)** | | | | |
| °F | Fahrenheit temperature | 5/9 (after subtracting 32) | Celsius temperature | °C |




## APPROXIMATE CONVERSIONS FROM METRIC MEASURES

| SYMBOL | WHEN YOU KNOW | MULTIPLY BY | TO FIND | SYMBOL |
|---|---|---|---|---|
| **LENGTH** | | | | |
| mm | millimeters | 0.04 | inches | in |
| cm | centimeters | 0.4 | inches | in |
| m | meters | 3.3 | feet | ft |
| m | meters | 1.1 | yards | yd |
| km | kilometers | 0.6 | miles | mi |
| **AREA** | | | | |
| $cm^2$ | square centimeters | 0.16 | square inches | $in^2$ |
| $m^2$ | square meters | 1.2 | square yards | $yd^2$ |
| $km^2$ | square kilometers | 0.4 | square miles | $mi^2$ |
| ha | hectares(10,000 $m^2$) | 2.5 | acres | |
| **MASS (weight)** | | | | |
| g | grams | 0.035 | ounces | oz |
| kg | kilograms | 2.2 | pounds | lb |
| t | tonnes (1000 kg) | 1.1 | short tons | |
| **VOLUME** | | | | |
| ml | milliliters | 8.03 | fluid ounces | fl oz |
| l | liters | 2.1 | pints | pt |
| l | liters | 1.06 | quarts | qt |
| l | liters | 0.26 | gallons | gal |
| $m^3$ | cubic meters | 36 | cubic feet | $ft^3$ |
| $m^3$ | cubic meters | 1.3 | cubic yards | $yd^3$ |
| **TEMPERATURE (exact)** | | | | |
| °C | Celsius temperature | 9/5 (then add 32) | Fahrenheit temperature | °F |



## DISCLAIMER

The contents of this report reflect the views of the authors who are responsible for the opinions, findings, and conclusions presented herein. The contents do not necessarily reflect the official views or policies of the Federal Highway Administration. This report does not constitute a standard, specification, or regulation.

TABLE OF CONTENTS

LIST OF FIGURES

## Introduction

To expedite mail delivery and to reduce cost, the U. S. Postal Service is installing "neighborhood" mailboxes. Typically, twelve to sixteen boxes are housed in a metal framework and supported by a single vertical post. The vertical post is typically attached to a concrete footing.

There are several neighborhood mailbox designs in use. The designs vary in terms of structural configuration and height. There is apparently no standard concrete footing in use.

Some of these neighborhood mailboxes have been installed along the shoulders of Texas roadways. Recent crash test studies have demonstrated the hazard of certain mailbox installations (1, 2, 3 and 4). In view of these studies, it was concluded that a typical neighborhood mailbox should be crash tested and evaluated in terms of recommended impact performance standards (5).

## Test Installation

An Auth No. 452 neighborhood mailbox, manufactured by Auth Electric Co., Deer Park, N. Y., was set up for Test 2343-1 according to typical field installation procedures. The sixteen compartment mailbox unit was supported by a 3-1/2" x 3-1/2" structural steel tube. Steel plates, 12" x 12" x 3/16", welded to the tube at the top and bottom, were used to attach the boxes to the tube and to anchor the tube to the concrete foundation. The lower anchor plate was connected to the concrete foundation with four 1/2" diameter J-bolts. Details of the mailbox and base are shown in Figures 1 and 2. Photographs of the test installation before testing are presented in Figures 3 and 4. Two of the lower compartments were taped closed because the locks were missing.

