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16. Abstract

This report describes a study of motorcycle handling qualities, involving both transient and steady-state directional stability and control properties, and the development of test procedures suitable for the evaluation of these properties. The approach used in the study consisted of the application of both experimental (with one machine) and simulation techniques (with six motorcycles) for the identification of the significant physical properties and performance measures with which to characterize the machine's accident avoidance capabilities. Emphasis was placed on evaluating the input-output relationships for the group of motorcycles in a series of constant speed-variable radius (hence, variable lateral acceleration) runs covering a range of cornering capability which encompasses normal operation. The primary test used for evaluating transient maneuvering and rider-vehicle interaction characteristics was the single lane change. Supporting activity involved testing of nine motorcycle tires in eighteen configurations to obtain side force performance data developed through slip angle and inclination angle; measurements of the physical characteristics, including all pertinent dimensions and masses and moments of inertia of major assemblies, for all machines; development of a special-purpose lightweight instrumentation system employing telemetering techniques (enabling the measurement of such variables as applied steering torque and rider lean angle); and the application of simplified analytical models of motorcycle response to provide some insight regarding motorcycle stability and control. Results of this initial handling

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16. Abstract - Cont'd.

study indicate that substantial differences in the values of several performance parameters (for example, steady state control gains) exist among various motorcycle designs and that tire performance characteristics play a very significant role in the determination of these parameters. It is concluded that the results of the study provide a firm foundation of information on several important aspects of motorcycle behavior and have identified special areas where additional study is required.

INTRODUCTION

This volume of the report contains several appendices which provide additional details of information on subjects discussed in the technical report, Vol. I. Appendix A contains descriptions of the two detailed test procedures which were used in the study. Appendix B is a collection of all the printed and plotted output from the tire performance measurement tests performed at the Calspan Tire Research Facility. Appendix C consists of a full set of machine-plotted responses of the principal input and output quantities from the simulation study. Appendix D contains data from the full-scale tests with the Honda CB 360 motorcycle including typical raw data time histories for both procedures.

Appendix A

This appendix includes the detailed procedures for the vehicle response and handling tests. Section A-1 describes the constant speed directional control test; Section A-2 outlines the lane change procedures. These procedures were used for the full-scale test work performed as part of this program and have proven to be practical methods but they should still be viewed as initial versions until they have been applied to a large number of vehicles and minor modifications have been incorporated.

A-1

Test Procedure for Measuring the Directional Control Properties of Motorcycles

1. Scope

This test procedure describes a method for measuring the principal control response characteristics of motorcycles. It is chiefly concerned with the steady state properties but may also be used to obtain transient response information.

2. Objectives

The objectives of this procedure are:

(a) To measure the lateral/directional performance characteristics of motorcycles at constant speed conditions.

(b) To provide a data base for computation of the motorcycle's steady state control gains.

3. Introduction

A basic concept for evaluating the stability and control properties of a vehicle is the determination of its steady-state response parameters - the relationships between a control input and the resultant motion after the transient has effectively decayed. This approach has been successfully used with the automobile and is being applied to the motorcycle in this procedure. In the case of the automobile, only the position control responses (i.e., the effects of a steering wheel displacement) have been of general interest; the situation is not as simple with the motorcycle. In its case, the position control mode is joined by a torque control mode (i.e., applied steering torque is the input of interest) and rider lean control mode (in which the rider's position relative to the machine produces control inputs). The problem is further complicated with the motorcycle because the driver is important to the stability of the system (unlike the automobile) as well as its control. A comparatively large number of response parameters are therefore required for

defining performance, and care must be taken to separate the effects of the different inputs. This procedure describes an experimental technique for measuring the variables of interest and methods for treating the resultant data to compute the principal response parameters.

4. Instrumentation

The following measurements are minimum requirements for this test procedure:

Vehicle velocity (including visual readout)
Yaw rate
Roll Angle
Steering displacement
Applied steering torque
Rider lean angle (relative to vehicle frame)

Optional equipment (for data checks and testing convenience) includes:

Lateral accelerometer
Visual readouts of input variables

It is important of course to minimize the weight of the instrumentation and related equipment, especially with lightweight machines. In any case, the added weight should be determined and an effort should be made to locate the gear so as to affect moments of inertia and centers-of-gravity locations minimally.

5. Test Area Requirements

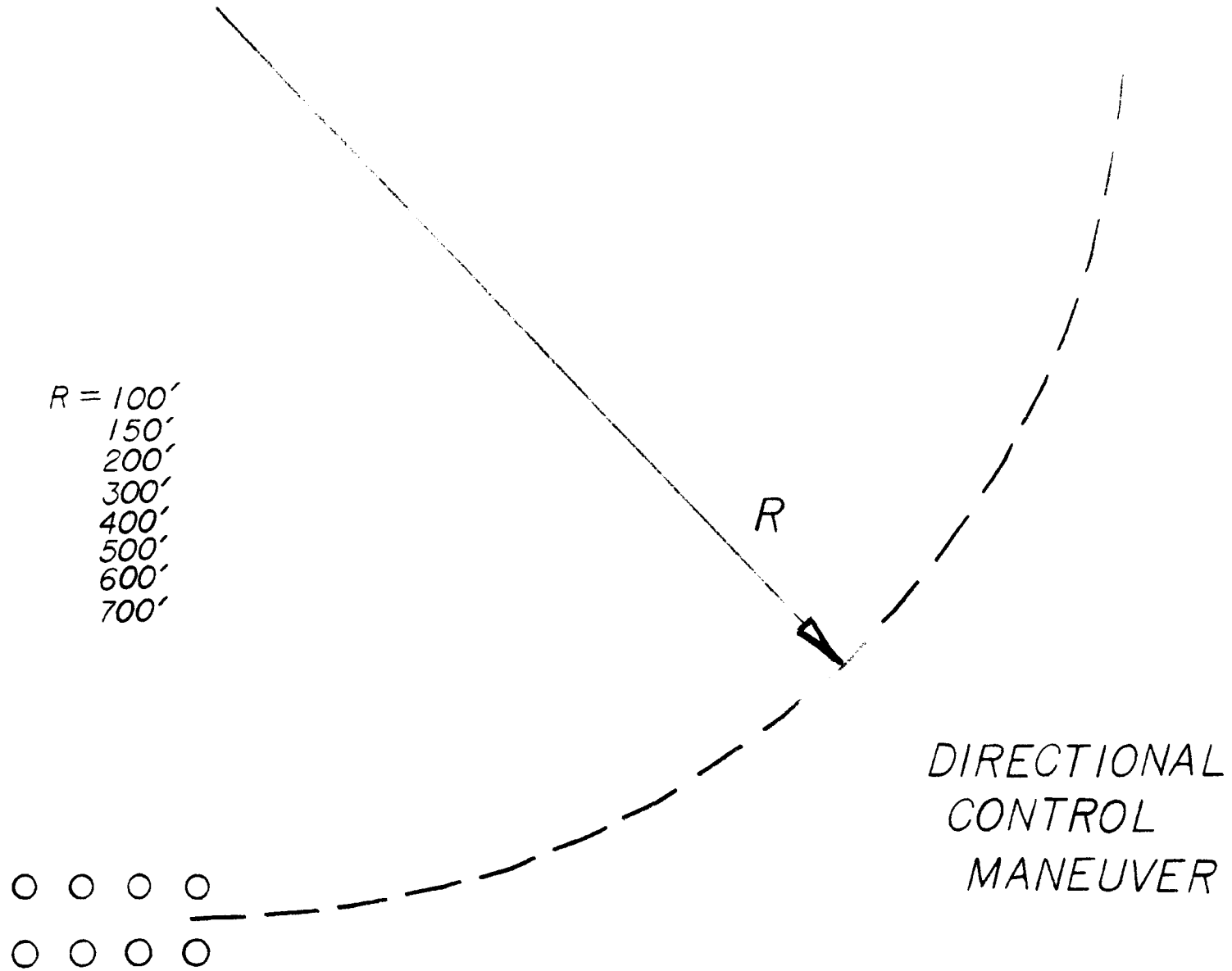
The size and shape of a test area required for performing to this procedure will depend on the selected operating speed and range of lateral accelerations to be investigated. The site must allow for build-up and stabilization of test speed, development of steady state cornering (including the transient and, preferably, several seconds of steady-state operation), and a way for exiting from the test area or braking without endangerment. Although not essential, paths of various radii emanating from an initial straight section as shown in the sketch provide the test rider with excellent references for performing this test. A series of arcs from 200 to 700 ft. radius covers a lateral acceleration range from less than .2g to over .5g at 40 mph.

6. Procedure

1. At standstill on a flat level surface with the test vehicle in an upright position and with front wheel at zero displacement, apply calibration signals to all data channels. Do not turn off instrumentation.

2. Accelerate test vehicle to nominal test speed on a straight course. Allow for sufficient run-up distance to assure development of steady state conditions.

3. Apply first pre-determined value of steer angle and allow test vehicle to reach and hold steady state cornering conditions for at least two seconds. (In some vehicles with high position control gain, it may be found that pre-selection of an approximate path facilitates performance). The rider should make every effort to attempt to be in the X-Z plane of the motorcycle during steady state conditions.


R = 100'
150'
200'
300'
400'
500'
600'
700'
R
DIRECTIONAL
CONTROL
MANEUVER

4. Bring test vehicle to a stop and turn off instrumentation.

5. Repeat steps 2 through 4 (being sure to start instrumentation prior to each run) for a series of increments of steering angle to cover as wide a range of lateral acceleration as is deemed safe and prudent. At least five increments should be used.

6. Repeat steps 2 through 5 for steering inputs of opposite sense.

The procedure may also be used to determine rider lean control performance parameters. In fact, it is essential that measurements of this effect be made to correct for possible biases in the data from steps 2 through 6.

7. At a low value of lateral acceleration (not necessarily specified), bring the test vehicle to steady state conditions with the rider leaning into the turn to the maximum angle deemed to be safe and prudent, repeating in effect steps 2 through 4.

8. Repeat step 7 with the rider leaning out of the turn.

9. Repeat steps 7 and 8 for a series of lateral accelerations within limits considered to be safe.

10. After completing all runs, apply calibration signals to all data channels.

7. Data Analysis

1. Plot the following two-variable curves from steady state test data -

- lateral acceleration vs. steer angle
- lateral acceleration vs. applied steer torques
- lateral acceleration vs. rider lean angle
- lateral acceleration vs. vehicle roll angle

In reducing the test data, care must be taken to correct the measurements in computing lateral acceleration -

$$a_{y\ actual} = a_{y\ measured} - g \tan \phi = V\ r/\cos \phi$$

2. Using best estimates for the slopes of the curves from the plots identified above, compute the following performance parameters -

- position control lateral acceleration gain
- torque control lateral acceleration gain
- lean control lateral acceleration gain
- understeer factor

A-2

Test Procedure for Measuring the Transient Handling Properties of Motorcycles in a Lane Change

1. Scope

This test procedure describes a method for measuring the performance characteristics of motorcycles in a single lane change maneuver. It may also be used for evaluating rider skill effects on performance in a transient maneuver. Techniques are described for investigating both sub-limit and limit behavior over a range of operating speed.

2. Objectives

The objectives of this procedure are:

(a) To measure the input-output characteristics of motorcycles in a transient maneuver at nominally constant speed.

(b) To obtain information on rider requirements for performing a lane change.

(c) To identify possible problem areas in the transient handling qualities of the test motorcycle.

3. Introduction

The development of test procedures suitable for obtaining objective measures of vehicle performance has received considerable attention in recent years. In the case of the automobile, emphasis has been placed on response tests which yield more-or-less direct measurements of certain motion variables (e.g., yaw rate, lateral acceleration) in relation to known steering control inputs. Various task performance tests have been tried, with mixed success due in part to driver variability effects. This problem is not less complicated for motorcycles. Indeed, the fact that the rider-motorcycle system depends on the rider for stability as well as control introduces additional dimensions into the problem. On the other hand, this dependence defines the approach -

there is really no alternative to the inclusion of the rider in motorcycle performance evaluations. In the test procedure outlined below, a fundamental path change maneuver is employed to obtain measures of input requirements (steering displacement and applied torque and rider lean motions) and output behavior (transient lateral-directional motions and steady-state lateral displacement) at nominally constant speed over a fixed path geometry course.

4. Instrumentation

The following measurements are minimum requirements for this test procedure:

Vehicle velocity (including visual readout)
Yaw rate
Roll Angle
Steering displacement
Applied steering torque
Rider lean angle (relative to vehicle frame)

Optional equipment (for data checks and testing convenience) includes:

Lateral accelerometer
Visual readouts of input variables

It is important of course to minimize the weight of the instrumentation and related equipment, especially with lightweight machines. In any case, the added weight should be determined and an effort should be made to locate the gear so as to affect moments of inertia and centers-of-gravity locations minimally.

5. Test Course Geometry

The test is to be performed over a course laid out as shown in the sketch. All dimensions may be varied according to the purposes of the test (speed range of interest, rider skill level, road condition) but experience with the procedure indicates that the values given in Table 1 represent reasonably challenging conditions for an experienced rider. In any case, it is recommended that the values for a, b, and Δy be fixed at the given levels to ensure good path definition and to simulate a real-world lateral displacement requirement.

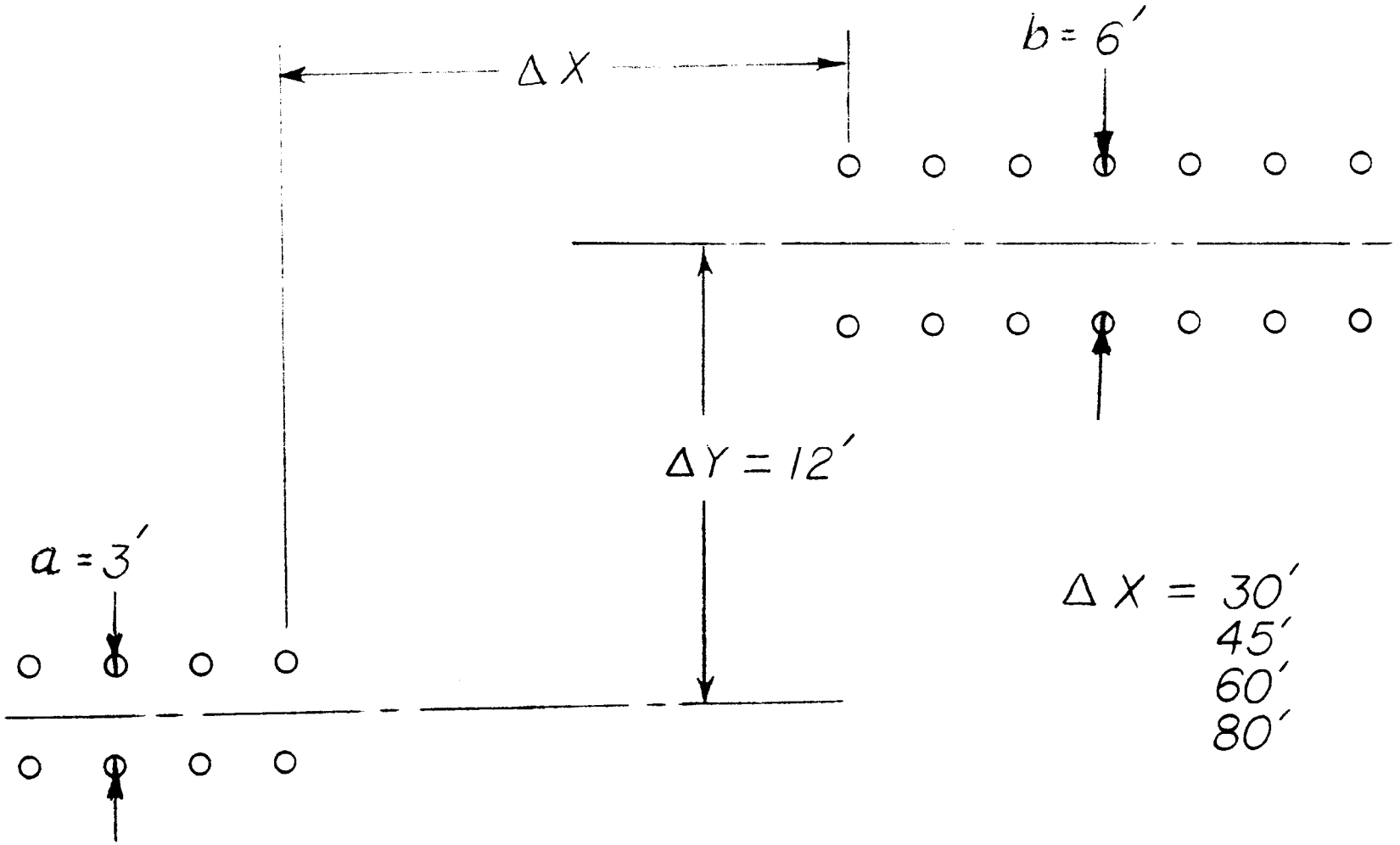
TABLE 1

TEST COURSE DIMENSIONS

Nominal* Speed (mph)	Dimensions (feet)				
	a	b	Δx	Δy	cone spacing
20	3	6	30	12	6
30	3	6	45	12	6
40	3	6	60	12	6
50	3	6	80	12	6

It will be observed that these values represent control input at a frequency of about 1 Hz (i.e., this is the frequency of the fundamental steering doublet required for a lane change).

*Test speeds may be increased to a maximum value at which the maneuver may be successfully performed. This speed is called proof speed.



LANE CHANGE MANEUVER

6. Procedure

1. At standstill on a flat level surface and the test vehicle in an upright position with front wheel at zero steer angle, apply calibration signals to all data channels.

2. Accelerate vehicle to desired speed and perform the maneuver. Allow for sufficient run-up distance to assure development of desired test speed. Tightening the throttle cable drag screw will aid in maintaining a constant speed through the maneuver. Record success-failure performance and identify any violated lane markers after coming to a stop.

3. Continue to repeat step 2, incrementing speed on each run until failure occurs or until desired proof speed has been achieved. Perform three runs at this condition.

4. After completing the series of runs, reapply calibration signals.

7. Data Analysis

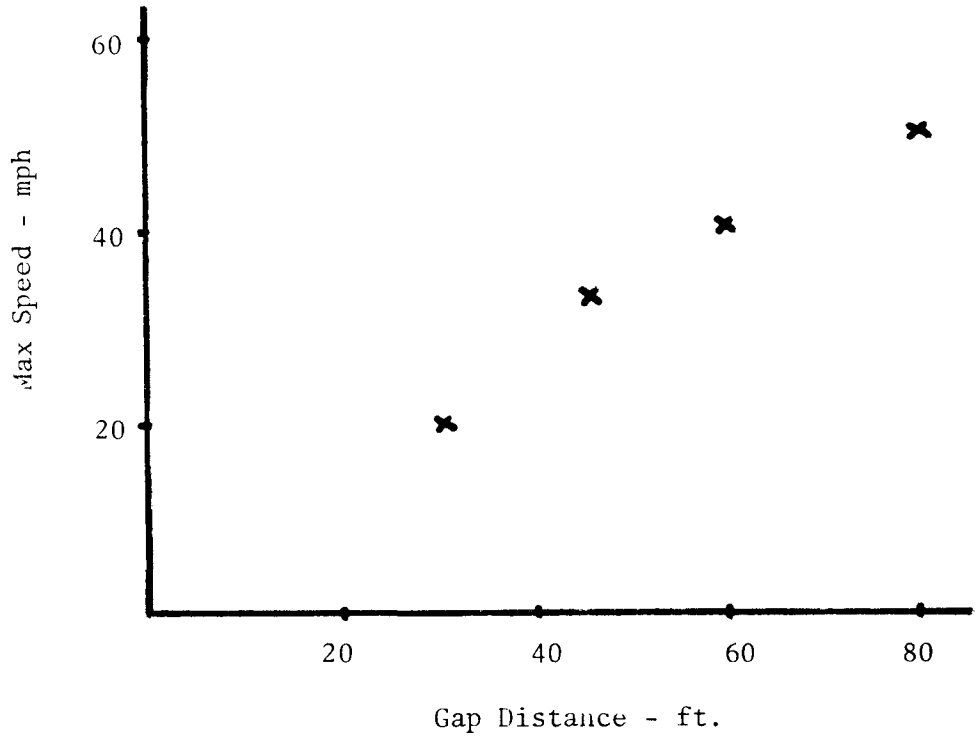
Data treatment will depend on the specific purposes for which the procedure has been applied--comparative vehicle evaluations, definition of rider input requirements for particular conditions, definition of maximum transient characteristics, etc. In all cases, the following should be noted:

1. Course geometry
2. Maximum speed at which the maneuver could be successfully performed
3. Input requirements:
   - maximum applied torque
   - maximum yaw rate achieved

- maximum steering rate

4. Failure pattern (identify which cones were hit or where lane violations occurred).

For test series in which the longitudinal gap is varied to obtain a performance profile of the test vehicle in this type of maneuver, it is convenient to plot results in the form of the example shown below. This method of presentation facilitates vehicle comparisons by giving a graphical portrait of the variable of interest across a range of operating conditions.



Appendix B

Tire Test Data

This appendix contains detailed data on the performance characteristics of tires used with each of the motorcycles which were studied in this program. For each tire configuration, the information consists of:

1. Tire description, test identification number, and the condition at which it was tested. These data are collected in Table B-1.

2. Machine-generated best fit carpet plots of side force capability as a function of slip angle and inclination angle at test conditions (normal load and inflation pressure).

3. Data listings of performance characteristics over the ranges of the independent test variables.

A brief discussion to facilitate interpretation of the information may be useful at this point. The data shown in the carpet plots give side force (SF) over a range of slip angles (α) from +1 degree to -8 degrees and a range of inclination (camber) angles (γ) from zero to +28 degrees. The actual test points were used to define best least-squares fit curves for the two variables--second order on α and second order on γ. All data were taken at a speed of 30 mph under free-rolling (non-driven) conditions on a dry high friction coefficient surface.

The listed data augment the information given in the side force plots. Each primary listing (odd-numbered tables) gives the measured values for the three principal forces and three moments as tested. The secondary listing (even-numbered listing) gives supplementary data (including normalized side force) for each test condition. The symbols used in these listings are:

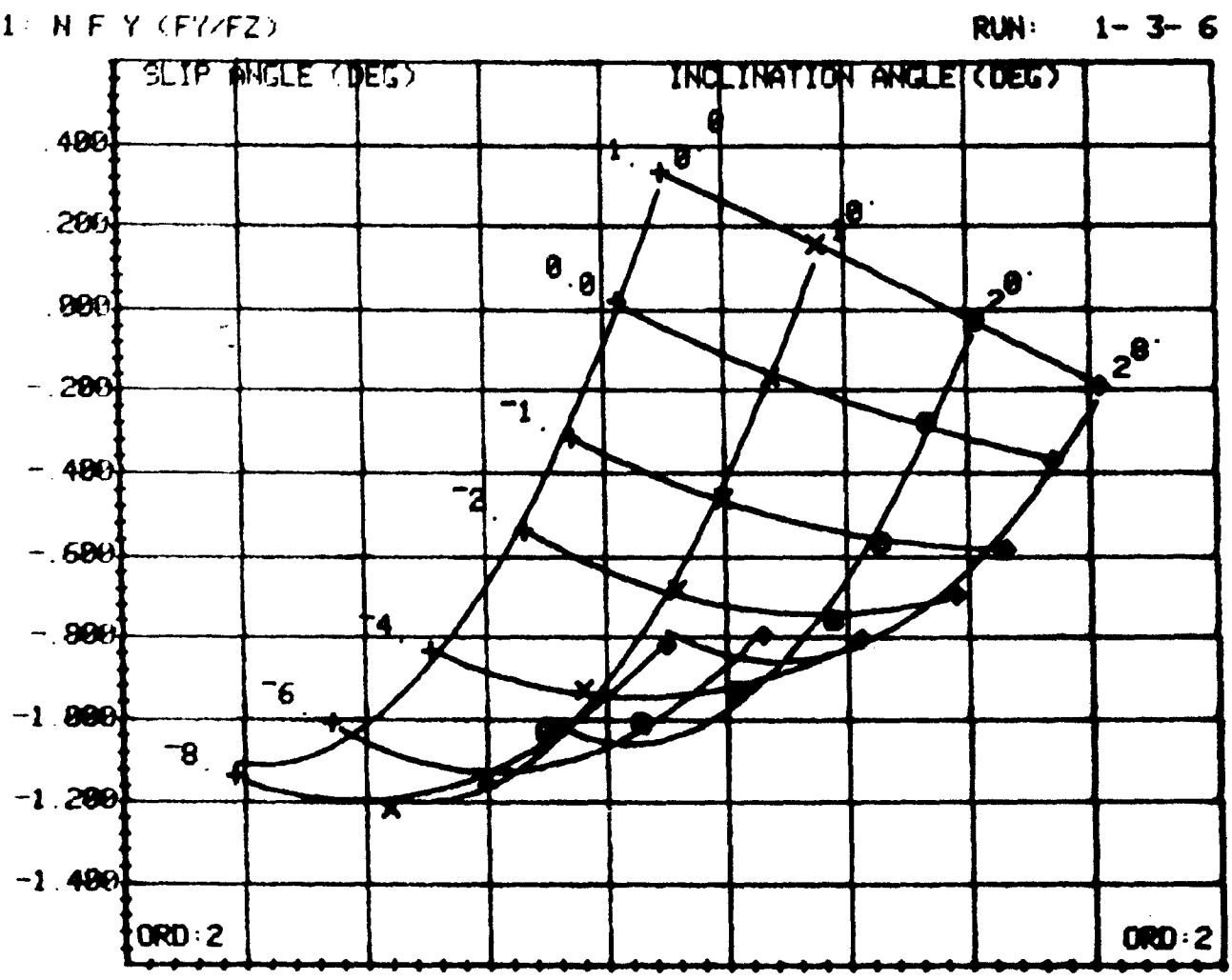
Test Designation	Tread Pattern	Test Identification No.	Normal Test Load (lbs.)	Test Inflation Pressure (psi)	Application
Dunlop 2.75 x 18	Ribbed	1-3-6 2-3-6	125 150	26	Honda 125 Front
Bridgestone 3.50 x 18	Universal	7-3-6 4-3-6	315 380	28	Honda 360 Rear
Bridgestone 3.00 x 18	Ribbed	5-3-6 6-3-6	210 250	26	Honda 360 Front
Yokohama 3.50 x 19	Ribbed	8-3-6 9-3-6	240 290	23	Yamaha 650 Front
Yokohama 4.00 x 18	Universal	10-3-6 11-3-6	360 430	28	Yamaha 650 Rear
Dunlop 4.00 x 19	Universal	12-3-6 13-3-6	215 260	24	Norton 850 Front & Rear
Dunlop 4.00 x 18	Trials	14-3-6 15-3-6	265 320	31	Kawasaki 250 Rear
Carlisle 3.00 x 17	Universal	16-3-6 17-3-6	230 275	28	Honda 125 Rear
Dunlop 3.00 x 21	Trials	18-3-6 19-3-6	155 185	24	Kawasaki 250 Front

Table B-1

Tire Identifications

SA	Slip Angle
IA	Inclination Angle
FZ	Normal Load
FY	Side Force
FX	Rolling Resistance
MX	Overturning Moment
MY	Rolling Resistance Moment
MZ	Aligning Torque
RL	Rolling Radius Under Load
V	Test Velocity
NFY	Normalized Side Force