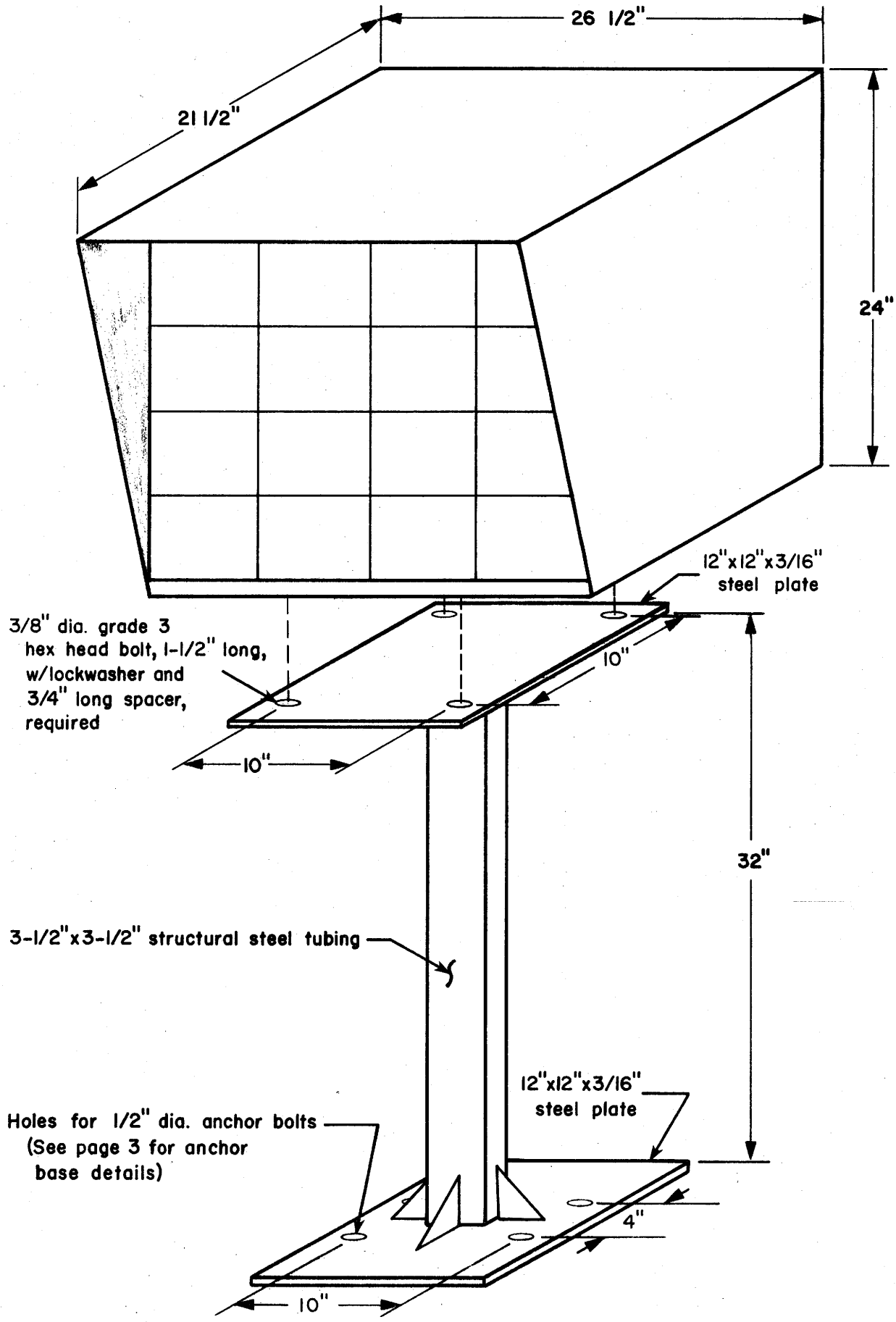



Figure 1. Details of Auth No. 452 Mailbox.

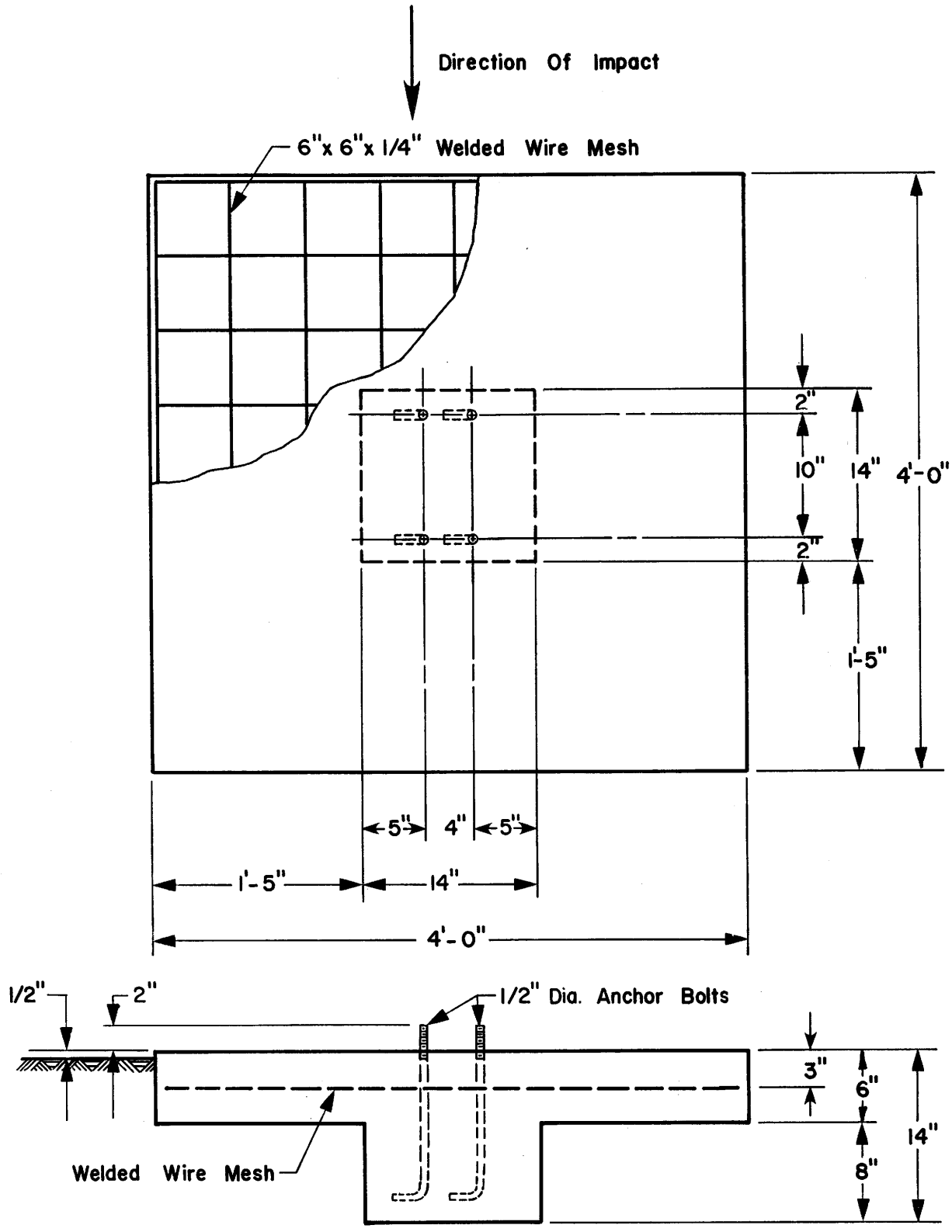



Figure 2. Details of Base.