Detailed test data for the Harley-Davidson 1200 machine are not included in this appendix. The recommended tires for this motorcycle (Goodyear MT90-16T) had been previously tested at Calspan under a different format and these data were adapted for use in this program. Their primary performance characteristics are given in Section 3 of the Technical Report.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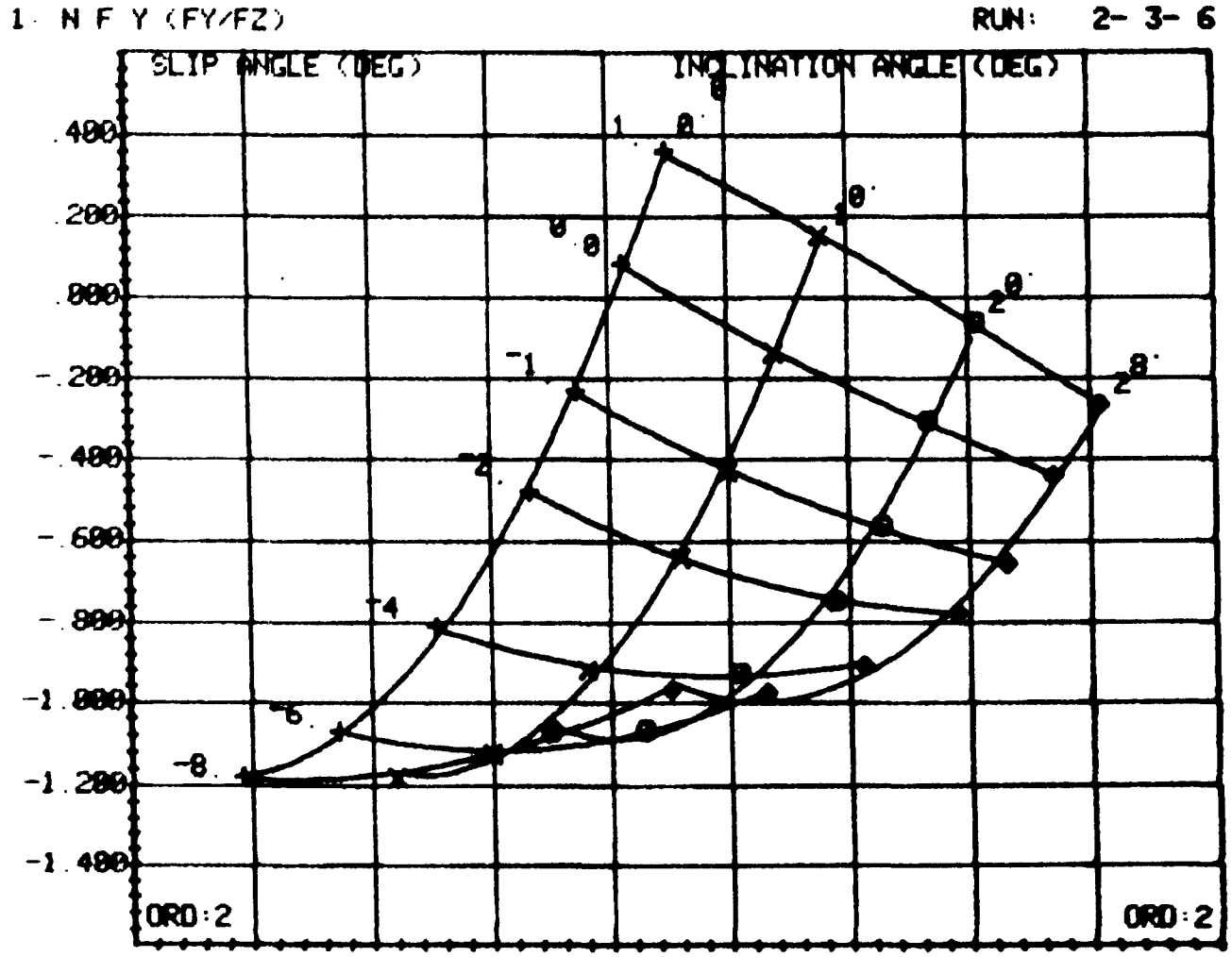
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INCLINATION ANGLE (DEG)
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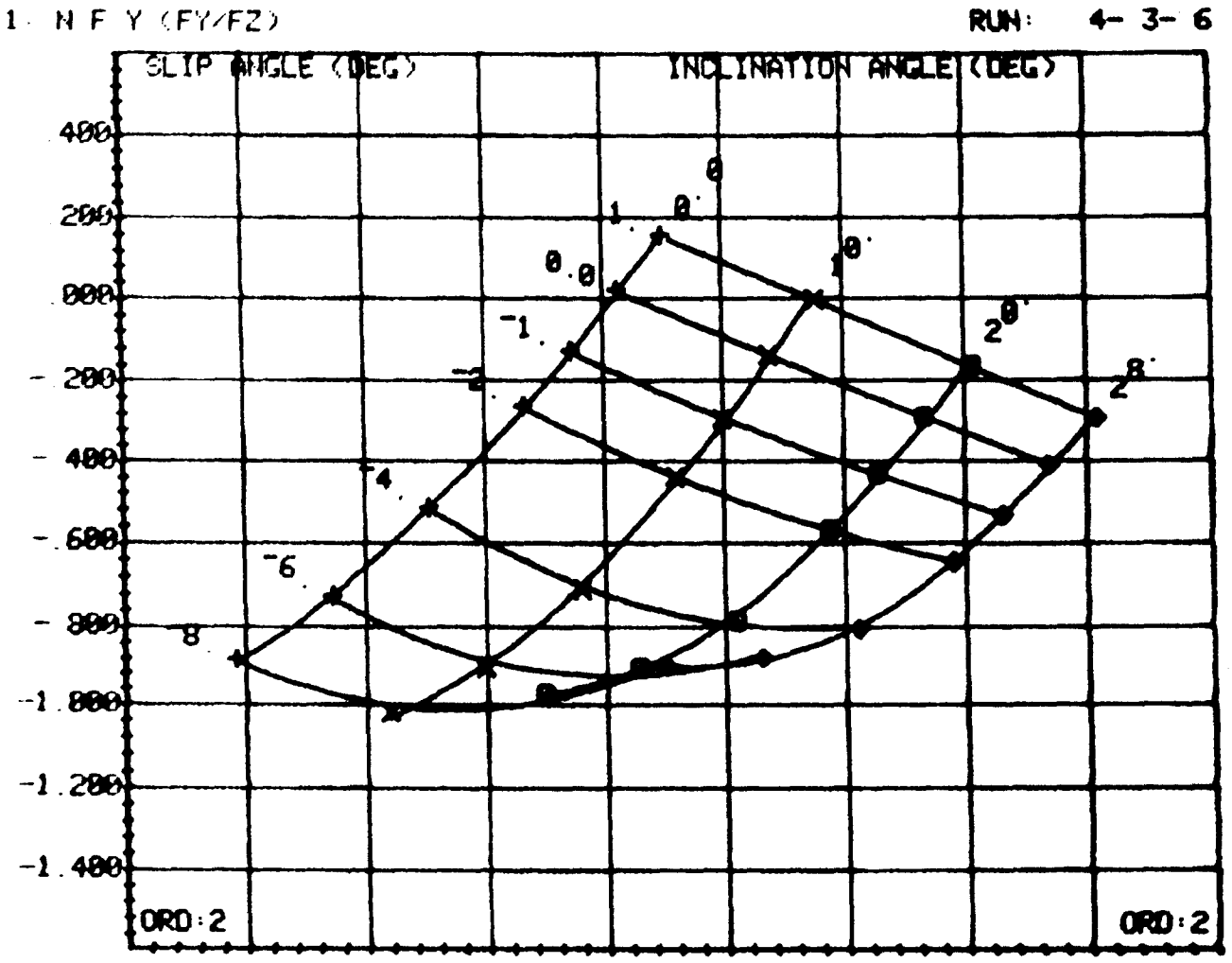
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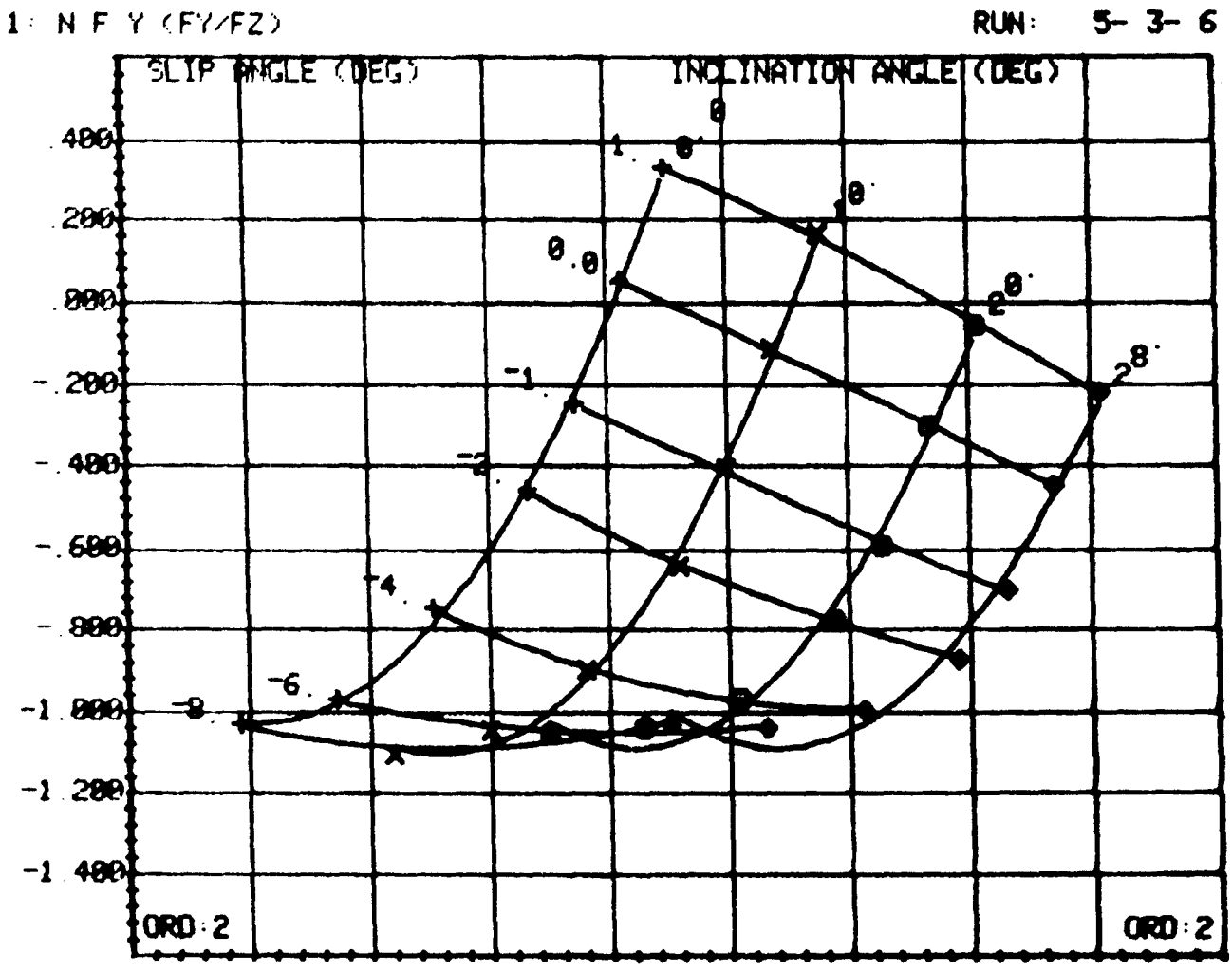
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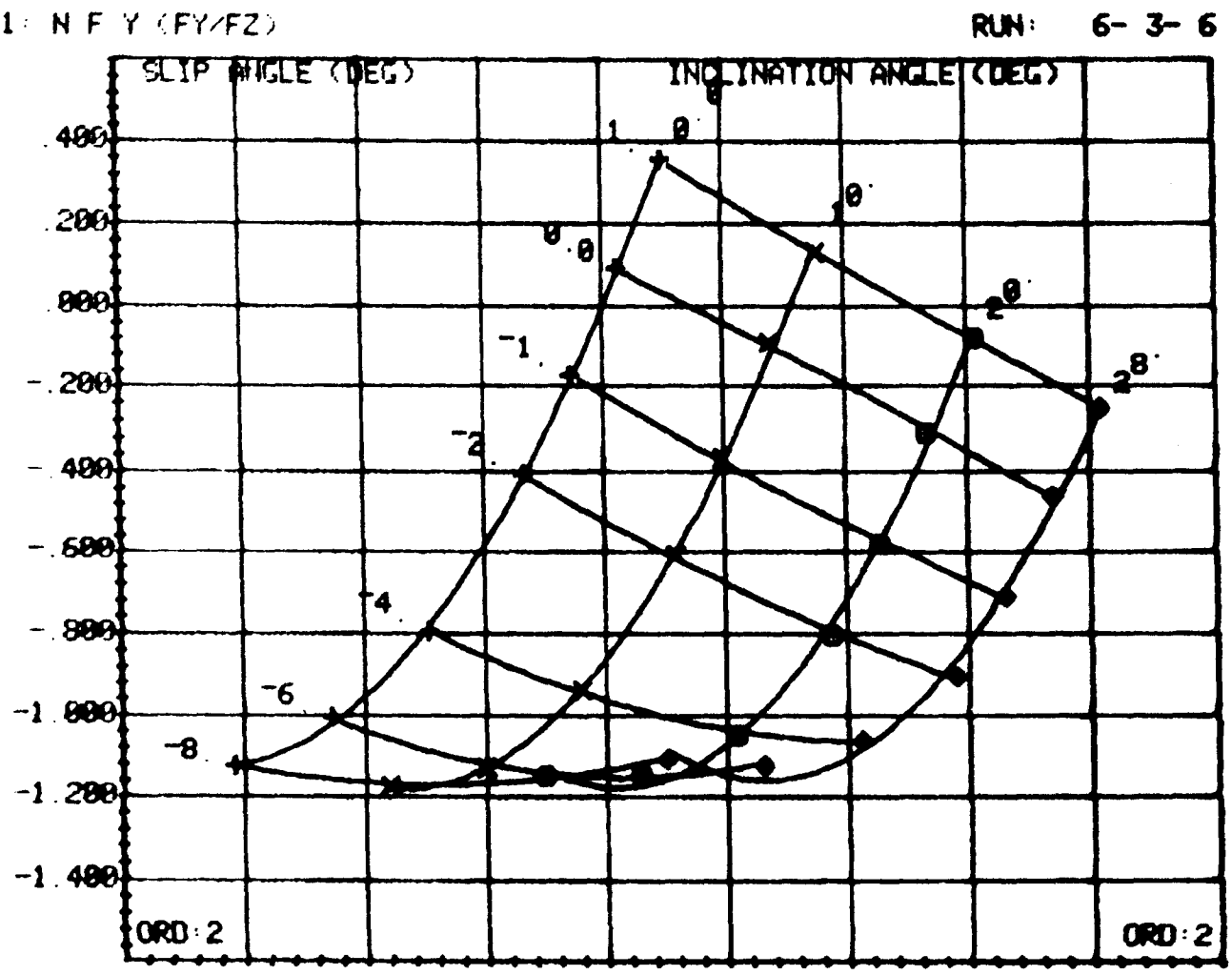
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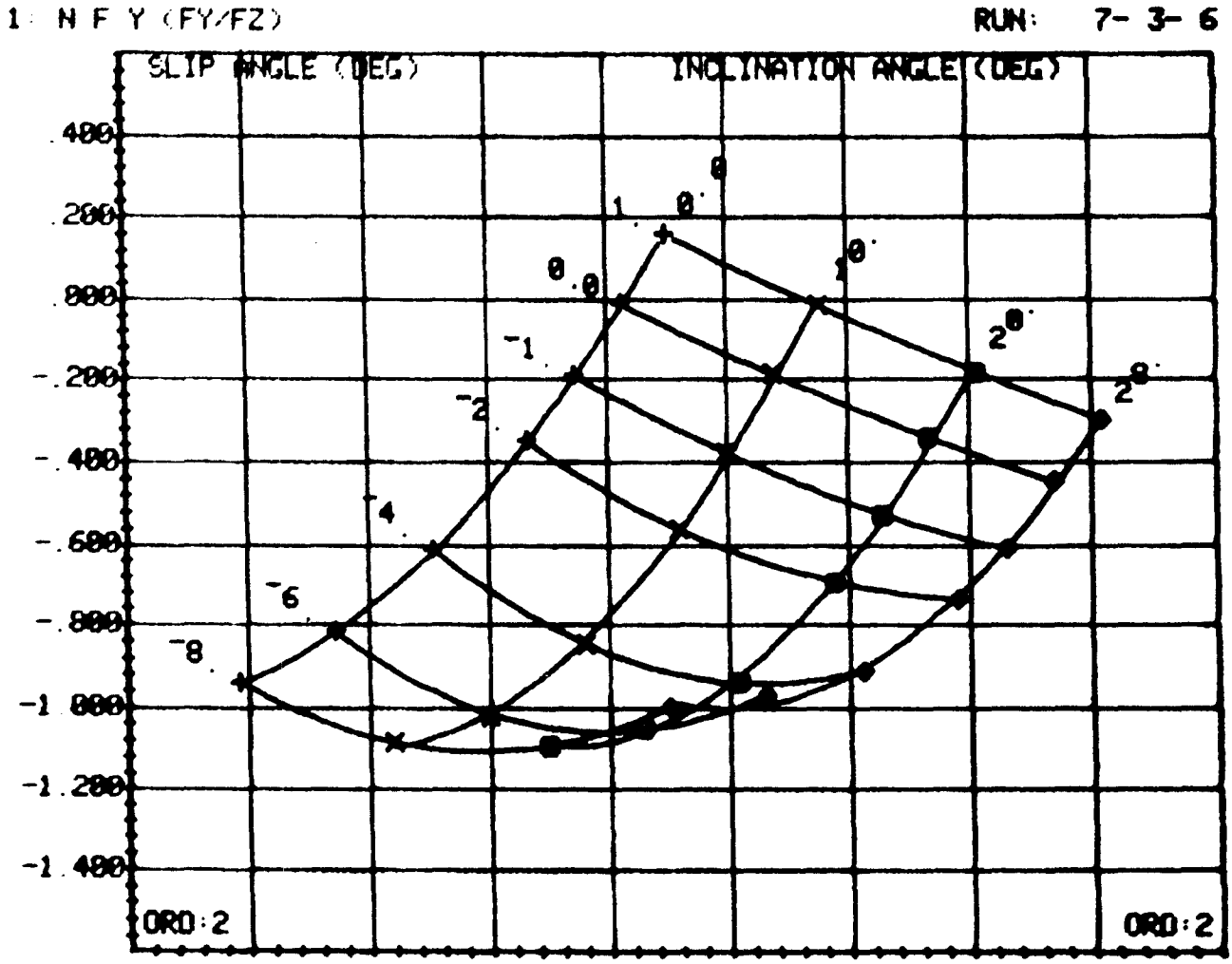
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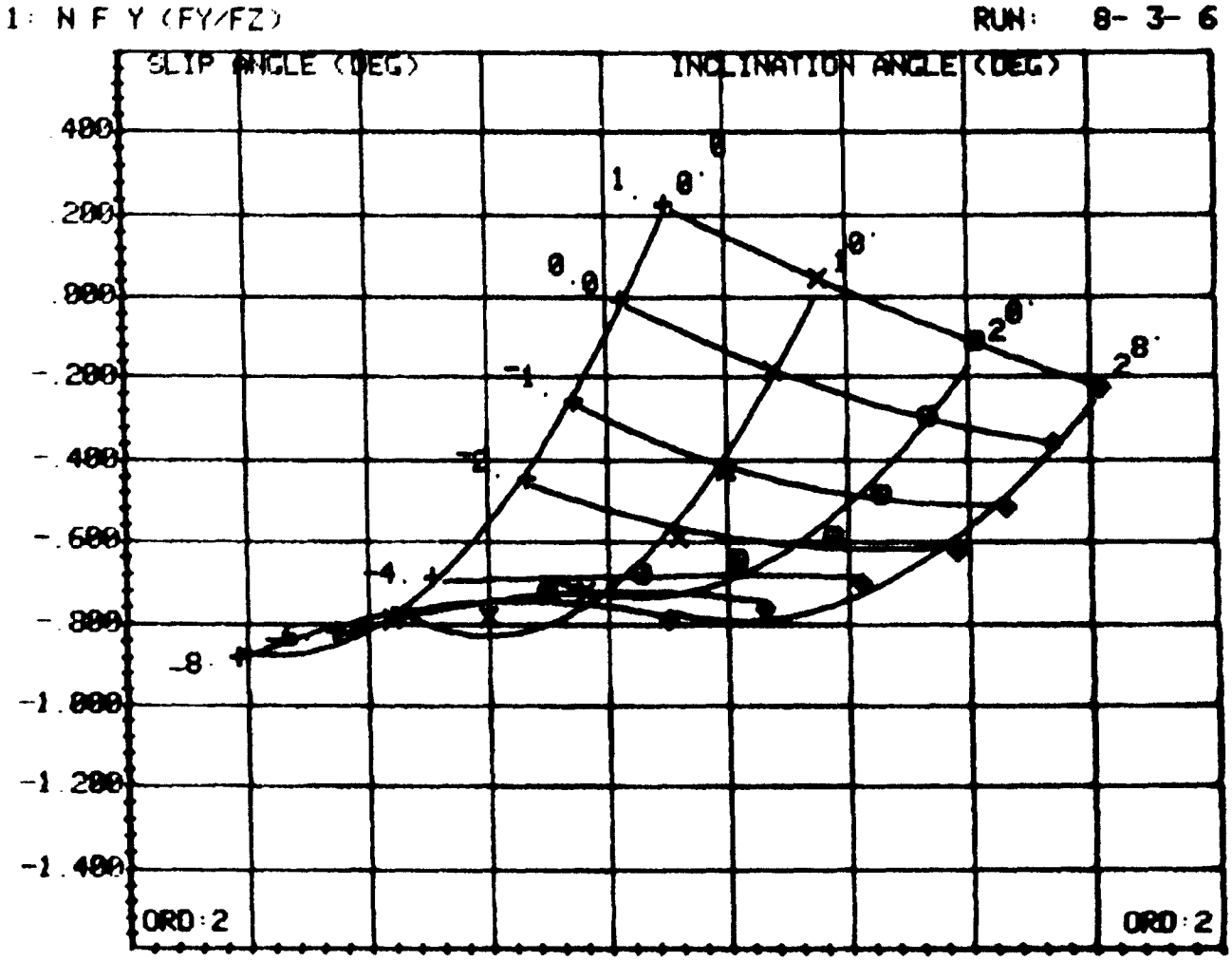
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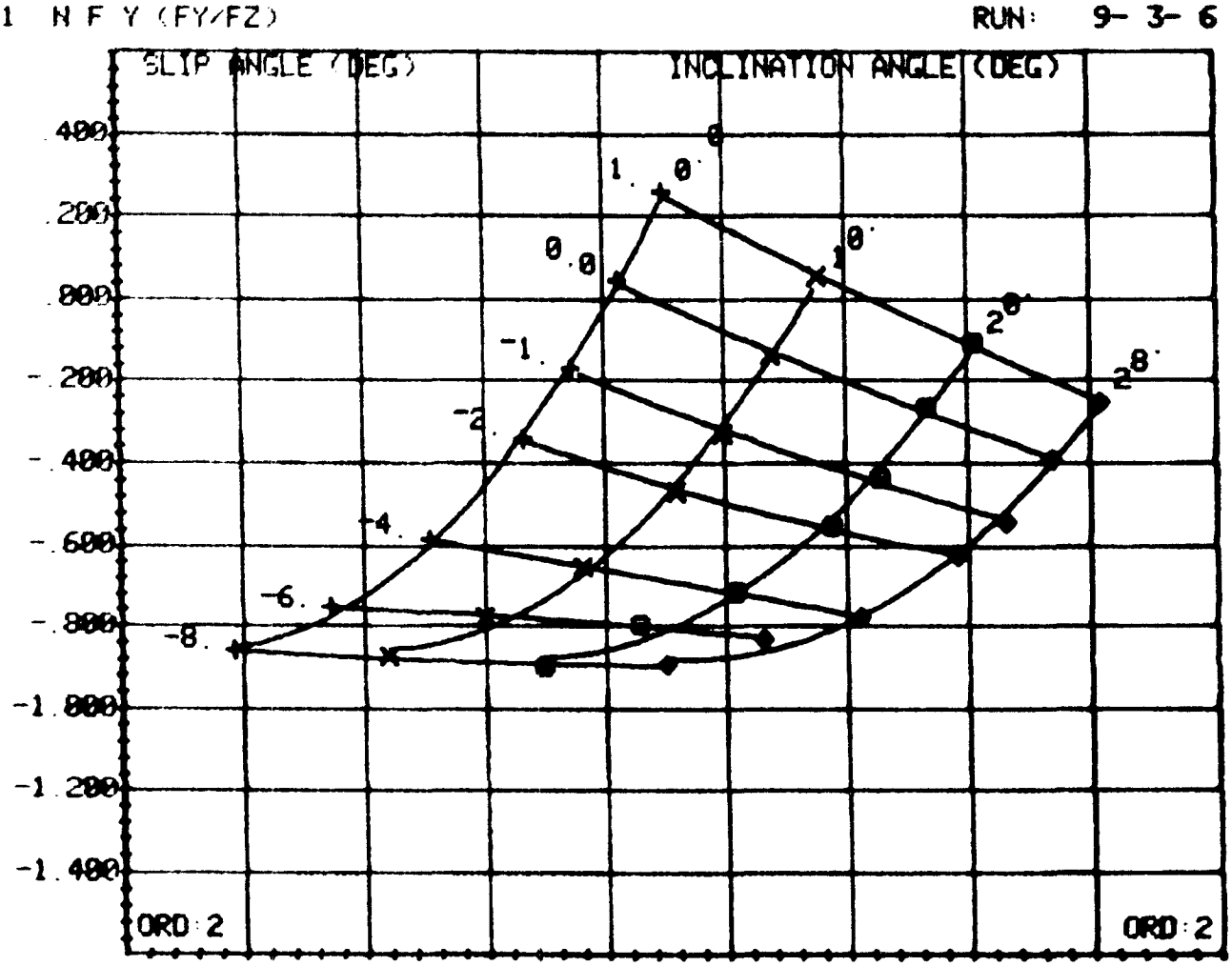
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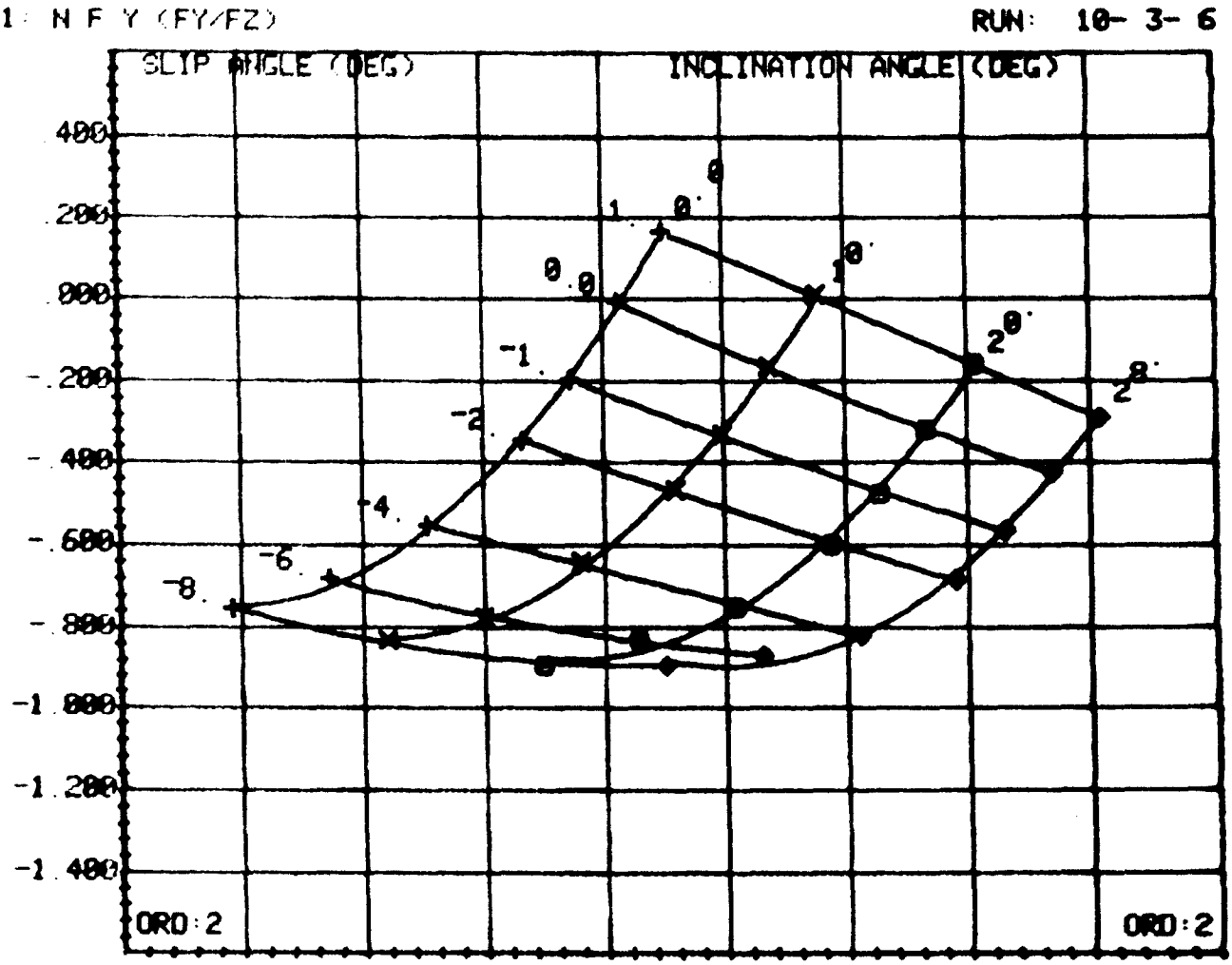
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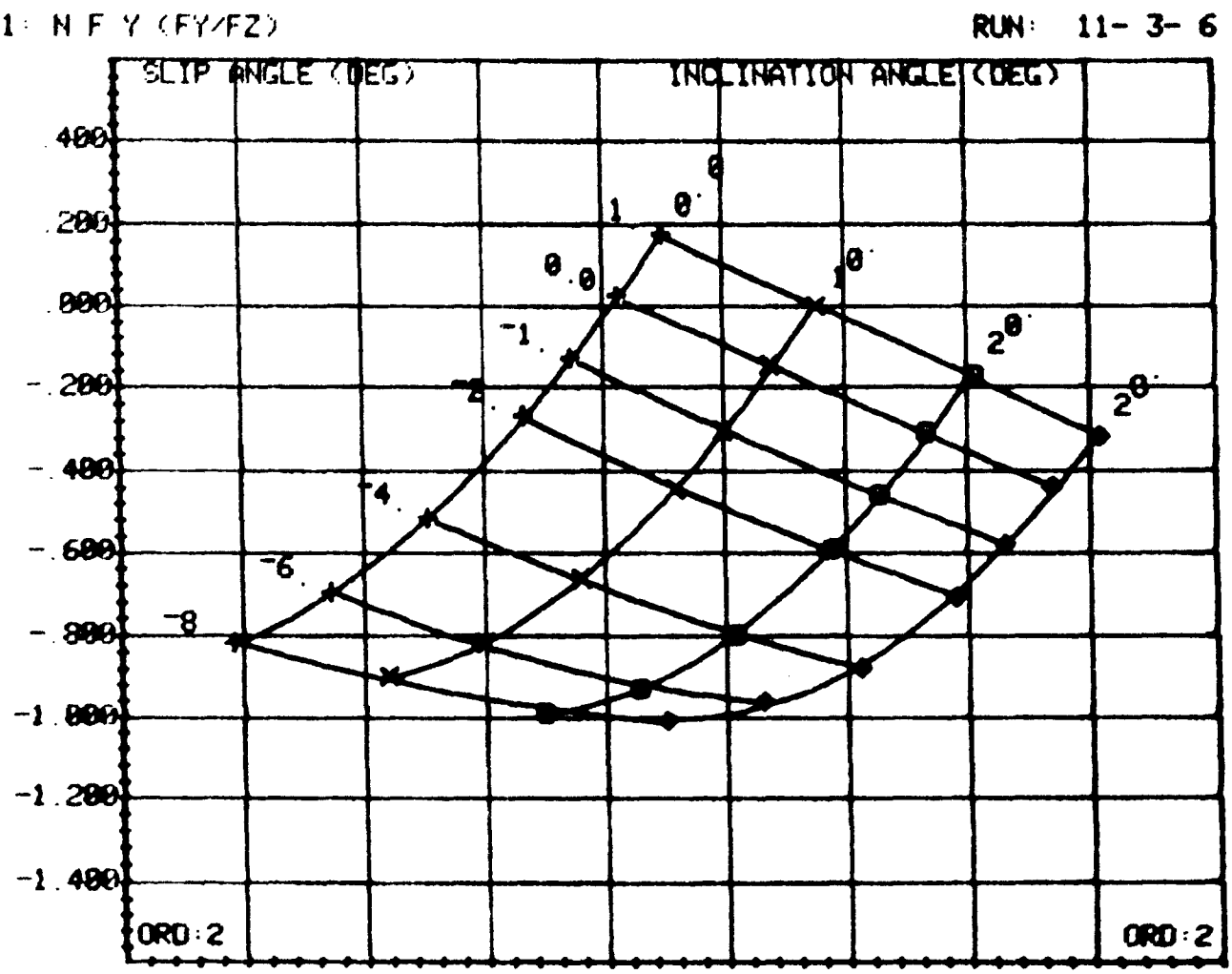
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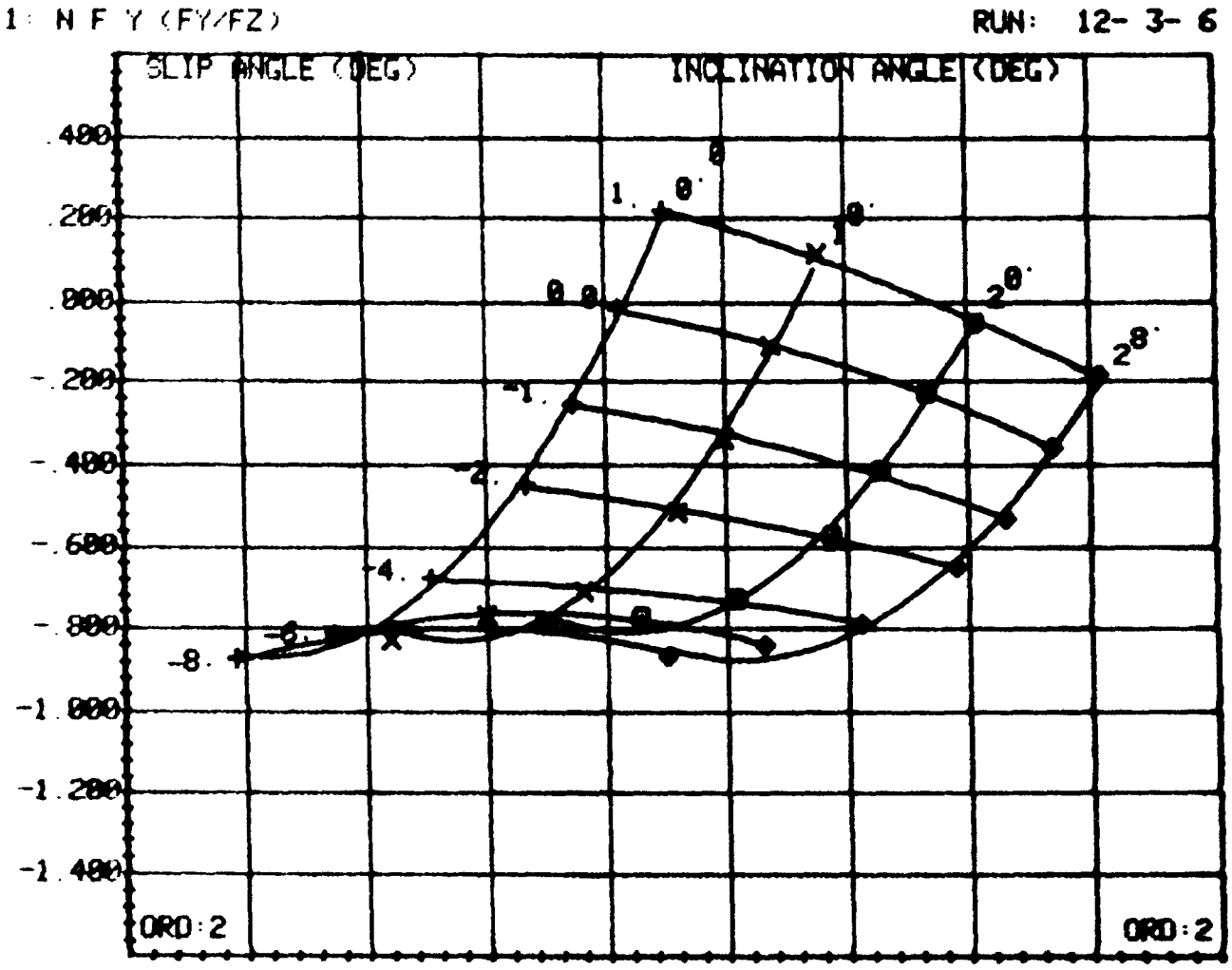
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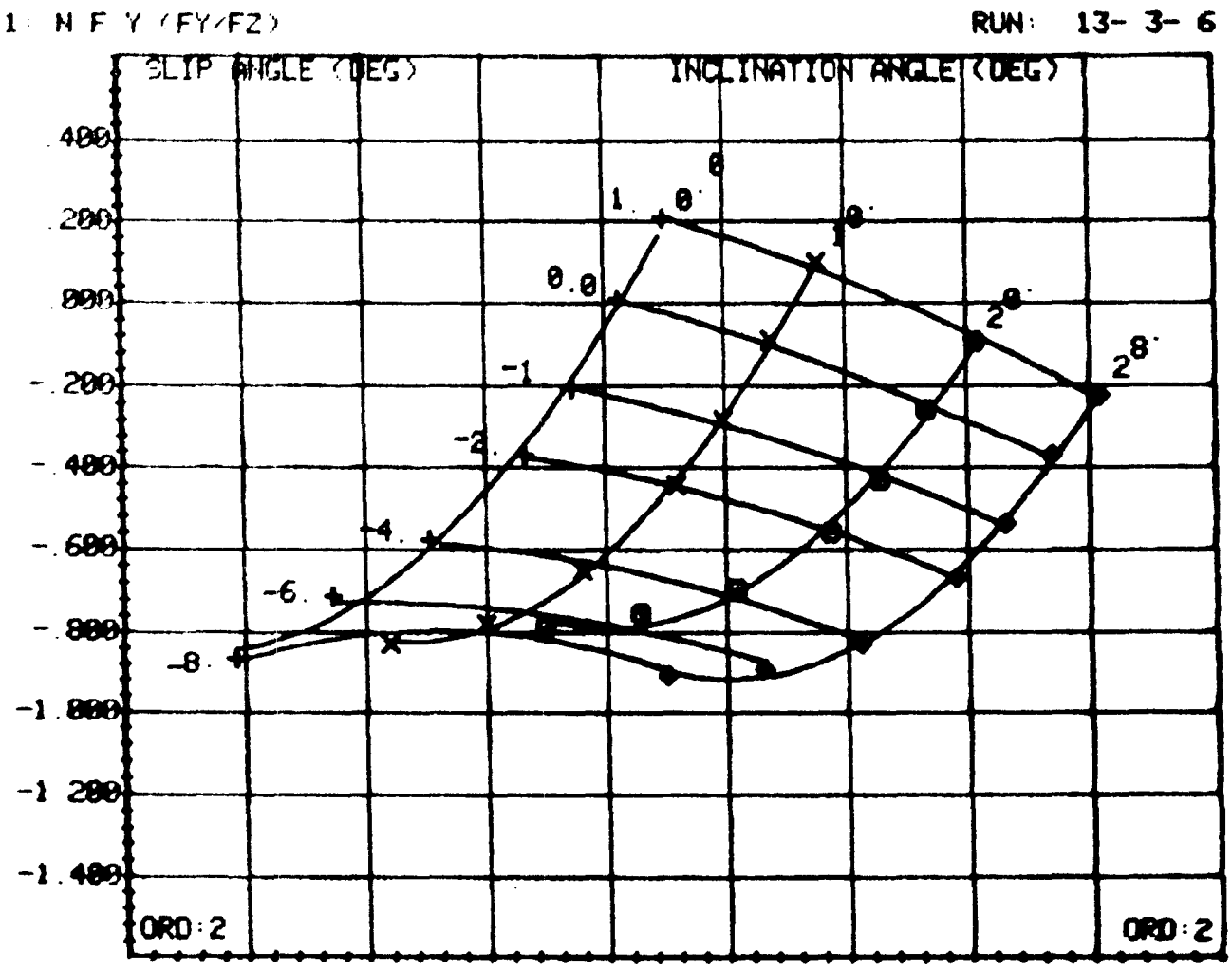
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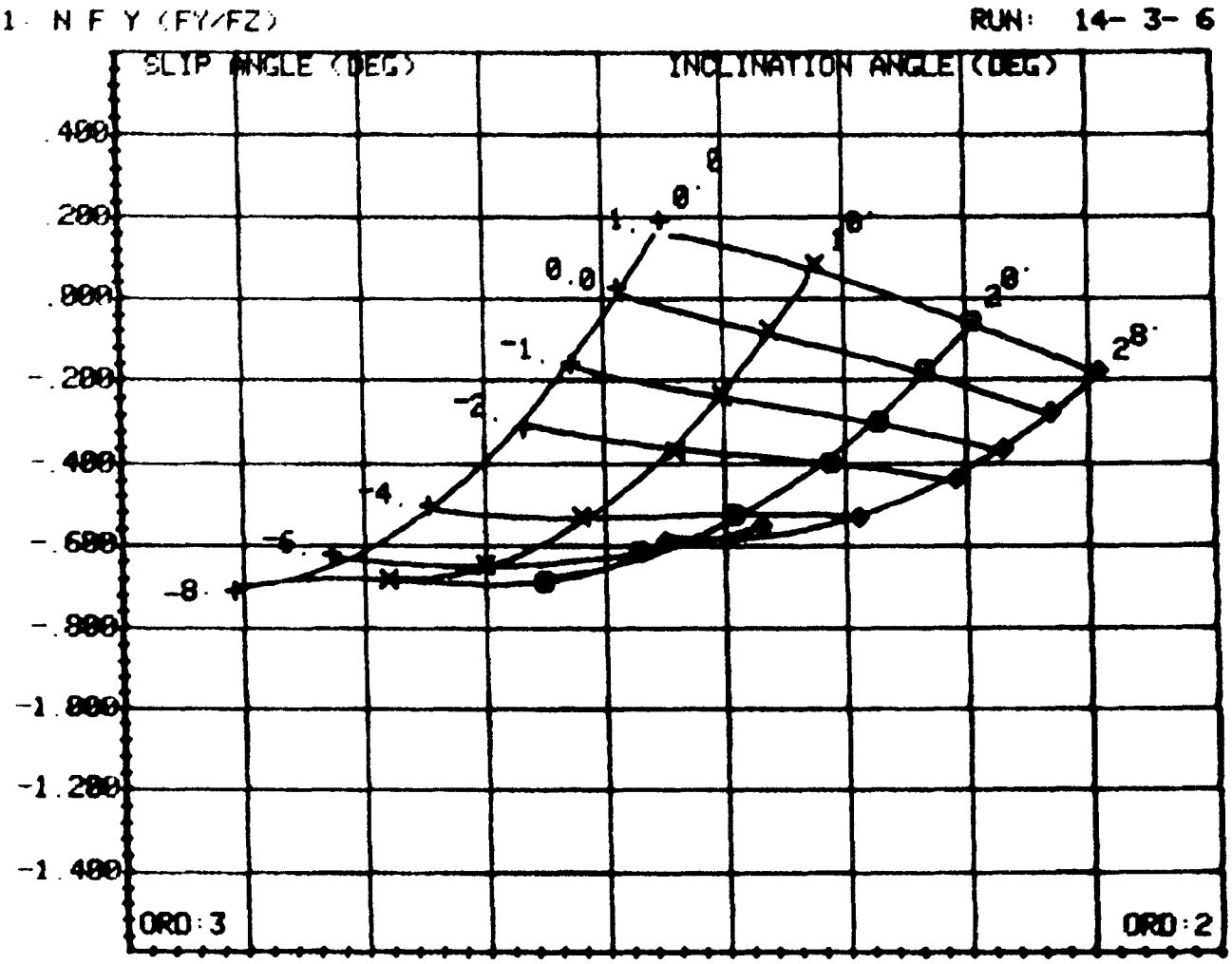
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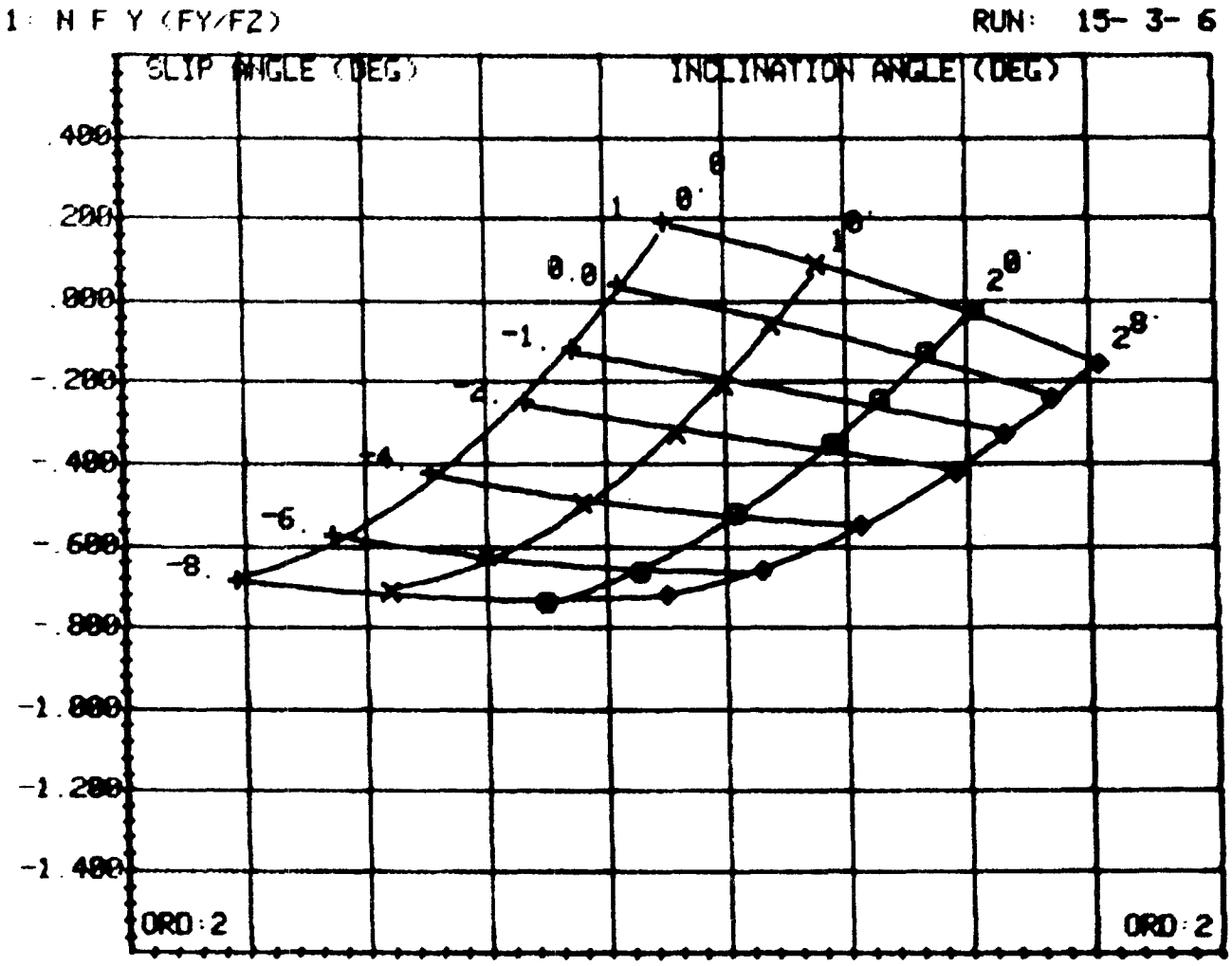
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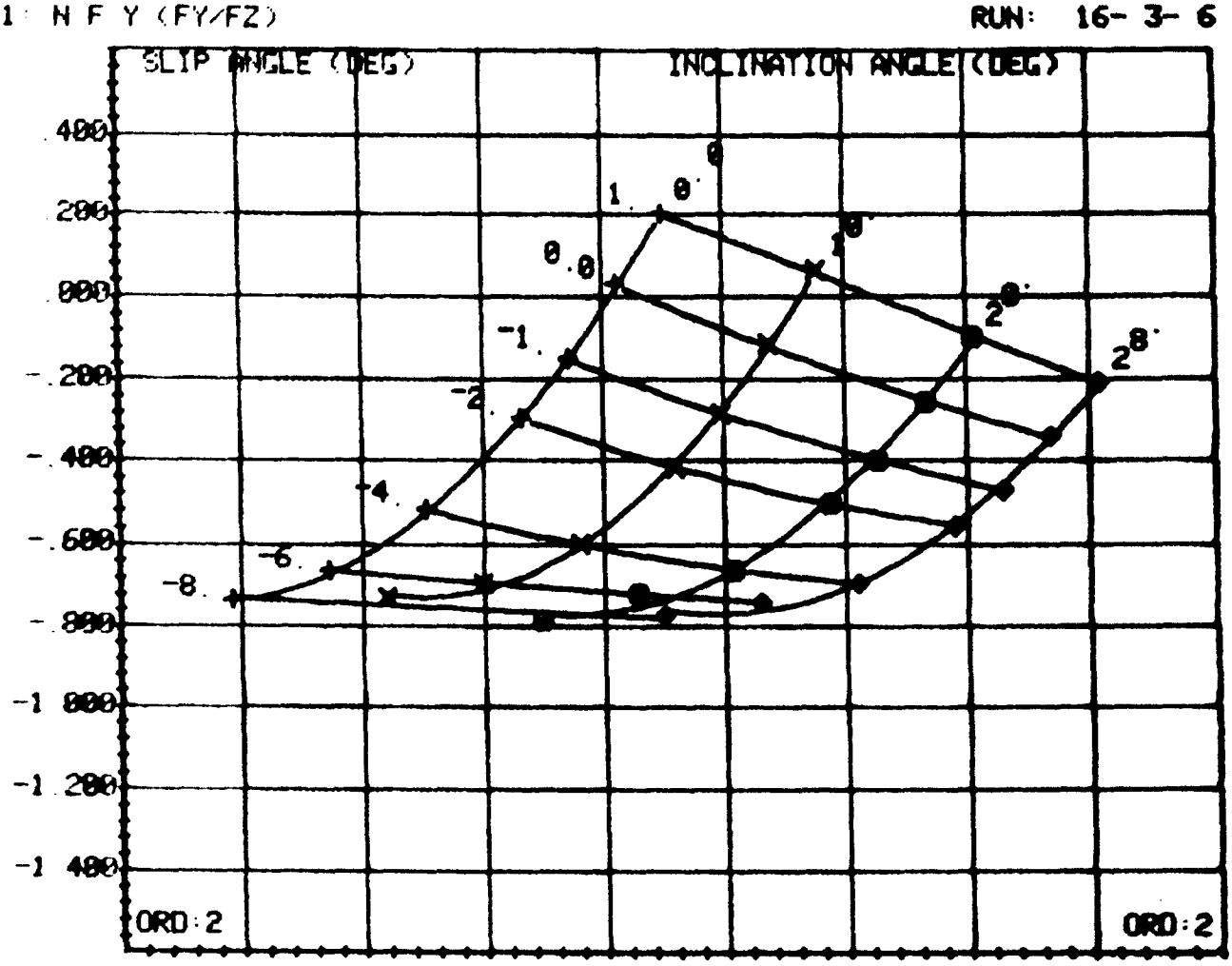
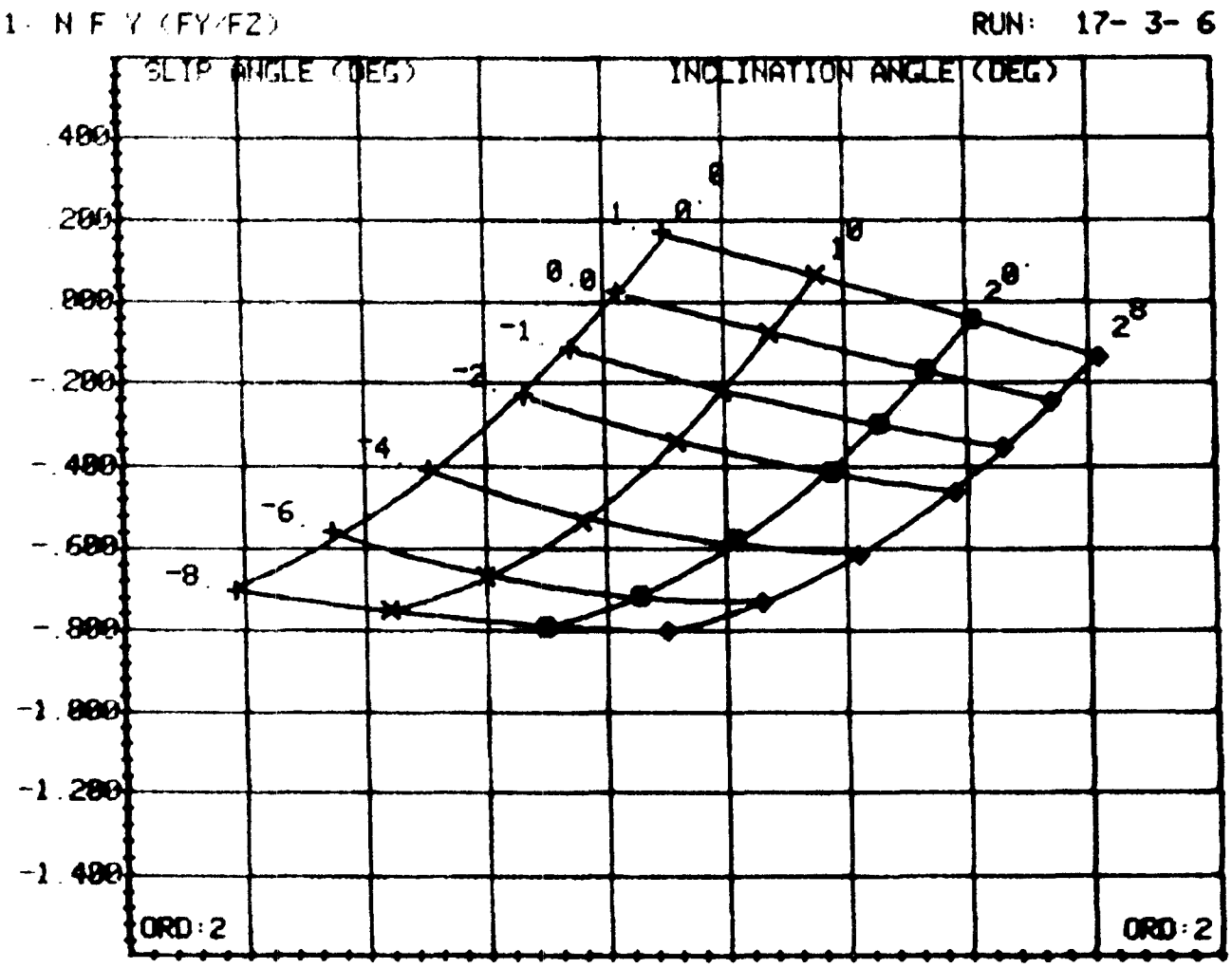
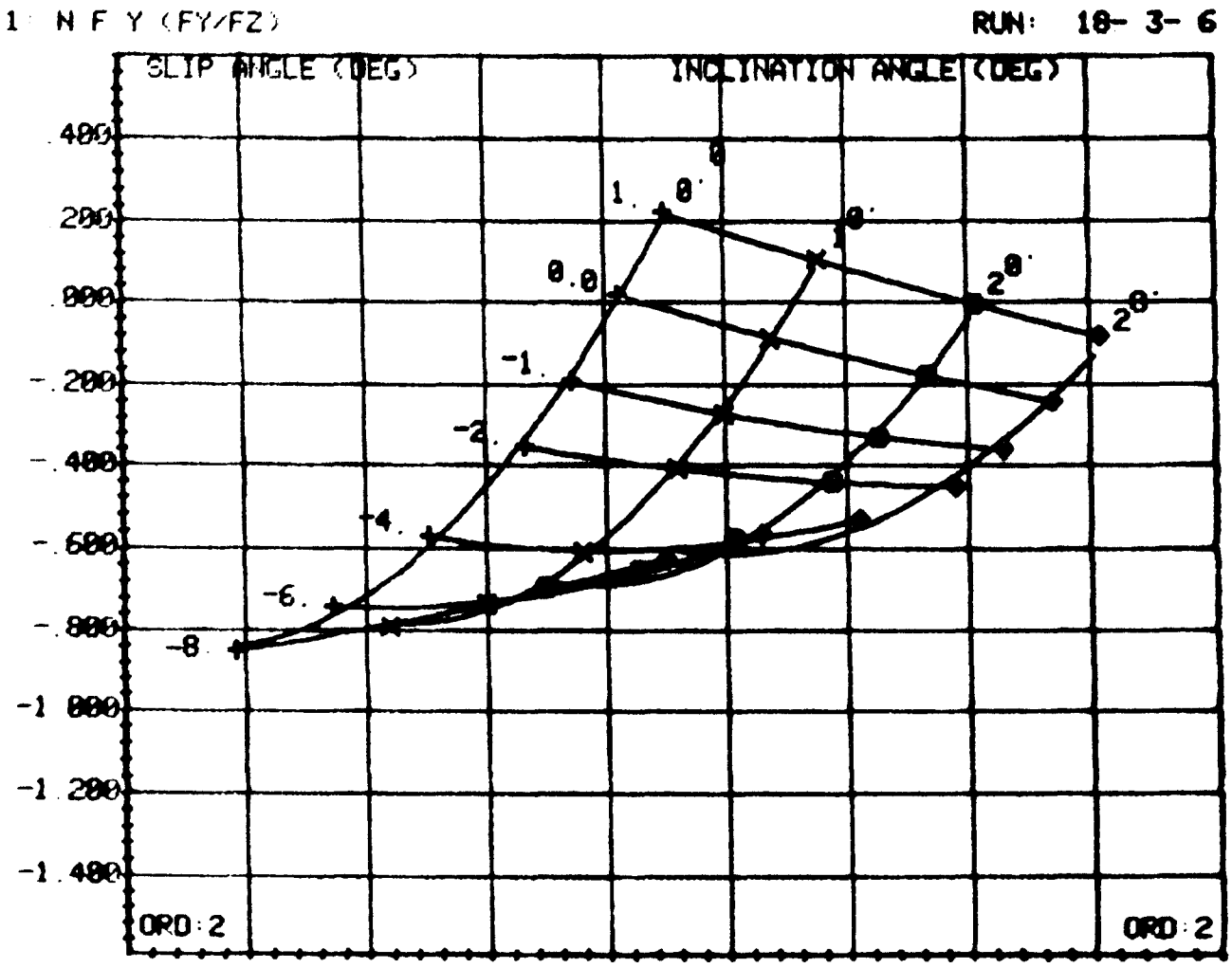
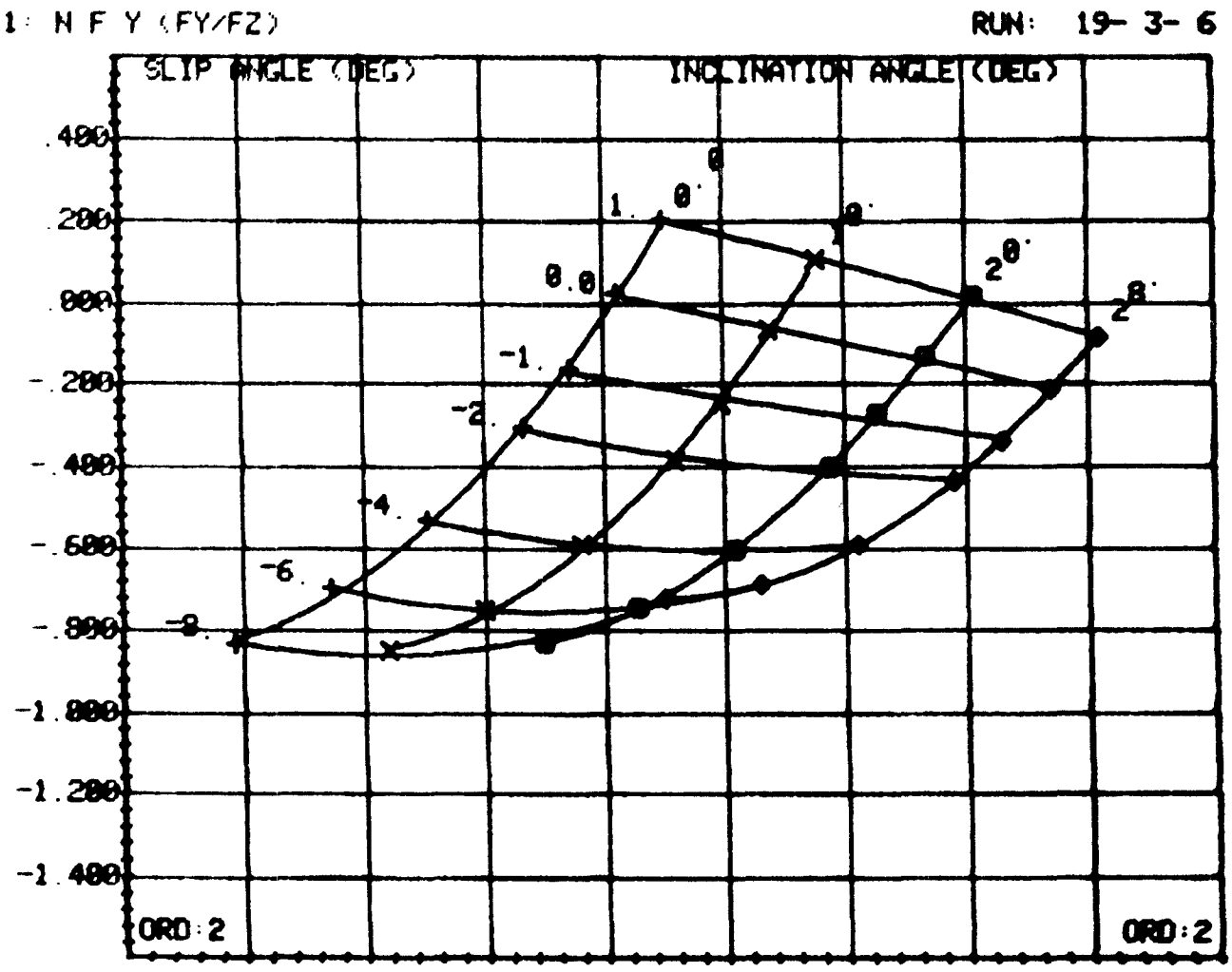
2°
2°