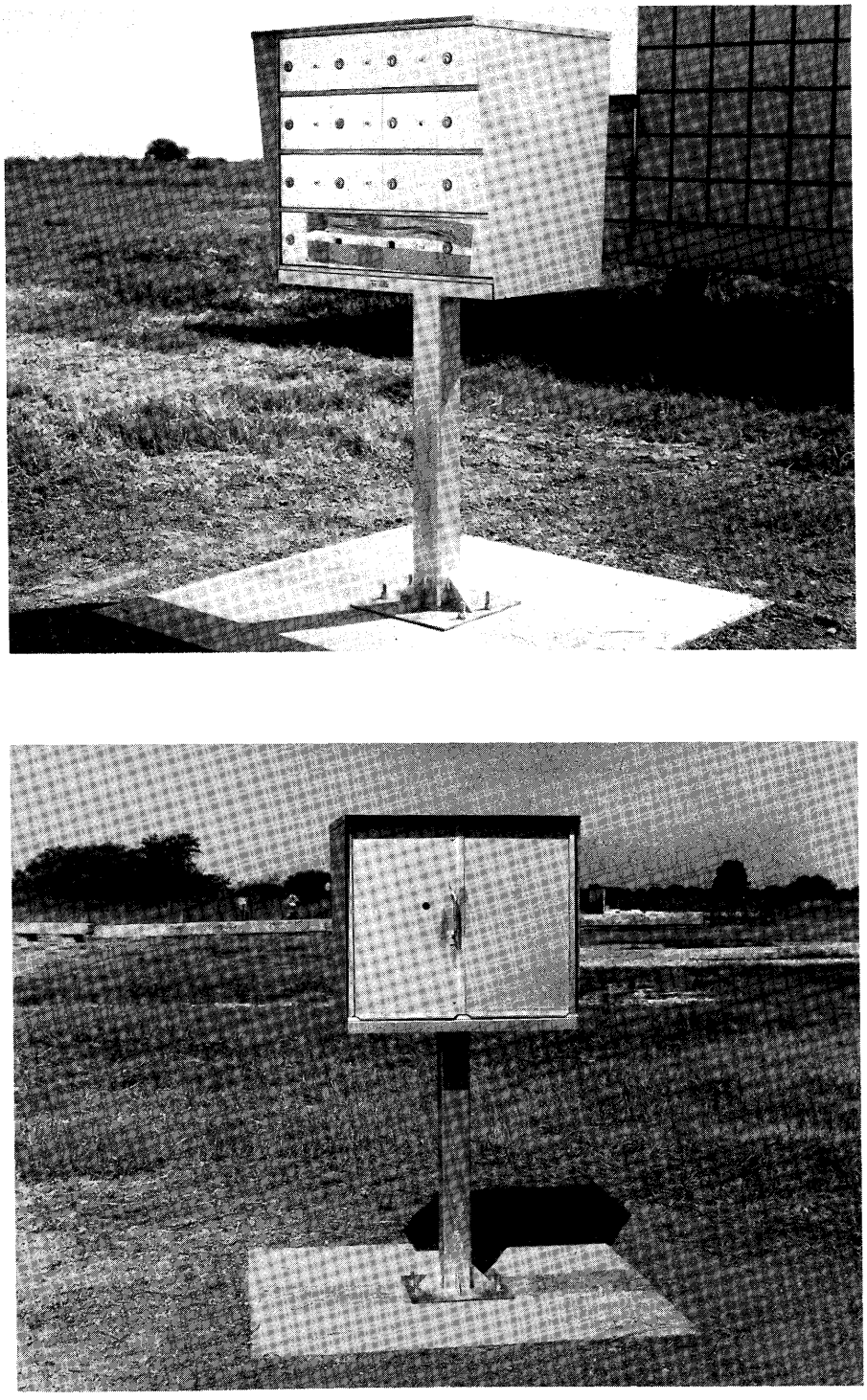


Figure 3 . Test Installation Before Test 2343-1.

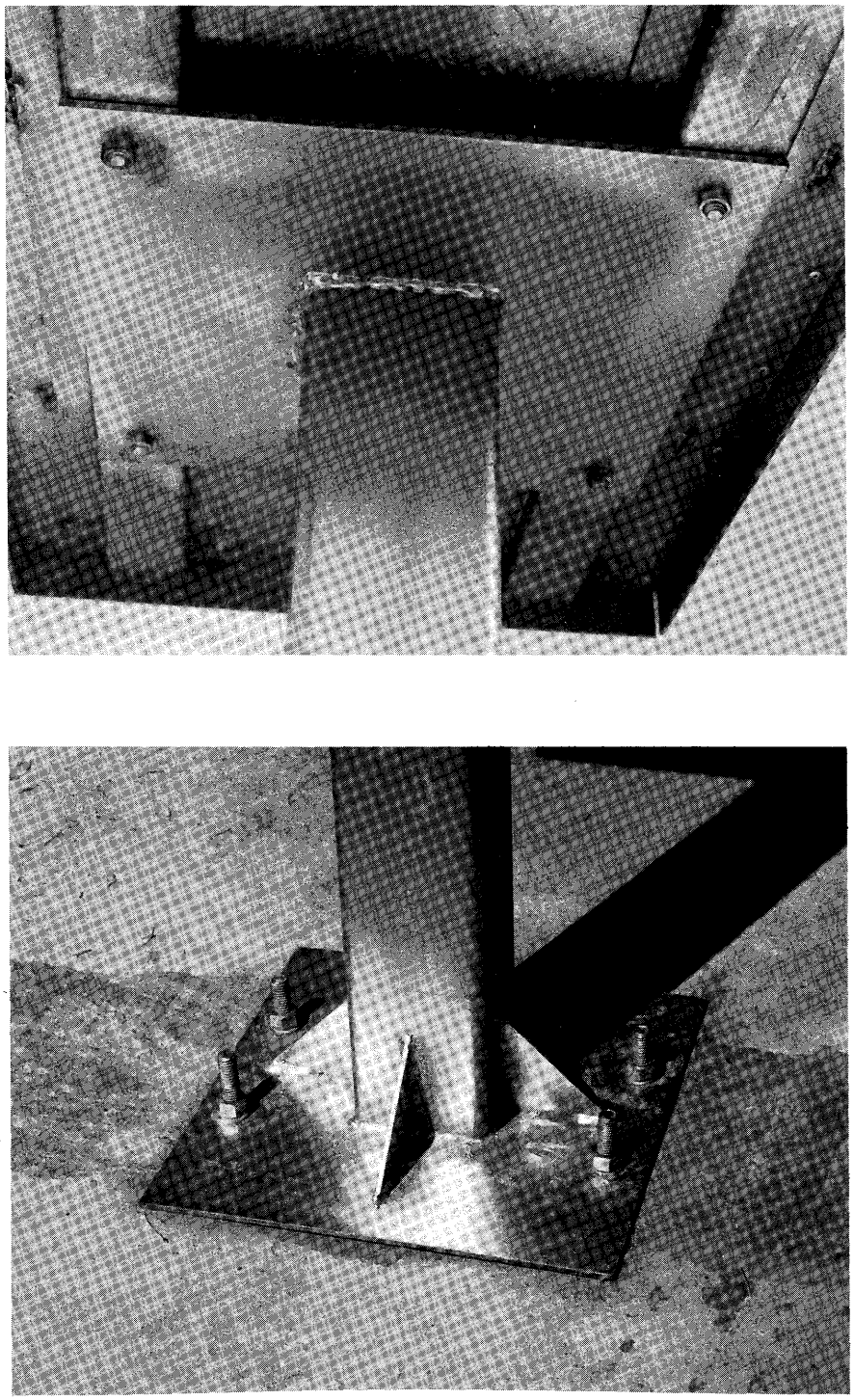


Figure 4. Upper and Lower Plates of Mailbox Support.

## Instrumentation and Data Analysis

The vehicle was equipped with triaxial accelerometers mounted near the center of gravity. Yaw, pitch, and roll were sensed by on-board gyroscopic instruments. The electronic signals were telemetered to a base station for recording on magnetic tape and for display on a real-time strip chart. Provision was made for transmission of calibration signals before and after the test, and an accurate time reference signal was simultaneously recorded with the data.

Tape switches near the impact area were actuated by the vehicle to indicate the elapsed time over a known distance to provide a quick check of impact speed. The initial contact also produced an "event" mark on the data record to establish the instant of impact.

Data from the electronic transducers were digitized, using a Southwest Technical Products 6800 micro-computer, for analysis and evaluation of performance. Several computer programs were used to process various types of data from the test vehicle.

Still and motion photography were used to document the test, to obtain time-displacement data, and to observe phenomena occurring during the impact. Still photography was used to record conditions of the test vehicle and mailbox installation before and after the test. Motion photography was used to record the collision event.

## Test Description

A 1978 Honda CVCC was directed into the mailbox at 62.3 mph (100.2 kph). Test inertia mass of the vehicle was 1,775 lbs (806 kg) and its gross static mass was 1,945 lbs (883 kg). The vehicle was free-wheeling and unrestrained at impact. Impact point was 15 in. to the left of the

vehicle centerline. Relative positions of the vehicle and mailbox are shown in Figure 5.

The mailbox compartments began to break away from the upper plate at 0.005 sec after impact. The anchor plate began pulling up at about 0.010 sec. As evidence in Figure 6 shows the downstream anchor bolts sheared off at the slab while the upstream anchor bolts pulled out of the anchor plate. The mailboxes hit the windshield at 0.046 sec after impact. The vehicle then rode over the post and lost contact at 0.195 sec with vehicle speed of 51.7 mph (83.2 kph). The vehicle subsequently rolled six complete revolutions.

The mailbox unit came completely apart during the test and was scattered as is shown in Figure 6. Damage to the vehicle was extensive due to rollover as depicted in Figure 7.

## Results and Evaluation

A summary of test data is provided in Figure 8. Sequential photographs are presented in Figure 9. Longitudinal vehicle acceleration is shown in Figure 10 and yaw, pitch and roll displacements are shown in Figure 11.

The maximum 50 msec longitudinal acceleration was -7.4 g. Change in vehicle velocity at 0.195 sec (loss of contact) was 10.6 mph (17.0 kph) and change in vehicle momentum was 938 lb-sec.

NCHRP Report 230 (5) contains recommended evaluation criteria for the impact performance of sign supports and places limits on these criteria for acceptable performance. It is generally felt that mailbox supports should meet these same criteria. In view of the violent multiple rollovers that occurred in the test, it is clear that the subject mailbox installation did