1 N F Y (FY/FZ)
RUN: 16- 3- 6
SLIP ANGLE (DEG)
INCLINATION ANGLE (DEG)
400
200
000
-200
-400
-600
-800
-1 000
-1 200
-1 400
1 0°
0.0
-1
-2
-4
-6
-8
1 8°
2 0°
2 8°
ORD:2
ORD:2


1 N F Y (FY/FZ)
RUN: 17- 3- 6
SLIP ANGLE (DEG)
INCLINATION ANGLE (DEG)
.400
.200
.000
-.200
-.400
-.600
-.800
-1.000
-1.200
-1.400
0
1.0
0.0
1.0
2.0
2.0
-1
-2
-4
-6
-8
ORD:2
ORD:2


1 N F Y (FY/FZ)
RUN: 18- 3- 6
SLIP ANGLE (DEG)
INCLINATION ANGLE (DEG)
.400
.200
.000
-.200
-.400
-.600
-.800
-1.000
-1.200
-1.400
ORD:2
ORD:2
1.0
0.0
-1.
-2.
-4.
-6.
-8.
2.0


1: N F Y (FY/FZ)
RUN: 19- 3- 6
SLIP ANGLE (DEG)
INCLINATION ANGLE (DEG)
.400
.200
.000
-.200
-.400
-.600
-.800
-1.000
-1.200
-1.400
ORD:2
ORD:2
10.0
8.0
6.0
4.0
2.0
0.0
-1.
-2.
-4.
-6.
-8.

1-3-6 S.A. DEG	1-3-6 F.Z. LB	1-3-6 F.Y. LB	1-3-6 F.X. LB	1-3-6 M.X. FT-LB	1-3-6 M.Y. FT-LB	1-3-6 M.Z. FT-LB
I.A. =	0.					
1.	-124.	-41.	-1.	-2.5	-1.6	6.1
0.04	-124.	-2.	-2.	-3.7	-0.6	3.8
-0.94	-125.	40.	-2.	-5.2	-0.9	2.6
-1.95	-125.	68.	-2.	-4.1	-0.8	2.5
-3.93	-124.	104.	-1.	-6.1	-1.7	3.5
-5.96	-125.	127.	-2.	-6.	-1.3	4.4
-7.97	-124.	141.	-3.	-8.7	-0.5	4.2
I.A. =	10.02					
1.03	-138.	-21.	-3.	-15.	-0.8	7.9
0.04	-125.	21.	-1.	-14.8	-2.8	5.4
-0.94	-111.	52.	-3.	-15.4	-0.4	2.4
-1.93	-105.	72.	-1.	-14.3	-2.2	3.1
-3.93	-99.	93.	-1.	-15.8	-2.3	4.1
-5.96	-96.	110.	-1.	-13.6	-2.	5.1
-7.97	-93.	113.	-1.	-14.8	-2.5	5.
I.A =	20.07					
1.03	-149.	4.	-3.	-23.2	-2.8	8.3
0.04	-122.	34.	-3.	-26.1	-1.	5.5
-0.94	-103.	59.	-1.	-24.8	-3.4	3.5
-1.95	-93.	71.	-3.	-22.6	-1.3	3.
-3.94	-82.	77.	-2.	-25.1	-2.1	3.9
-5.95	-81.	82.	-0.	-22.8	-4.1	4.3
-7.97	-81.	84.	-1.	-23.	-2.8	4.7
I.A. =	28.08					
1.03	-156.	29.	-4.	-32.2	-3.6	10.1
0.04	-128.	48.	-3.	-34.1	-2.7	7.
-0.94	-108.	63.	-3.	-33.2	-2.7	4.6
-1.95	-101.	71.	-1.	-31.1	-3.4	4.2
-3.93	-94.	76.	-1.	-32.5	-3.4	4.2
-5.96	-91.	72.	-1.	-31.7	-3.	4.5
-7.97	-89.	73.	-1.	-33.1	-2.9	4.5

1-3-6 S.A. DEG	1-3-6 R.L. IN	1-3-6 I.A DEG	1-3-6 U. MPH	1-3-6 N.F.Y. FY/FZ		
I.A. =	0.					
1	11.75	0	30.	0.33		
0.04	11.75	0	30.	0.02		
-0.94	11.75	0	30.	-0.32		
-1.95	11.73	0	30.	-0.54		
-3.93	11.72	0	30.	-0.84		
-5.96	11.71	0	30.	-1.01		
-7.97	11.7	0.	30.	-1.14		
I.A. =	10.02					
1.03	11.74	10.02	30.	0.16		
0.04	11.78	10.02	30.	-0.17		
-0.94	11.81	10.02	30.	-0.47		
-1.93	11.82	10.02	30.	-0.69		
-3.93	11.83	10.02	30.	-0.94		
-5.96	11.83	10.02	30.	-1.15		
-7.97	11.83	10.02	30.	-1.22		
I.A. =	20.07					
1.03	11.8	20.07	30.	-0.03		
0.04	11.86	20.07	30.	-0.28		
-0.94	11.91	20.07	30.	-0.57		
-1.95	11.93	20.07	30.	-0.76		
-3.94	11.94	20.08	30.	-0.94		
-5.96	11.95	20.07	30.	-1.01		
-7.97	11.95	20.07	30.	-1.04		
I.A. =	28.08					
1.03	11.88	28.08	30.	-0.19		
0.04	11.94	28.1	30.	-0.37		
-0.94	12.	28.08	30.	-0.59		
-1.95	12.02	28.08	30.	-0.7		
-3.93	12.04	28.1	30.	-0.81		
-5.96	12.03	28.08	30.	-0.8		
-7.97	12.04	28.1	30.	-0.83		