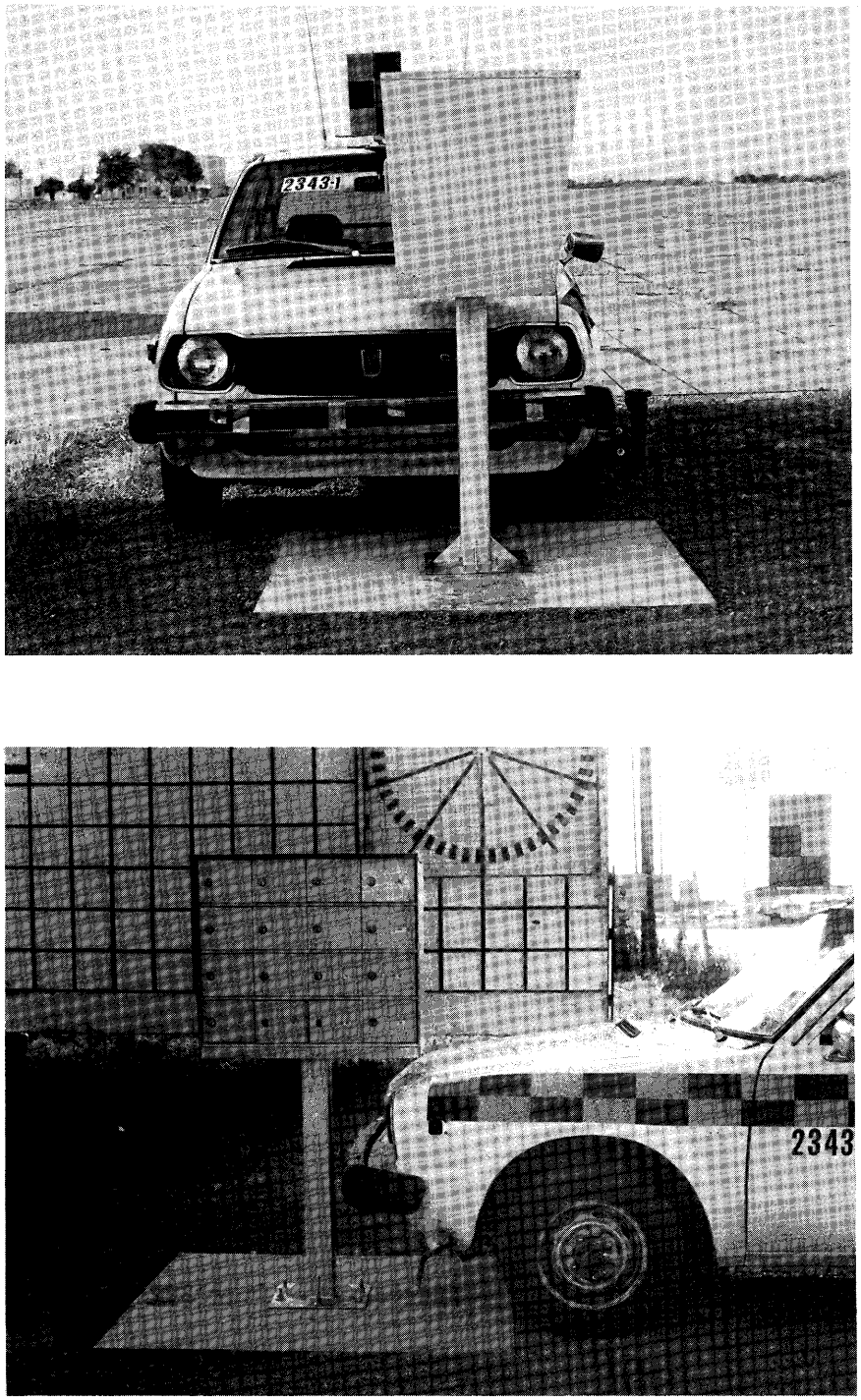



Figure 5. Relative Position of Vehicle and Mailbox.

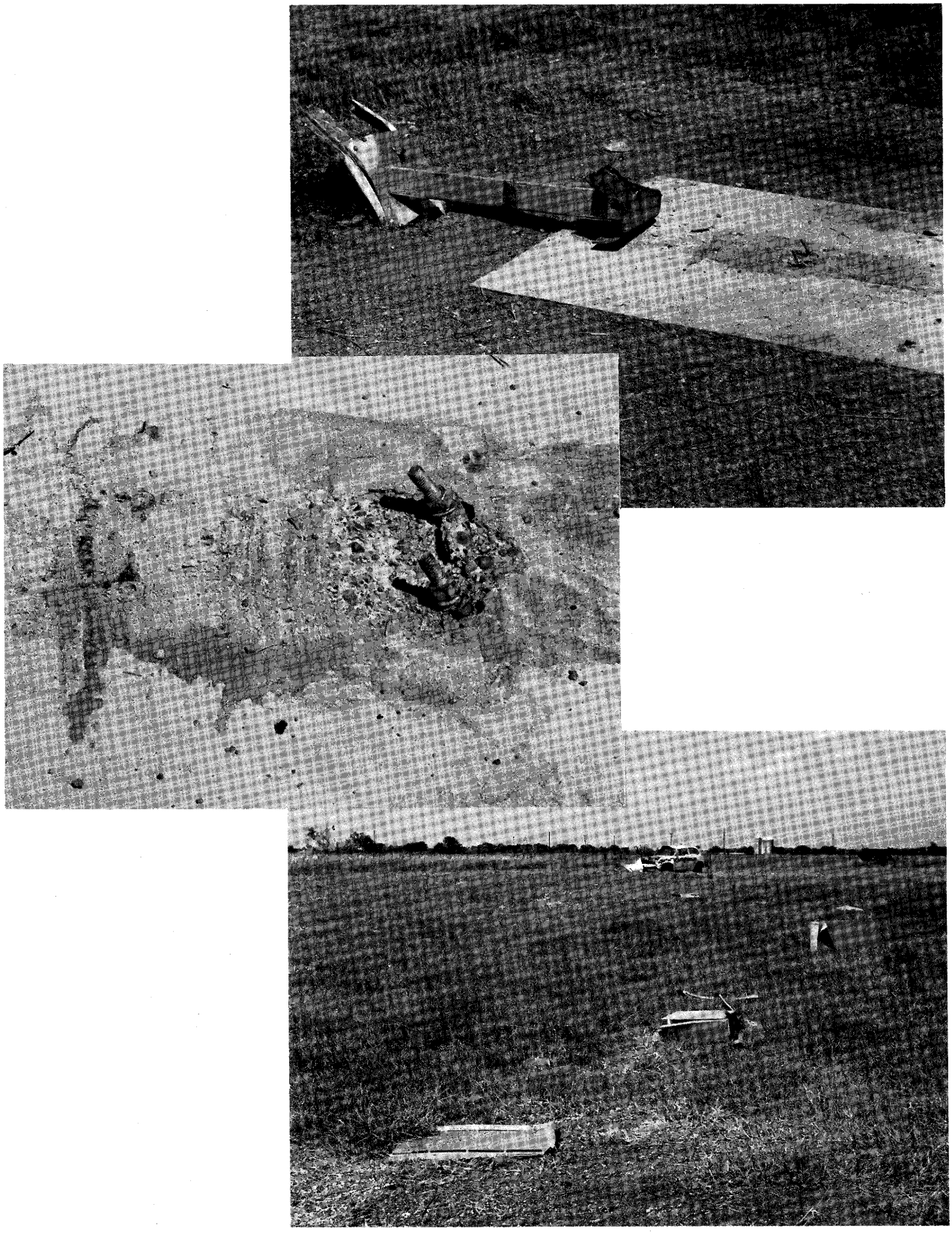


Figure 6. Test Site After Test 2343-1.


Figure 7. Vehicle Before and After Test 2343-1.

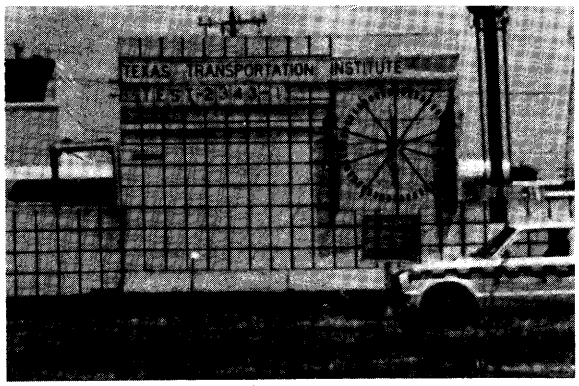

0.000 sec | 0.071 sec | 0.142 sec | 0.213 sec (Vehicle subsequently rolled six complete revolutions)

11

| | |
|---|---|
| Test No. | 2343-1 |
| Date | 8/30/83 |
| Test Installation. | Auth No. 452 16-Compartment Neighborhood Mailbox |
| Vehicle | 1978 Honda CVCC |
| Vehicle Weight | |
| Test Inertia | 1775 lbs (806 kg) |
| Gross Static. | 1945 lbs (883 kg) |
| Vehicle Damage Classification | |
| TAD | 12-R&T-6 |
| SAE | 12FYA09 |

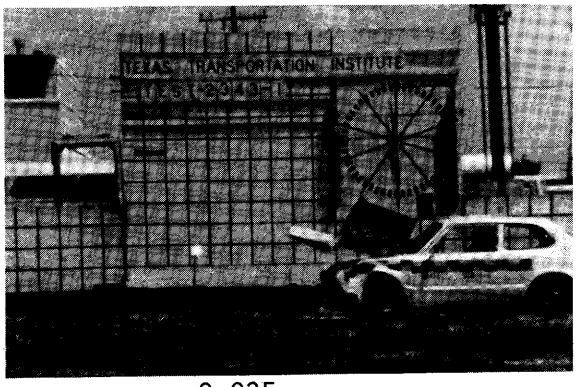
| | |
|---|---|
| Impact Speed. | 62.3 mph (100.2 kph) |
| Exit Speed at loss of contact | 51.7 mph (83.2 kph) |
| Change in Velocity. | 10.6 mph (17.0 kph) |
| Change in Momentum mph. | 938 lb-sec |
| Vehicle Accelerations (Max. 0.050 sec Avg) | |
| Longitudinal | -7.4 g |
| Lateral. | -1.4 g |
| Occupant Impact Velocity | |
| Longitudinal | 16.04 fps (4.89 m/s) |
| Lateral. | None |
| Occupant Ridedown Accelerations | |
| Longitudinal | -2.41 g |
| Lateral | No Contact |

Figure 8. Data Summary.