2-3-6 S.A. DEG	2-3-6 F.Z. LB	2-3-6 F.Y. LB	2-3-6 F.X. LB	2-3-6 M.X. FT-LB	2-3-6 M.Y. FT-LB	2-3-6 M.Z. FT-LB
I.A. =	0.					
1	-147.	-53.	-2.	-2.8	-0.8	6.1
0.04	-148.	-12.	-2.	-3.1	-0.6	3.8
-0.94	-151.	35.	-2.	-4.2	-0.4	1.5
-1.95	-147.	71.	-2.	-4.7	-0.7	0.4
-3.93	-151	123.	-3.	-5.5	-0.3	1.2
-5.96	-150.	161.	-4.	-8.	0.5	3.
-7.97	-148.	176.	-3.	-9.6	-0.4	4.1
I.A. =	10.02					
1.03	-170.	-26.	-4.	-12.	-0.1	7.9
0.04	-151.	20.	-1.	-14.2	-2.3	5.4
-0.94	-136.	59.	-1.	-12.	-2.3	3.2
-1.95	-128.	83.	-1.	-15.	-2.2	3.1
-3.94	-120.	111.	-3.	-16.	-0.8	3.1
-5.96	-114.	128.	-3.	-13.3	-0.6	4.1
-7.97	-112.	133.	-3.	-14.9	-1.2	5.1
I.A. =	20.07					
1.03	-178.	11.	-4.	-22.6	-1.5	9.7
0.04	-152.	47.	-3.	-22.4	-2.3	6.1
-0.94	-129.	73.	-1.	-21.1	-2.9	3.6
-1.95	-113.	85.	-1.	-22.5	-3.3	3.4
-3.94	-104.	97.	-2.	-20.6	-2.	3.8
-5.96	-101.	108.	-1.	-21.3	-3.2	4.4
-7.97	-100.	108.	0.	-18.9	-4.8	5.1
I.A. =	28.1					
1.01	-181.	46.	-6.	-31.5	-2.5	11.7
0.04	-150.	67.	-4.	-29.3	-2.2	7.2
-0.94	-131.	86.	-4.	-28.9	-1.5	5.1
-1.95	-119.	93.	-1.	-27.6	-3.8	4.
-3.94	-112.	102.	-3.	-28.1	-2.6	4.5
-5.96	-107.	105.	-2.	-29.3	-3.4	5.2
-7.97	-108.	106.	-2.	-27.	-3.4	5.2

2-3-6 S.A. DEG	2-3-6 R.L IN	2-3-6 I.A DEG	2-3-6 U MPH	2-3-6 N.F.Y. FY/FZ		
I.A. =	0.					
1.	11.7	0.	30.	0.36		
0.04	11.71	0.	30.	0.00		
-0.94	11.71	0.	30.	-0.23		
-1.95	11.7	0.	30.	-0.48		
-3.93	11.67	0.	30.	-0.82		
-5.96	11.65	0.	30.	-1.00		
-7.97	11.63	0	30.	-1.19		
I.A. =	10.02					
1.03	11.68	10.02	30.	0.15		
0.04	11.73	10.02	30.	-0.14		
-0.94	11.76	10.02	30.	-0.44		
-1.95	11.77	10.02	30.	-0.65		
-3.94	11.78	10.02	30.	-0.92		
-5.96	11.79	10.02	30.	-1.13		
-7.97	11.79	10.02	30.	-1.19		
I.A =	20.07					
1.03	11.75	20.07	30.	-0.06		
0.04	11.82	20.07	30.	-0.31		
-0.94	11.87	20.07	30.	-0.57		
-1.95	11.89	20.08	30.	-0.75		
-3.94	11.9	20.08	30.	-0.93		
-5.96	11.93	20.07	30.	-1.07		
-7.97	11.91	20.08	30.	-1.08		
I.A. =	28.1					
1.01	11.86	28.1	30.	-0.27		
0.04	11.92	28.1	30.	-0.45		
-0.94	11.99	28.08	30.	-0.66		
-1.95	12.02	28.1	30.	-0.78		
-3.94	12.03	28.1	30.	-0.91		
-5.96	12.04	28.1	30.	-0.98		
-7.97	12.04	28.1	30.	-0.98		

4-3-6 S.A. DEG	4-3-6 F.Z. LB	4-3-6 F.Y. LB	4-3-6 F.X. LB	4-3-6 M.X. FT-LB	4-3-6 M.Y. FT-LB	4-3-6 M.Z. FT-LB
I.A. =	0.					
1.	-378.	-59.	-5.	-3.1	1.1	12.7
0.04	-377.	-6.	-7.	-7.3	3.2	5.1
-0.94	-379.	49.	-6.	-10.7	2.3	-0.2
-1.95	-380.	101.	-6.	-12.6	3.1	-4.7
-3.94	-380.	197.	-8.	-19.	4.3	-10.4
-5.96	-378.	276.	-8.	-26.5	4.5	-9.6
-7.97	-377.	334.	-10.	-33.6	6.6	-8.
I.A. =	10.02					
1.03	-403.	2.	-7.	-22.8	1.9	16.
0.04	-383.	53.	-6.	-24.9	1.2	9.5
-0.94	-364.	108.	-5.	-26.9	1.5	3.
-1.95	-349.	155.	-5.	-30.	2.	-1.3
-3.94	-324.	232.	-3.	-34.	1.1	-3.8
-5.96	-305.	278.	-5.	-37.9	1.6	-1.8
-7.97	-296.	305.	-4.	-36.5	0.3	2.1
I.A. =	20.07					
1.03	-433.	72.	-11.	-41.6	1.8	20.
0.04	-394.	115.	-7.	-43.5	0.3	12.8
-0.94	-359.	156.	-4.	-42.5	-0.5	5.9
-1.95	-330.	189.	-4.	-44.8	-0.	1.6
-3.93	-293.	231.	-3.	-44.3	0.1	0.4
-5.96	-279.	254.	-2.	-43.1	-1.9	1.9
-7.97	-267.	262.	-4.	-42.5	-0.5	4.4
I.A. =	28.1					
1.01	-465.	137.	-13.	-57.4	-0.3	23.6
0.04	-415.	171.	-9.	-57.3	-0.2	14.3
-0.94	-371.	200.	-6.	-56.1	-0.1	7.4
-1.95	-338.	220.	-6.	-56.3	0.8	4.2
-3.94	-302.	244.	-2.	-54.7	-2.3	2.7
-5.96	-290.	256.	-3.	-53.1	-1.9	4.
-7.97	-287.	261.	-5.	-50.6	-0.8	5.6

4-3-6 S.A. DEG	4-3-6 R.L IN	4-3-6 I.A. DEG	4-3-6 V MPH	4-3-6 N.F.Y. FY/FZ		
I.A. =	0					
1	12.18	0	30.	0.15		
0.04	12.19	0	30.	0.02		
-0.94	12.18	0	30.	-0.13		
-1.95	12.16	0	30.	-0.27		
-3.94	12.11	0	30.	-0.52		
-5.96	12.04	0	30.	-0.73		
-7.97	11.98	0	30.	-0.89		
I.A. =	10.02					
1.03	12.17	10.02	30.	-0.		
0.04	12.2	10.02	30.	-0.14		
-0.94	12.23	10.02	30.	-0.3		
-1.95	12.24	10.02	30.	-0.44		
-3.94	12.25	10.02	30.	-0.72		
-5.96	12.25	10.02	30.	-0.91		
-7.97	12.25	10.03	30.	-1.03		
I.A. =	20.07					
1.03	12.23	20.07	30.	-0.17		
0.04	12.31	20.07	30.	-0.29		
-0.94	12.37	20.07	30.	-0.44		
-1.95	12.4	20.07	30.	-0.57		
-3.93	12.45	20.08	30.	-0.79		
-5.96	12.47	20.08	30.	-0.91		
-7.97	12.48	20.08	30.	-0.98		
I.A. =	28.1					
1.01	12.31	28.1	30.	-0.29		
0.04	12.41	28.1	30.	-0.41		
-0.94	12.49	28.08	30.	-0.54		
-1.95	12.54	28.1	30.	-0.65		
-3.94	12.61	28.1	30.	-0.81		
-5.96	12.63	28.1	30.	-0.89		
-7.97	12.63	28.08	30.	-0.91		

5-3-6 S.A. DEG	5-3-6 F.Z. LB	5-3-6 F.Y. LB	5-3-6 F.X. LB	5-3-6 M.X. FT-LB	5-3-6 M.Y. FT-LB	5-3-6 M.Z. FT-LB
I.A. =	0.					
1.	-209.	-69.	-4.	-1.9	1.2	8.
0.04	-212.	-11.	-3.	-1.3	0.7	5.7
-0.94	-211.	53.	-3.	-4.3	0.5	2.4
-1.95	-212.	99.	-3.	-2.7	0.6	2.2
-3.94	-211.	159.	-3.	-5.9	0.7	4.
-5.96	-213.	208.	-4.	-7.7	1.2	4.8
-7.97	-210.	218.	-4.	-7.1	1.	5.8
I.A. =	10.02					
1.03	-240.	-40.	-5.	-13.9	0.2	11.1
0.03	-214.	24.	-4.	-14.3	0.	6.6
-0.94	-194.	80.	-4.	-15.7	-0.	3.3
-1.95	-182.	118.	-3.	-16.3	-0.2	3.1
-3.94	-172.	156.	-3.	-15.9	0.1	4.
-5.96	-166.	174.	-4.	-15.5	-0.2	5.
-7.97	-162.	180.	-3.	-15.6	-0.8	5.9
I.A. =	20.07					
1.03	-254.	14.	-8.	-30.5	-0.2	14.4
0.04	-211.	64.	-5.	-30.6	-0.4	8.7
-0.94	-179.	107.	-2.	-27.7	-2.8	5.6
-1.95	-162.	126.	-3.	-27.7	-0.6	4.1
-3.94	-147.	144.	-2.	-27.9	-2.6	5.5
-5.96	-142.	149.	-1.	-27.8	-3.4	6.4
-7.97	-142.	150.	-1.	-26.7	-3.4	6.4
I.A. =	28.1					
1.01	-271.	60.	-9.	-43.2	-1.5	17.8
0.04	-219.	99.	-4.	-40.8	-2.9	11.3
-0.94	-175.	123.	-3.	-39.4	-3.1	6.5
-1.95	-157.	138.	-2.	-35.3	-2.8	5.4
-3.94	-143.	143.	-1.	-36.9	-4.2	5.8
-5.96	-141.	148.	-3.	-36.1	-3.4	6.2
-7.97	-141.	146.	-3.	-36.9	-3.4	6.2

5-3-6 S.A. DEG	5-3-6 P.L. IN	5-3-6 I.A DEG	5-3-6 V. MPH	5-3-6 N.F.Y. FY/FZ
I.A. =	0.			
1.	12.04	0.	30.	0.33
0.04	12.04	0.	30.	0.05
-0.94	12.04	0.	30.	-0.25
-1.95	12.02	0.	30.	-0.46
-3.94	11.99	0.	30.	-0.75
-5.96	11.96	0.	30.	-0.98
-7.97	11.95	0.	30.	-1.04
I.A. =	10.02			
1.03	12.02	10.02	30.	0.17
0.03	12.06	10.02	30.	-0.11
-0.94	12.08	10.02	30.	-0.41
-1.95	12.1	10.02	30.	-0.65
-3.94	12.1	10.02	30.	-0.9
-5.96	12.1	10.02	30.	-1.05
-7.97	12.1	10.02	30.	-1.11
I.A. =	20.07			
1.03	12.08	20.07	30.	-0.05
0.04	12.15	20.07	30.	-0.31
-0.94	12.21	20.07	30.	-0.6
-1.95	12.24	20.07	30.	-0.78
-3.94	12.25	20.08	30.	-0.98
-5.96	12.26	20.08	30.	-1.05
-7.97	12.25	20.08	30.	-1.06
I.A. =	28.1			
1.01	12.16	28.1	30.	-0.22
0.04	12.25	28.1	30.	-0.45
-0.94	12.33	28.1	30.	-0.7
-1.95	12.36	28.1	30.	-0.88
-3.94	12.39	28.08	30.	-1.
-5.96	12.38	28.1	30.	-1.05
-7.97	12.39	28.08	30.	-1.04

6-3-6 S.A. DEG	6-3-6 F.Z. LB	6-3-6 F.Y. LB	6-3-6 F.X. LB	6-3-6 M.X. FT-LB	6-3-6 M.Y. FT-LB	6-3-6 M.Z. FT-LB
I.A. =	0.					
1.	-247.	-87.	-5.	1.5	1.5	9.
0.04	-252.	-22.	-4.	1.1	1.4	5.6
-0.94	-251.	45.	-3.	-2.7	2.2	0.1
-1.95	-249.	103.	-4.	-4.5	1.2	-1.1
-3.94	-247.	198.	-5.	-7.3	2.2	-1.5
-5.96	-250.	253.	-5.	-10.7	2.1	2.4
-7.97	-249.	281.	-6.	-12.3	2.4	5.4
I.A. =	10.02					
1.03	-276.	-36.	-6.	-14.4	0.6	13.2
0.04	-258.	24.	-6.	-15.8	1.5	7.8
-0.94	-237.	88.	-4.	-14.5	0.5	3.3
-1.95	-219.	135.	-4.	-15.5	0.6	1.
-3.94	-198.	187.	-5.	-17.8	0.9	1.8
-5.96	-186.	212.	-4.	-18.7	-0.1	4.8
-7.97	-188.	222.	-4.	-17.4	0.1	5.8
I.A. =	20.07					
1.03	-296.	24.	-8.	-31.5	-0.6	17.5
0.04	-252.	79.	-5.	-31.1	-0.7	10.7
-0.94	-214.	126.	-4.	-28.4	-0.6	5.1
-1.95	-189.	153.	-4.	-27.3	0.3	3.1
-3.94	-167.	177.	-3.	-28.5	-1.7	4.6
-5.96	-160.	184.	-3.	-28.5	-2.4	6.5
-7.97	-161.	187.	-2.	-27.6	-3.2	7.3
I.A. =	28.1					
1.01	-309.	78.	-11.	-44.7	-1.6	21.1
0.04	-253.	117.	-8.	-42.4	-0.7	12.2
-0.94	-206.	147.	-4.	-39.	-2.2	6.7
-1.95	-183.	167.	-4.	-37.7	-1.1	4.9
-3.93	-164.	175.	-3.	-37.8	-3.3	6.1
-5.96	-160.	180.	-2.	-35.4	-4.2	6.8
-7.97	-160.	179.	-2.	-35.5	-3.7	7.

6-3-6 S.A. DEG	6-3-6 R.L. IN	6-3-6 I.A. DEG	6-3-6 U MPH	6-3-6 N.F.Y. FY/FZ		
I.A. =	0.					
1.	11.96	0	30.	0.35		
0.04	11.96	0.	30.	0.09		
-0.94	11.96	0.	30.	-0.18		
-1.95	11.94	0.	30.	-0.41		
-3.94	11.89	0.	30.	-0.8		
-5.96	11.84	0.	30.	-1.01		
-7.97	11.81	0	30.	-1.13		
I.A. =	10.02					
1.03	11.94	10.02	30.	0.13		
0.04	11.97	10.02	30.	-0.09		
-0.94	12.01	10.02	30.	-0.37		
-1.95	12.02	10.02	30.	-0.61		
-3.94	12.03	10.02	30.	-0.95		
-5.96	12.03	10.02	30.	-1.14		
-7.97	12.02	10.02	30.	-1.18		
I.A. =	20.07					
1.03	12.	20.07	30.	-0.08		
0.04	12.07	20.07	30.	-0.31		
-0.94	12.13	20.07	30.	-0.59		
-1.95	12.17	20.07	30.	-0.81		
-3.94	12.2	20.07	30.	-1.05		
-5.96	12.2	20.07	30.	-1.15		
-7.97	12.2	20.07	30.	-1.16		
I.A. =	28.1					
1.01	12.07	28.1	30.	-0.25		
0.04	12.17	28.1	30.	-0.46		
-0.94	12.27	28.08	30.	-0.72		
-1.95	12.3	28.1	30.	-0.91		
-3.93	12.33	28.08	30.	-1.07		
-5.96	12.33	28.08	30.	-1.13		
-7.97	12.33	28.1	30.	-1.12		

7-3-6 S.A. DEG	7-3-6 F.Z. LB	7-3-6 F.Y. LB	7-3-6 F.X. LB	7-3-6 M.X. FT-LB	7-3-6 M.Y. FT-LB	7-3-6 M.Z. FT-LB
I.A. =	0.					
1.	-315.	-50.	-5.	1.6	1.2	10.7
0.04	-315.	4.	-5.	-1.1	1.6	5.3
-0.94	-314.	61.	-4.	-2.7	1.6	-0.1
-1.95	-313.	111.	-6.	-5.3	2.2	-4.5
-3.94	-316	194.	-8.	-10.9	4.1	-6.1
-5.96	-316.	260.	-6.	-14.3	2.4	-3.1
-7.97	-318.	300.	-8.	-15.8	4.1	-0.3
I.A. =	10.02					
1.03	-335.	5.	-7.	-18.1	1.9	14.
0.04	-315.	60.	-5.	-20.	0.6	8.4
-0.94	-294.	112.	-4.	-22.6	0.2	3.
-1.95	-279.	157.	-4.	-23.9	0.1	-0.4
-3.94	-257.	220.	-3.	-25.9	-0.6	-0.7
-5.96	-246.	253.	-4.	-28.	0.1	2.3
-7.97	-242.	263.	-2.	-25.8	-2.3	5.2
I.A. =	20.07					
1.03	-349.	64.	-9.	-41.5	0.2	17.3
0.04	-315.	109.	-6.	-39.7	-0.1	10.6
-0.94	-281.	148.	-3.	-40.7	-2.2	4.4
-1.95	-252.	176.	-2.	-39.9	-2.1	2.1
-3.93	-226.	213.	-1.	-38.2	-2.8	2.9
-5.95	-215.	227.	-3.	-36.9	-1.4	4.3
-7.97	-212.	233.	-2.	-35.7	-2.7	5.
I.A. =	28.1					
1.01	-373.	112.	-13.	-58.1	0.1	20.4
0.04	-328.	148.	-7.	-55.3	-1.3	12.8
-0.94	-284.	174.	-6.	-54.9	-0.4	6.2
-1.95	-259.	192.	-3.	-53.9	-1.2	3.4
-3.94	-232.	213.	-3.	-51.4	-2.	4.1
-5.96	-222.	217.	-2.	-50.8	-3.4	4.6
-7.97	-221.	222.	-4.	-50.9	-2.2	6.2

7-3-6 S.A. DEG	7-3-6 P.L. IN	7-3-6 I.A. DEG	7-3-6 V MPH	7-3-6 N.F.Y. FY/FZ
I.A. =	0			
1	12.25	0.	30.	0.16
0.04	12.25	0.	30.	-0.01
-0.94	12.25	0.	30.	-0.19
-1.95	12.24	0.	30.	-0.36
-3.94	12.18	0.	30.	-0.61
-5.96	12.13	0.	30.	-0.82
-7.97	12.08	0.	30.	-0.94
I.A. =	10.02			
1.03	12.24	10.02	30.	-0.01
0.04	12.27	10.02	30.	-0.19
-0.94	12.3	10.02	30.	-0.38
-1.95	12.31	10.02	30.	-0.56
-3.94	12.31	10.02	30.	-0.85
-5.96	12.32	10.02	30.	-1.03
-7.97	12.31	10.02	30.	-1.09
I.A. =	20.07			
1.03	12.32	20.07	30.	-0.18
0.04	12.39	20.07	30.	-0.35
-0.94	12.44	20.07	30.	-0.53
-1.95	12.47	20.07	30.	-0.7
-3.93	12.52	20.07	30.	-0.95
-5.96	12.53	20.08	30.	-1.06
-7.97	12.53	20.08	30.	-1.1
I.A. =	28.1			
1.01	12.4	28.1	30.	-0.3
0.04	12.48	28.1	30.	-0.45
-0.94	12.57	28.1	30.	-0.61
-1.95	12.63	28.1	30.	-0.74
-3.94	12.67	28.1	30.	-0.92
-5.96	12.68	28.1	30.	-0.98
-7.97	12.7	28.1	30.	-1.