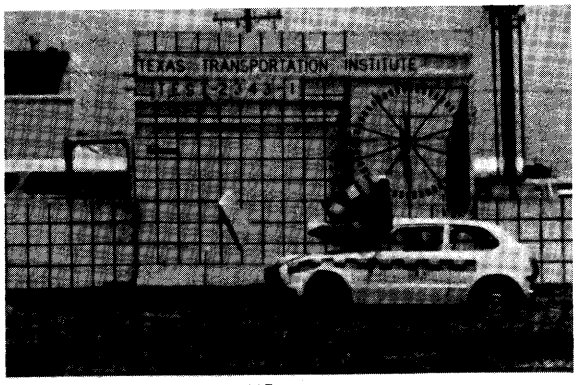

0.000 sec


0.142 sec

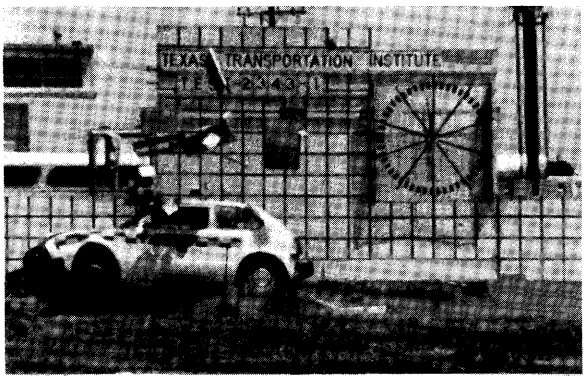



0.035 sec

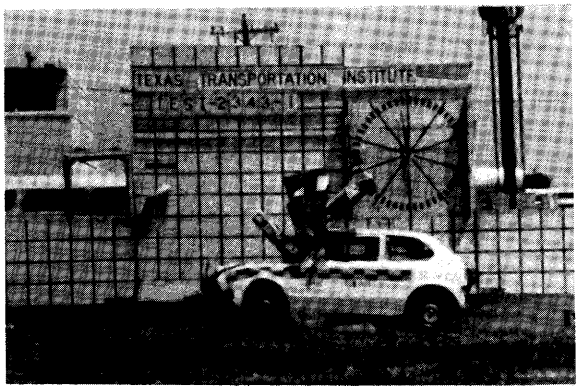

0.177 sec



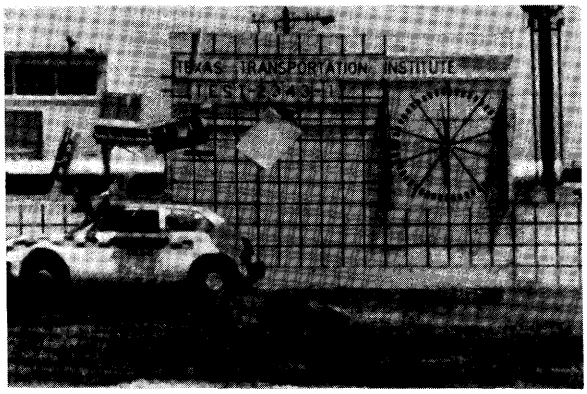

0.071 sec




0.213 sec




0.106 sec




0.248 sec

Figure 9. Sequential Photographs for Test 2343-1.

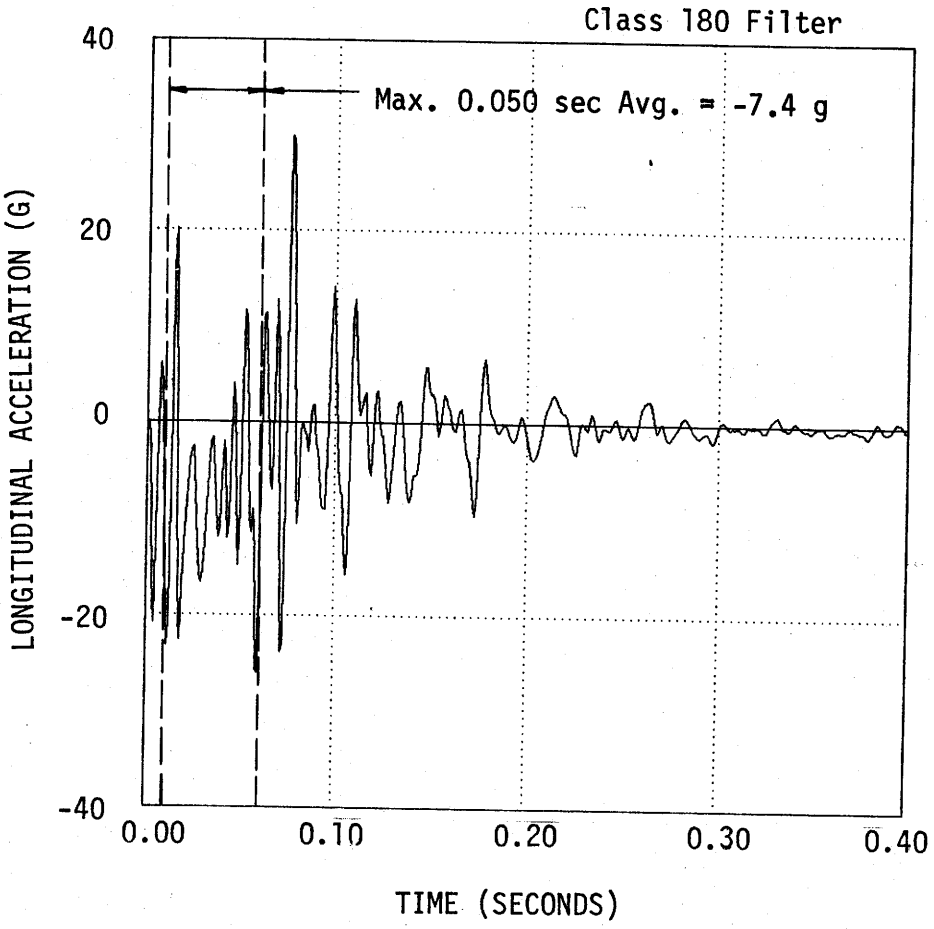
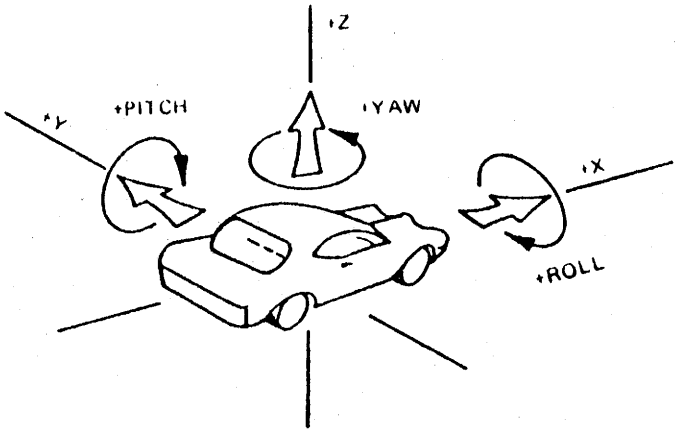



Figure 10. Vehicle Longitudinal Accelerometer Trace for Test 2343-1.




Axes are vehicle fixed.
Sequence for determining orientation is:

1. Yaw
2. Pitch
3. Roll

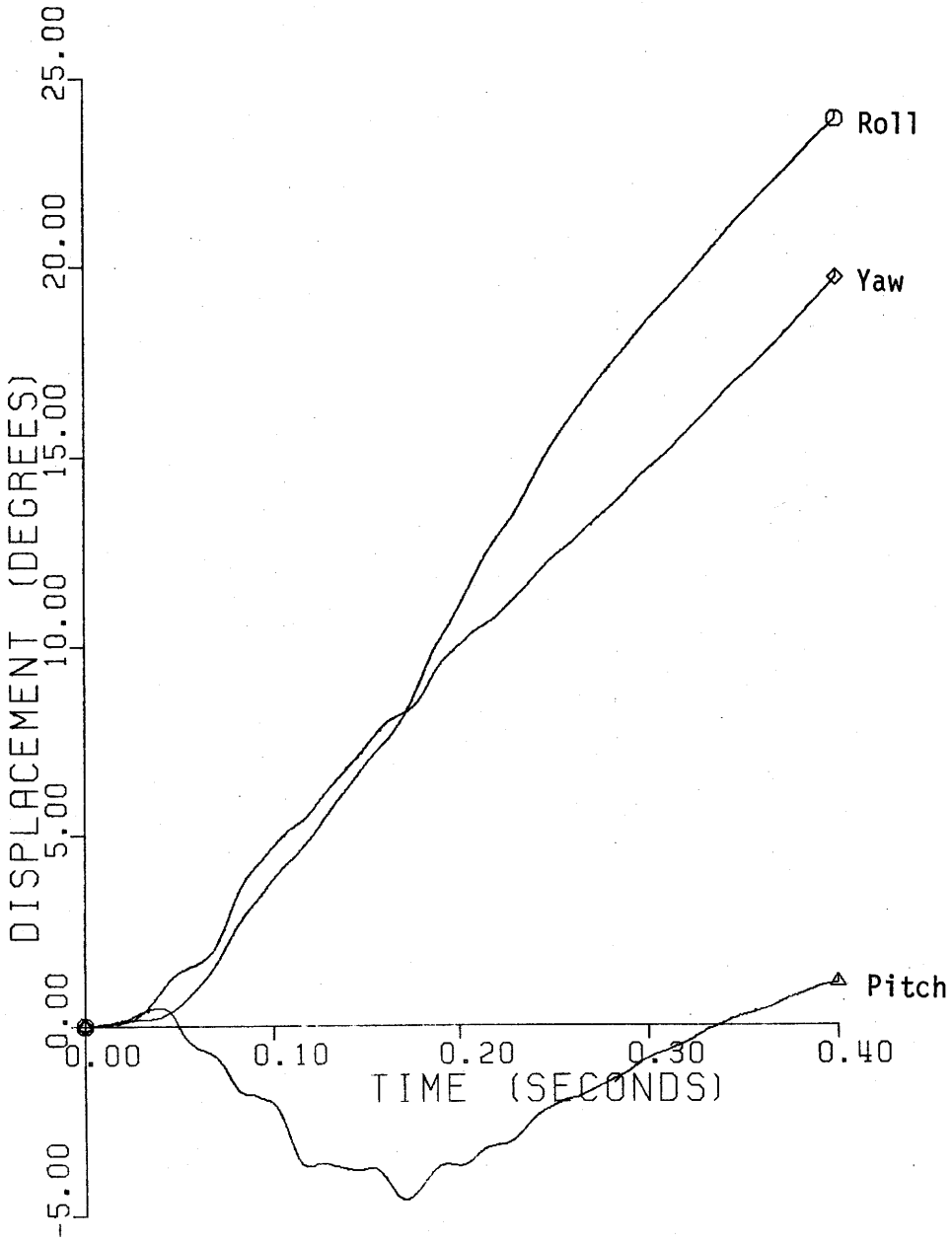



Figure 11. Vehicle Angular Displacements for Test 2343-1.

not meet the recommended performance criteria (5). It is therefore concluded that this mailbox installation and similar installations should not be permitted within the clear zone of high-speed roadways. Further testing and evaluation would be necessary to establish safe and acceptable operating conditions for the installation on other than high-speed roadways. Pending such investigation, these installations should also be considered undesirable within the clear zone of all roadways.

Impact performance of the installation can probably be improved by the inclusion of breakaway features such as a slipbase, breakaway welds at the post-to-base plate connection, a weakened support, etc. However, any such feature should be fully analyzed and crash tested prior to implementation.

## REFERENCES


1. Ross, Hayes E., Jr., and Walker, Kenneth C., "Crash Tests of Rural Mailbox Installations", Report No. FHWA/RD-80/504, Federal Highway Administration, Office of Development, Washington, D. C., May 1980.

2. Ross, Hayes E., Jr., Miller, James W., and Sicking, Dean L., "Test and Evaluation with Rural Mailbox Supports", Report Number 627-1, Texas State Department of Highways and Public Transportation, October 1980.

3. Ross, Hayes E., Jr., and O'Reilly, Patrick L., "Test and Evaluation of Rural Mailbox Installations", Research Report 0982-1, Texas Transportation Institute, Texas A&M University, August 1981.

4. Hall, Patricia R., and Ross, Hayes E., Jr., "Test and Evaluation of Rural Mailbox Supports", Research Report 2370-1F, Texas Transportation Institute, Texas A&M University, May 1983.

5. Michie, Jarvis D., "Recommended Procedures for the Safety Performance Evaluation of Highway Appurtenances", National Cooperative Highway Research Program Report 230, Transportation Research Board, Washington, D.C., March 1981.