8-3-6 S.A. DEG	8-3-6 F.Z. LB	8-3-6 F.Y. LB	8-3-6 F.X. LB	8-3-6 M.X. FT-LB	8-3-6 M.Y. FT-LB	8-3-6 M.Z. FT-LB
I.A. =	0.					
1.	-237.	-53.	-4.	3.2	1.2	7.2
0.04	-241.	2.	-5.	0.9	1.4	3.9
-0.94	-238.	63.	-4.	0.1	1.2	0.6
-1.95	-243.	110.	-3.	-2.4	0.5	0.3
-3.94	-241.	167.	-3.	-3.8	0.5	2.2
-5.96	-241.	198.	-4.	-5.5	1.4	4.2
-7.97	-240.	213.	-3.	-6.8	0.5	6.1
I.A. =	10.02					
1.03	-258.	-12.	-4.	-15.8	-0.8	11.2
0.04	-238.	44.	-5.	-17.5	1.4	6.1
-0.94	-221.	94.	-3.	-18.2	-0.7	3.4
-1.95	-211.	126.	-3.	-18.4	-0.	3.3
-3.93	-200.	146.	-3.	-19.2	-0.9	5.2
-5.96	-196.	155.	-4.	-18.7	-0.	5.4
-7.97	-200.	159.	-3.	-17.1	-0.2	4.3
I.A. =	20.07					
1.03	-279.	32.	-7.	-33.	0.1	12.9
0.03	-246.	74.	-5.	-32.2	-0.3	8.1
-0.94	-219.	107.	-3.	-31.3	-0.6	4.5
-1.95	-202.	120.	-1.	-32.3	-2.2	4.8
-3.94	-194.	126.	-3.	-33.4	-1.	4.2
-5.96	-194.	133.	-3.	-31.3	-1.8	5.
-7.97	-188.	137.	-3.	-32.8	-1.8	5.
I.A. =	28.1					
1.01	-313.	71.	-11.	-49.8	1.9	16.
0.04	-267.	96.	-6.	-47.4	0.3	10.
-0.94	-232.	120.	-4.	-47.7	-1.3	5.4
-1.95	-218.	137.	-4.	-44.9	-0.2	4.7
-3.94	-207.	146.	-4.	-44.7	-1.6	5.1
-5.96	-199.	153.	-4.	-44.9	-1.1	5.4
-7.97	-193.	153.	-4.	-45.	-1.5	5.1

8-3-6 S.A. DEG	8-3-6 P.L. IN	8-3-6 I.A DEG	8-3-6 U MPH	8-3-6 N.F.Y. FY/FZ		
I.A. =	0.					
1.	12.84	0.	30.	0.22		
0.04	12.85	0.	30.	-0.01		
-0.94	12.84	0.	30.	-0.26		
-1.95	12.83	0.	30.	-0.45		
-3.94	12.81	0.	30.	-0.69		
-5.96	12.79	0.	30.	-0.82		
-7.97	12.78	0.	30.	-0.89		
I.A. =	10.02					
1.03	12.82	10.02	30.	0.04		
0.04	12.86	10.02	30.	-0.19		
-0.94	12.88	10.02	30.	-0.43		
-1.95	12.91	10.02	30.	-0.6		
-3.93	12.92	10.02	30.	-0.73		
-5.96	12.91	10.02	30.	-0.79		
-7.97	12.9	10.02	30.	-0.8		
I.A =	20.07					
1.03	12.87	20.07	30.	-0.11		
0.03	12.93	20.08	30.	-0.3		
-0.94	13.	20.07	30.	-0.49		
-1.95	13.01	20.07	30.	-0.59		
-3.94	13.02	20.07	30.	-0.65		
-5.96	13.03	20.07	30.	-0.68		
-7.97	13.03	20.07	30.	-0.73		
I.A =	28.1					
1.01	12.93	28.1	30.	-0.23		
0.04	13.02	28.1	30.	-0.36		
-0.94	13.07	28.1	30.	-0.52		
-1.95	13.13	28.08	30.	-0.63		
-3.94	13.15	28.08	30.	-0.71		
-5.96	13.17	28.1	30.	-0.77		
-7.97	13.17	28.1	30.	-0.8		

9-3-6 S.A. DEG	9-3-6 F.Z. LB	9-3-6 F.Y. LB	9-3-6 F.X. LB	9-3-6 M.X. FT-LB	9-3-6 M.Y. FT-LB	9-3-6 M.Z. FT-LB
I.A. =	0.					
1.	-288.	-73.	-5.	2.7	2.4	8.3
0.04	-285.	-12.	-4.	1.5	1.4	4.9
-0.94	-291.	51.	-4.	-0.1	1.2	0.5
-1.95	-284.	98.	-6.	-4.3	2.8	-1.7
-3.93	-289.	170.	-6.	-6.4	3.4	-0.9
-5.96	-290.	221.	-6.	-9.	3.4	0.9
-7.97	-290.	252.	-5.	-11.1	2.	3.8
I.A. =	10.02					
1.03	-313.	-17.	-7.	-13.	2.2	11.9
0.04	-291.	40.	-5.	-14.9	1.6	7.2
-0.94	-273.	92.	-4.	-16.3	0.7	3.6
-1.93	-263.	125.	-4.	-17.6	0.9	2.5
-3.93	-248.	164.	-3.	-19.7	1.1	2.4
-5.96	-241.	189.	-3.	-20.3	0.3	4.2
-7.97	-233.	206.	-4.	-20.7	0.6	5.3
I.A. =	20.08					
1.01	-343.	37.	-9.	-30.9	1.3	15.7
0.04	-304.	82.	-7.	-30.7	1.8	10.1
-0.94	-271.	119.	-4.	-30.5	-0.1	5.7
-1.95	-251.	139.	-3.	-31.5	-0.5	4.3
-3.93	-230.	166.	-2.	-29.	-1.2	3.9
-5.96	-224.	180.	-3.	-28.5	-0.8	4.1
-7.97	-214.	193.	-4.	-28.2	-0.3	5.3
I.A. =	28.1					
1.01	-368.	94.	-12.	-44.3	1.4	19.2
0.04	-326.	129.	-9.	-41.6	0.8	12.6
-0.94	-286.	156.	-5.	-41.5	-0.1	7.2
-1.93	-262.	165.	-5.	-42.4	0.1	6.
-3.93	-242.	189.	-5.	-40.4	-0.1	4.6
-5.96	-229.	192.	-4.	-39.3	-1.	5.3
-7.97	-220.	198.	-4.	-40.3	-0.9	5.2

9-3-6 S.A. DEG	9-3-6 R.L. IN	9-3-6 I.A. DEG	9-3-6 U MPH	9-3-6 N.F.Y. FY/FZ		
I.A. =	0.					
1.	12.77	0.	30.	0.25		
0.04	12.78	0.	30.	0.04		
-0.94	12.77	0.	30.	-0.18		
-1.95	12.76	0.	30.	-0.35		
-3.93	12.73	0.	30.	-0.59		
-5.96	12.7	0.	30.	-0.76		
-7.97	12.68	0.	30.	-0.87		
I.A. =	10.02					
1.03	12.73	10.02	30.	0.05		
0.04	12.77	10.02	30.	-0.14		
-0.94	12.8	10.02	30.	-0.34		
-1.93	12.82	10.02	30.	-0.47		
-3.93	12.83	10.02	30.	-0.66		
-5.96	12.84	10.02	30.	-0.78		
-7.97	12.84	10.02	30.	-0.88		
I.A. =	20.08					
1.01	12.76	20.08	30.	-0.11		
0.04	12.84	20.07	30.	-0.27		
-0.94	12.9	20.07	30.	-0.44		
-1.95	12.92	20.07	30.	-0.55		
-3.93	12.95	20.07	30.	-0.72		
-5.96	12.98	20.08	30.	-0.8		
-7.97	13.	20.07	30.	-0.9		
I.A. =	28.1					
1.01	12.83	28.1	30.	-0.26		
0.04	12.93	28.1	30.	-0.4		
-0.94	13.01	28.1	30.	-0.54		
-1.93	13.04	28.08	30.	-0.63		
-3.93	13.11	28.1	30.	-0.78		
-5.96	13.11	28.1	30.	-0.84		
-7.97	13.12	28.08	30.	-0.9		

10-3-6 S.A. DEG	10-3-6 F.Z. LB	10-3-6 F.Y. LB	10-3-6 F.X. LB	10-3-6 M.X. FT-LB	10-3-6 M.Y. FT-LB	10-3-6 M.Z. FT-LB
I.A. =	0.					
1.	-361.	-58.	-6.	1.7	3.7	9.5
0.04	-359.	4.	-6.	-3.2	2.6	5.2
-0.94	-363.	72.	-6.	-3.8	3.5	0.7
-1.95	-359.	126.	-6.	-5.9	3.7	-1.6
-3.94	-361.	202.	-8.	-9.6	4.7	0.1
-5.96	-361.	248.	-6.	-12.6	3.2	4.1
-7.97	-359.	272.	-7.	-12.	3.6	5.
I.A. =	10.02					
1.03	-384.	-2.	-7.	-20.2	2.6	14.1
0.03	-361.	60.	-6.	-21.6	2.1	8.6
-0.94	-342.	115.	-4.	-24.	1.	4.
-1.95	-328.	155.	-5.	-22.7	1.1	1.8
-3.94	-310.	200.	-5.	-24.5	2.	2.8
-5.96	-298.	233.	-5.	-25.7	1.6	4.7
-7.97	-294.	247.	-4.	-25.7	-0.2	6.5
I.A. =	20.07					
1.03	-405.	65.	-11.	-43.7	2.6	16.9
0.04	-366.	118.	-9.	-42.6	2.2	11.2
-0.94	-331.	160.	-6.	-40.9	1.	6.4
-1.95	-307.	186.	-5.	-43.2	0.7	5.1
-3.94	-282.	213.	-3.	-40.4	-0.9	5.6
-5.96	-270.	226.	-4.	-38.2	-0.5	5.6
-7.97	-261.	235.	-4.	-38.6	-1.2	6.4
I.A. =	28.1					
1.01	-431.	125.	-14.	-63.1	2.1	22.4
0.03	-382.	164.	-9.	-59.5	0.6	14.7
-0.94	-335.	191.	-5.	-58.8	-1.2	8.
-1.95	-307.	211.	-5.	-55.6	-0.9	5.8
-3.94	-282.	233.	-5.	-55.	-0.7	5.8
-5.96	-274.	240.	-5.	-55.6	-0.3	7.
-7.97	-266.	239.	-3.	-54.6	-3.	6.9

10-3-6 S.A. DEG	10-3-6 R.L. IN	10-3-6 I.A DEG	10-3-6 U MPH	10-3-6 N.F.Y. FY/FZ
I.A. =	0			
1	12.6	0	30	0.16
0.04	12.6	0	30	-0.01
-0.94	12.61	0	30	-0.2
-1.95	12.6	0	30	-0.35
-3.94	12.57	0	30	-0.56
-5.96	12.54	0	30	-0.69
-7.97	12.53	0	30	-0.76
I.A. =	10.02			
1.03	12.62	10.02	30	0.01
0.03	12.65	10.03	30	-0.17
-0.94	12.68	10.02	30	-0.33
-1.95	12.68	10.03	30	-0.47
-3.94	12.7	10.02	30	-0.65
-5.96	12.7	10.02	30	-0.78
-7.97	12.7	10.02	30	-0.84
I.A. =	20.07			
1.03	12.7	20.07	30	-0.16
0.04	12.76	20.07	30	-0.32
-0.94	12.81	20.07	30	-0.48
-1.95	12.86	20.07	30	-0.6
-3.94	12.87	20.08	30	-0.75
-5.96	12.89	20.08	30	-0.84
-7.97	12.9	20.07	30	-0.9
I.A. =	28.1			
1.01	12.82	28.1	30	-0.29
0.03	12.88	28.1	30	-0.43
-0.94	12.95	28.1	30	-0.57
-1.95	13	28.1	30	-0.69
-3.94	13.04	28.1	30	-0.83
-5.96	13.05	28.1	30	-0.88
-7.97	13.05	28.08	30	-0.9

11-3-6 S.A. DEG	11-3-6 F.Z. LB	11-3-6 F.Y. LB	11-3-6 F.X. LB	11-3-6 M.X. FT-LB	11-3-6 M.Y. FT-LB	11-3-6 M.Z. FT-LB
I.A. =	0.					
1.	-429.	-75.	-8.	2.9	4.8	10.4
0.04	-431.	-10.	-8.	-0.5	5.3	4.9
-0.94	-430.	57.	-9.	-6.1	5.7	-1.6
-1.95	-430.	117.	-8.	-8.	5.1	-5.
-3.94	-432.	225.	-10.	-13.4	7.1	-6.6
-5.96	-432.	303.	-9.	-17.3	6.3	-2.7
-7.97	-430.	354.	-9.	-23.9	6.2	1.3
I.A. =	10.02					
1.03	-456.	1.	-10.	-23.1	4.3	16.2
0.04	-437.	66.	-8.	-24.1	3.7	9.6
-0.94	-412.	126.	-6.	-26.6	3.	3.1
-1.95	-393.	176.	-6.	-27.9	2.9	-0.3
-3.94	-373.	250.	-7.	-28.8	4.6	-0.4
-5.96	-356.	293.	-8.	-31.4	4.4	2.5
-7.97	-349.	315.	-7.	-31.4	3.4	5.5
I.A. =	20.07					
1.03	-487.	84.	-14.	-50.5	4.	22.7
0.04	-442.	138.	-9.	-50.7	1.9	14.3
-0.94	-402.	186.	-8.	-49.2	2.8	6.7
-1.95	-371.	221.	-6.	-48.8	2.9	3.4
-3.94	-333.	268.	-7.	-48.1	3.1	3.2
-5.96	-309.	289.	-5.	-48.8	0.2	5.5
-7.97	-304.	303.	-6.	-47.4	1.2	6.8
I.A. =	28.1					
1.01	-512.	164.	-18.	-75.5	3.2	28.4
0.03	-452.	200.	-12.	-73.7	2.	17.4
-0.94	-402.	235.	-7.	-69.5	0.5	9.7
-1.95	-364.	259.	-6.	-68.1	1.5	5.5
-3.94	-329.	290.	-7.	-65.6	1.2	5.2
-5.96	-308.	298.	-4.	-63.9	-2.4	7.
-7.97	-300.	304.	-6.	-63.1	-0.7	7.7

11-3-6 S.A. DEG	11-3-6 R.L. IN	11-3-6 I A DEG	11-3-6 U. MPH	11-3-6 N.F.Y. FY/FZ
I.A. =	0.			
1.	12.52	0.	30.	0.17
0.04	12.52	0.	30.	0.02
-0.94	12.52	0.	30.	-0.13
-1.95	12.5	0.	30.	-0.27
-3.94	12.46	0.	30.	-0.52
-5.96	12.42	0.	30.	-0.7
-7.97	12.38	0.	30.	-0.82
I.A. =	10.02			
1.03	12.53	10.02	30.	-0.
0.04	12.56	10.02	30.	-0.15
-0.94	12.59	10.02	30.	-0.31
-1.95	12.6	10.02	30.	-0.45
-3.94	12.61	10.02	30.	-0.67
-5.96	12.61	10.02	30.	-0.82
-7.97	12.61	10.02	30.	-0.9
I.A. =	20.07			
1.03	12.61	20.07	30.	-0.17
0.04	12.67	20.07	30.	-0.31
-0.94	12.73	20.07	30.	-0.46
-1.95	12.77	20.07	30.	-0.6
-3.94	12.8	20.07	30.	-0.8
-5.96	12.83	20.08	30.	-0.94
-7.97	12.84	20.08	30.	-1.
I.A. =	28.1			
1.01	12.74	28.1	30.	-0.32
0.03	12.81	28.1	30.	-0.44
-0.94	12.88	28.1	30.	-0.58
-1.95	12.93	28.1	30.	-0.71
-3.94	13.	28.1	30.	-0.88
-5.96	13.	28.1	30.	-0.97
-7.97	13.02	28.1	30.	-1.01

12-3-6 S.A. DEG	12-3-6 F.Z. LB	12-3-6 F.Y LB	12-3-6 F.X. LB	12-3-6 M.X. FT-LB	12-3-6 M.Y. FT-LB	12-3-6 M.Z. FT-LB
I A. =	0.					
1.	-214.	-46.	-3.	1.5	0.3	6.2
0.04	-219.	4.	-5.	2.	1.4	4.
-0.94	-218.	56.	-4.	2.4	0.8	1.6
-1.95	-218.	99.	-4.	-0.1	1.4	0.5
-3.94	-216.	148.	-6.	-2.	2.3	2.4
-5.96	-217.	179.	-6.	-3.8	2.3	4.3
-7.96	-220.	193.	-4.	-3.2	1.3	6.3
I A. =	10.02					
1.03	-238.	-27.	-4.	-10.4	0.3	8.4
0.04	-222.	25.	-5.	-12.6	1.5	5.2
-0.94	-205.	70.	-2.	-13.	-0.7	3.5
-1.93	-195.	101.	-3.	-13.2	-0.5	2.4
-3.93	-182.	130.	-3.	-13.7	-0.3	4.4
-5.96	-180.	140.	-4.	-13.5	-0.1	5.5
-7.96	-177.	148.	-3.	-14.2	-0.7	6.4
I A. =	20.07					
1.03	-260.	13.	-7.	-26.1	1.1	10.1
0.04	-232.	53.	-4.	-25.9	-0.8	6.9
-0.94	-203.	85.	-4.	-24.6	0.1	3.8
-1.95	-183.	105.	-3.	-25.4	-0.3	2.4
-3.93	-170.	125.	-1.	-25.	-3.1	4.5
-5.96	-164.	127.	-3.	-23.8	-1.8	5.
-7.96	-164.	129.	-2.	-25.2	-2.6	5.8
I.A. =	28.1					
1.01	-284.	54.	-9.	-42.7	0.8	14.2
0.04	-238.	86.	-6.	-40.9	0.9	8.1
-0.94	-203.	108.	-4.	-38.4	-1.3	5.5
-1.95	-182.	119.	-4.	-38.9	-0.7	4.6
-3.93	-164.	130.	-2.	-37.3	-3.3	5.4
-5.95	-160.	136.	-4.	-37.1	-1.6	5.2
-7.96	-159.	139.	-3.	-35.8	-2.	6.1

12-3-6 S.A. DEG	12-3-6 R.L IN	12-3-6 I.A. DEG	12-3-6 U MPH	12-3-6 N.F.Y. FY/FZ
I.A. =	0.			
1.	12.91	0	30.	0.22
0.04	12.92	0	30.	-0.02
-0.94	12.92	0	30.	-0.26
-1.95	12.91	0	30.	-0.45
-3.94	12.9	0	30.	-0.68
-5.96	12.88	0.	30.	-0.82
-7.96	12.88	0.	30.	-0.88
I.A. =	10.02			
1.03	12.87	10.02	30.	0.11
0.04	12.91	10.02	30.	-0.11
-0.94	12.94	10.02	30.	-0.34
-1.93	12.95	10.02	30.	-0.52
-3.93	12.97	10.02	30.	-0.71
-5.96	12.97	10.02	30.	-0.78
-7.96	12.97	10.02	30.	-0.83
I.A =	20.07			
1.03	12.89	20.07	30.	-0.05
0.04	12.94	20.07	30.	-0.23
-0.94	13.	20.07	30.	-0.42
-1.95	13.02	20.07	30.	-0.57
-3.93	13.05	20.07	30.	-0.73
-5.96	13.07	20.07	30.	-0.78
-7.96	13.07	20.07	30.	-0.79
I.A. =	28.1			
1.01	12.94	28.1	30.	-0.19
0.04	13.03	28.1	30.	-0.36
-0.94	13.1	28.1	30.	-0.53
-1.95	13.13	28.1	30.	-0.66
-3.93	13.15	28.08	30.	-0.79
-5.95	13.17	28.1	30.	-0.85
-7.96	13.17	28.1	30.	-0.87

13-3-6 S.A. DEG	13-3-6 F.Z. LB	13-3-6 F.Y. LB	13-3-6 F.X. LB	13-3-6 M.X. FT-LB	13-3-6 M.Y. FT-LB	13-3-6 M.Z. FT-LB
I.A. =	0.					
1.	-258.	-53.	-5.	3.7	2.6	6.2
0.04	-261.	-1.	-6.	3.	2.8	4.
-0.94	-259.	55.	-5.	2.	2.1	0.6
-1.95	-261.	99.	-5.	-1.1	2.3	-0.6
-3.93	-261.	152.	-6.	-2.7	3.3	1.3
-5.96	-260.	187.	-6.	-4.	3.2	3.2
-7.96	-261.	227.	-6.	-3.6	2.9	4.
I.A. =	10.02					
1.03	-285.	-28.	-6.	-11.7	2.3	9.8
0.04	-266.	25.	-5.	-12.6	0.9	6.1
-0.94	-253.	72.	-4.	-14.2	1.3	2.8
-1.93	-240.	108.	-4.	-14.	1.2	1.6
-3.93	-223.	146.	-4.	-14.2	0.4	3.4
-5.96	-214.	168.	-3.	-15.4	-0.2	4.2
-7.96	-210.	175.	-4.	-16.2	0.7	4.4
I.A. =	20.07					
1.03	-306.	30.	-8.	-27.9	2.1	12.7
0.04	-271.	70.	-8.	-29.1	3.4	7.4
-0.94	-240.	104.	-4.	-27.6	0.2	4.8
-1.95	-225.	127.	-5.	-28.5	1.1	2.8
-3.94	-206.	144.	-4.	-28.3	0.4	4.7
-5.95	-201.	153.	-4.	-29.1	-0.9	5.3
-7.96	-198.	157.	-5.	-28.8	0.4	5.8
I.A. =	28.1					
1.11	-334.	75.	-11.	-43.3	1.7	17.1
0.14	-287.	108.	-8.	-43.2	0.6	10.2
-0.94	-252.	137.	-5.	-40.3	-0.	6.1
-1.95	-220.	147.	-4.	-42.4	-0.2	4.7
-3.93	-200.	166.	-4.	-39.7	-1.	5.3
-5.95	-190.	170.	-3.	-39.4	-1.9	6.
-7.96	-186.	170.	-3.	-40.	-1.9	6.

13-3-6 S.A. DEG	13-3-6 R.L. IN	13-3-6 I.A. DEG	13-3-6 V. MPH	13-3-6 N.F.Y. FY/FZ		
I.A. =	0.					
1.	12.86	0.	30.	0.21		
0.04	12.86	0.	30.	0.		
-0.94	12.86	0.	30.	-0.21		
-1.95	12.85	0.	30.	-0.38		
-3.93	12.83	0.	30.	-0.58		
-5.96	12.81	0.	30.	-0.72		
-7.96	12.79	0.	30.	-0.87		
I.A. =	10.02					
1.03	12.79	10.02	30.	0.1		
0.04	12.83	10.02	30.	-0.09		
-0.94	12.86	10.02	30.	-0.28		
-1.93	12.87	10.02	30.	-0.45		
-3.93	12.89	10.02	30.	-0.66		
-5.96	12.9	10.02	30.	-0.78		
-7.96	12.9	10.02	30.	-0.83		
I.A. =	20.07					
1.03	12.83	20.07	30.	-0.1		
0.04	12.89	20.07	30.	-0.26		
-0.94	12.94	20.07	30.	-0.44		
-1.95	12.97	20.07	30.	-0.56		
-3.94	13.	20.07	30.	-0.7		
-5.95	13.	20.08	30.	-0.76		
-7.96	13.	20.08	30.	-0.79		
I.A. =	28.1					
1.01	12.86	28.1	30.	-0.22		
0.04	12.96	28.1	30.	-0.37		
-0.94	13.04	28.1	30.	-0.54		
-1.95	13.07	28.1	30.	-0.67		
-3.93	13.12	28.1	30.	-0.83		
-5.95	13.13	28.1	30.	-0.9		
-7.96	13.13	28.1	30.	-0.91		

14-3-6 S.A. DEG	14-3-6 F.Z. LB	14-3-6 F.Y LB	14-3-6 F.X. LB	14-3-6 M.X. FT-LB	14-3-6 M.Y. FT-LB	14-3-6 M.Z. FT-LB
I.A. =	0.					
0.98	-270.	-52.	-3.	1.9	0.2	7.8
0.04	-267.	-6.	-4.	-0.9	1.5	4.5
-0.95	-268.	45.	-3.	-1.6	0.8	2.2
-1.95	-266.	84.	-4.	-3.3	1.4	1.
-3.94	-268	136.	-5.	-5.4	2.4	0.7
-5.96	-269.	169.	-5.	-4.	1.9	2.6
-7.96	-268.	191.	-4.	-4.9	2.	3.6
I.A. =	10.02					
1.03	-290.	-24.	-5.	-20.3	0.6	8.9
0.04	-274.	22.	-4.	-19.	0.9	6.7
-0.94	-265.	63.	-4.	-20.5	0.2	3.2
-1.95	-248.	92.	-4.	-21.1	1.5	2.2
-3.94	-235.	126.	-4.	-20.8	1.1	2.
-5.96	-230.	150.	-4.	-21.3	0.5	2.9
-7.96	-229.	158.	-3.	-21.3	-1.3	4.8
I.A. =	20.07					
1.01	-326.	19.	-7.	-36.2	0.4	12.3
0.04	-301.	53.	-6.	-36.7	0.8	9.
-0.94	-278.	83.	-3.	-36.	-1.4	6.1
-1.95	-257.	103.	-5.	-35.1	1.8	3.7
-3.94	-238.	126.	-3.	-34.4	-1.7	4.7
-5.96	-226.	141.	-3.	-34.2	-0.8	3.8
-7.96	-220.	152.	-2.	-33.5	-2.4	4.4
I.A. =	28.1					
1.03	-366.	66.	-9.	-54.2	-0.1	14.9
0.04	-329.	91.	-8.	-51.2	1.4	10.9
-0.94	-297.	109.	-7.	-49.3	1.	7.2
-1.93	-277.	123.	-3.	-49.8	-2.	5.8
-3.93	-260.	139.	-3.	-47.9	-1.9	5.7
-5.96	-252.	140	-5.	-48.3	-0.	5.4
-7.97	-246.	146.	-4.	-47.5	-1.3	4.8

14-3-6 S.A. DEG	14-3-6 P.L. IN	14-3-6 I.A. DEG	14-3-6 V. MPH	14-3-6 N.F.Y. FY/FZ		
I.A. =	0.					
0.98	13.04	0.	30.	0.19		
0.04	13.05	0.	30.	0.02		
-0.95	13.04	0.	30.	-0.17		
-1.95	13.04	0.	30.	-0.32		
-3.94	13.03	0.	30.	-0.51		
-5.96	13.02	0.	30.	-0.63		
-7.96	13.01	0.	30.	-0.71		
I.A. =	10.02					
1.03	13.03	10.02	30.	0.08		
0.04	13.06	10.02	30.	-0.08		
-0.94	13.09	10.02	30.	-0.24		
-1.95	13.11	10.02	30.	-0.37		
-3.94	13.12	10.02	30.	-0.54		
-5.96	13.13	10.02	30.	-0.65		
-7.96	13.13	10.02	30.	-0.69		
I.A. =	20.07					
1.01	13.13	20.07	30.	-0.06		
0.04	13.17	20.07	30.	-0.18		
-0.94	13.21	20.07	30.	-0.3		
-1.95	13.23	20.07	30.	-0.4		
-3.94	13.25	20.08	30.	-0.53		
-5.96	13.26	20.07	30.	-0.62		
-7.96	13.28	20.07	30.	-0.69		
I.A. =	28.1					
1.03	13.24	28.1	30.	-0.18		
0.04	13.3	28.1	30.	-0.28		
-0.94	13.35	28.1	30.	-0.37		
-1.93	13.38	28.1	30.	-0.44		
-3.93	13.42	28.08	30.	-0.54		
-5.96	13.41	28.1	30.	-0.56		
-7.97	13.43	28.08	30.	-0.6		

15-3-6 S.A. DEG	15-3-6 F.Z LB	15-3-6 F.Y LB	15-3-6 F.X. LB	15-3-6 M.X. FT-LB	15-3-6 M.Y. FT-LB	15-3-6 M.Z. FT-LB
I.A. =	0.					
1.	-326.	-62.	-5.	1.1	2.	7.6
0.04	-323.	-13.	-4.	-2.	1.9	5.4
-0.95	-323.	40.	-4.	-4.	1.7	2.1
-1.95	-323.	82.	-6.	-3.5	2.8	-0.3
-3.94	-322.	137.	-5.	-6.9	2.9	0.6
-5.96	-323.	186.	-7.	-9.3	4.4	-0.8
-7.96	-324.	224.	-6.	-9.5	3.	1.2
I.A. =	10.02					
1.01	-352.	-31.	-6.	-21.4	1.5	11.
0.04	-335.	21.	-5.	-21.5	2.6	6.7
-0.95	-318.	67.	-5.	-21.3	1.6	3.3
-1.95	-305.	102.	-5.	-23.8	1.7	1.1
-3.94	-293.	146.	-5.	-21.3	2.4	1.
-5.95	-282.	177.	-4.	-22.8	1.1	2.8
-7.96	-271.	195.	-5.	-24.	2.1	2.8
I.A. =	20.07					
1.03	-402.	10.	-8.	-43.	0.8	15.7
0.04	-376.	49.	-7.	-40.2	1.2	10.2
-0.94	-348.	86.	-5.	-39.4	1.3	6.9
-1.95	-318.	113.	-4.	-39.3	0.4	4.3
-3.93	-288.	151.	-5.	-40.2	0.9	2.1
-5.95	-266.	178.	-3.	-38.	-0.7	2.6
-7.96	-258.	192.	-4.	-39.6	0.3	2.8
I.A. =	28.1					
1.01	-459.	73.	-13.	-60.	2.5	19.5
0.04	-412.	100.	-11.	-59.2	3.2	14.
-0.94	-376.	125.	-8.	-58.9	1.1	9.5
-1.95	-348.	147.	-5.	-56.6	0.7	6.9
-3.93	-310.	172.	-6.	-54.	1.4	4.8
-5.96	-288.	191.	-5.	-51.5	0.3	4.2
-7.96	-275.	200.	-4.	-52.8	-0.7	4.8

15-3-6 S.A. DEG	15-3-6 P.L. IN	15-3-6 I.A. DEG	15-3-6 V. MPH	15-3-6 N.F.Y. FY/FZ		
I.A. =	0.					
1.	13.	0.	30.	0.19		
0.04	13.	0.	30.	0.04		
-0.95	12.98	0.	30.	-0.12		
-1.95	12.98	0.	30.	-0.25		
-3.94	12.96	0.	30.	-0.43		
-5.96	12.95	0.	30.	-0.58		
-7.96	12.93	0.	30.	-0.69		
I.A. =	10.02					
1.01	12.95	10.02	30.	0.09		
0.04	12.98	10.02	30.	-0.06		
-0.95	13.01	10.02	30.	-0.21		
-1.95	13.03	10.02	30.	-0.33		
-3.94	13.05	10.02	30.	-0.5		
-5.95	13.05	10.02	30.	-0.63		
-7.96	13.06	10.02	30.	-0.72		
I.A. =	20.07					
1.03	13.01	20.07	30.	-0.03		
0.04	13.06	20.07	30.	-0.13		
-0.94	13.11	20.07	30.	-0.25		
-1.95	13.15	20.08	30.	-0.36		
-3.93	13.2	20.07	30.	-0.52		
-5.95	13.22	20.08	30.	-0.67		
-7.96	13.24	20.08	30.	-0.74		
I.A. =	28.1					
1.01	13.09	28.1	30.	-0.16		
0.04	13.17	28.1	30.	-0.24		
-0.94	13.23	28.1	30.	-0.33		
-1.95	13.28	28.1	30.	-0.42		
-3.93	13.34	28.1	30.	-0.55		
-5.96	13.38	28.08	30.	-0.66		
-7.96	13.4	28.1	30.	-0.72		

16-3-6 S.A. DEG	16-3-6 F.Z. LB	16-3-6 F.Y. LB	16-3-6 F.X. LB	16-3-6 M.X. FT-LB	16-3-6 M.Y. FT-LB	16-3-6 M.Z. FT-LB
I.A. =	0.					
1.	-217.	-43.	-5.	-1.5	1.9	6.4
0.03	-217.	-6.	-6.	-4.	2.5	4.2
-0.97	-219.	34.	-5.	-3.1	1.5	1.9
-1.96	-220.	66.	-6.	-5.3	2.3	-0.2
-3.96	-219.	115.	-7.	-5.5	3.3	0.7
-5.98	-218.	146.	-7.	-8.4	3.2	2.7
-7.97	-219.	162.	-5.	-9.6	2.	4.6
I.A. =	10.02					
1.03	-223.	-14.	-6.	-7.3	2.	7.9
0.03	-222.	26.	-6.	-8.8	1.5	5.5
-0.97	-224.	64.	-5.	-8.3	1.9	3.2
-1.95	-222.	94.	-7.	-11.6	2.6	1.2
-3.96	-224.	135.	-6.	-11.6	2.6	2.1
-5.96	-222.	155.	-6.	-13.3	1.7	4.
-7.97	-225.	165.	-7.	-13.4	2.5	4.1
I.A. =	20.07					
1.01	-228.	23.	-7.	-8.6	0.7	9.1
0.03	-229.	60.	-7.	-7.5	1.6	7.1
-0.97	-230.	93.	-5.	-10.6	1.1	5.5
-1.95	-231.	117.	-7.	-11.8	2.1	3.7
-3.96	-235.	157.	-6.	-10.5	1.6	3.3
-5.98	-232.	168.	-6.	-13.4	0.9	5.1
-7.97	-232.	184.	-7.	-12.7	1.6	5.4
I.A. =	28.1					
1.01	-236.	50.	-7.	-7.4	-0.2	10.5
0.03	-241.	84.	-7.	-6.8	0.9	8.6
-0.97	-238.	113.	-6.	-7.8	0.2	6.8
-1.95	-241.	135.	-5.	-9.	0.5	5.6
-3.96	-239.	167.	-5.	-12.	0.4	4.2
-5.98	-239.	178.	-6.	-11.8	0.2	5.2
-7.97	-239.	186.	-7.	-13.4	0.9	5.6

16-3-6 S.A. DEG	16-3-6 R.L. IN	16-3-6 I.A. DEG	16-3-6 U. MPH	16-3-6 N.F.Y. FY/FZ
I.A. =	0.			
1.	11.29	0.	30.	0.2
0.03	11.29	0.	30.	0.03
-0.97	11.29	0.	30.	-0.15
-1.96	11.27	0.	30.	-0.3
-3.96	11.25	0.	30.	-0.52
-5.98	11.23	0.	30.	-0.67
-7.97	11.22	0.	30.	-0.74
I.A. =	10.02			
1.03	11.29	10.02	30.	0.06
0.03	11.3	10.02	30.	-0.12
-0.97	11.31	10.02	30.	-0.29
-1.95	11.3	10.02	30.	-0.42
-3.96	11.3	10.02	30.	-0.6
-5.96	11.29	10.02	30.	-0.7
-7.97	11.28	10.02	30.	-0.74
I.A. =	20.07			
1.01	11.37	20.07	30.	-0.1
0.03	11.38	20.07	30.	-0.26
-0.97	11.39	20.07	30.	-0.4
-1.95	11.39	20.07	30.	-0.51
-3.96	11.39	20.07	30.	-0.67
-5.98	11.38	20.08	30.	-0.72
-7.97	11.39	20.07	30.	-0.79
I.A. =	28.1			
1.01	11.48	28.1	30.	-0.21
0.03	11.49	28.08	30.	-0.35
-0.97	11.5	28.08	30.	-0.48
-1.95	11.51	28.08	30.	-0.56
-3.96	11.52	28.08	30.	-0.7
-5.98	11.52	28.08	30.	-0.75
-7.97	11.52	28.1	30.	-0.78

17-3-6 S.A. DEG	17-3-6 F.Z. LB	17-3-6 F.Y. LB	17-3-6 F.X. LB	17-3-6 M.X. FT-LB	17-3-6 M.Y. FT-LB	17-3-6 M.Z. FT-LB
I.A. =	0.					
1.	-265.	-45.	-6.	1.1	2.2	7.5
0.03	-263.	-6.	-7.	-0.1	3.2	4.2
-0.97	-263.	32.	-8.	-1.3	4.2	0.1
-1.95	-262.	61.	-9.	-5.2	3.9	-1.1
-3.96	-265.	108.	-9.	-7.7	4.8	-0.3
-5.98	-261.	148.	-8.	-8.8	4.	0.6
-7.97	-265.	188.	-9.	-12.5	4.8	0.5
I.A. =	10.02					
1.03	-269.	-18.	-7.	-11.8	1.5	8.9
0.03	-268.	21.	-6.	-13.6	1.4	6.5
-0.97	-269.	60.	-7.	-14.2	3.1	2.5
-1.95	-268.	92.	-7.	-16.	3.5	1.4
-3.94	-267.	144.	-7.	-19.9	3.2	1.1
-5.98	-267.	180.	-8.	-21.7	3.4	2.1
-7.97	-269.	203.	-8.	-23.9	3.6	3.1
I.A. =	20.07					
1.01	-277.	13.	-9.	-19.6	1.9	9.8
0.03	-276.	47.	-8.	-22.9	2.6	7.6
-0.95	-274.	83.	-7.	-24.9	2.4	5.1
-1.95	-277.	115.	-6.	-24.4	1.9	3.5
-3.94	-277.	162.	-9.	-27.8	2.8	2.6
-5.96	-278.	200.	-9.	-28.5	3.6	2.8
-7.97	-277.	221.	-8.	-30.3	2.9	4.6
I.A. =	28.1					
1.01	-288.	40.	-9.	-27.4	1.	12.4
0.03	-285.	70.	-8.	-28.7	1.1	9.9
-0.97	-286.	102.	-7.	-30.9	1.2	7.4
-1.95	-286.	133.	-6.	-30.4	1.3	4.9
-3.96	-286.	178.	-7.	-33.3	3.1	3.4
-5.93	-288.	212.	-7.	-33.5	2.4	4.
-7.97	-287.	232.	-8.	-38.5	2.3	5.

17-3-6 S.A. DEG	17-3-6 R.L. IN	17-3-6 I.A DEG	17-3-6 U. MPH	17-3-6 N.F.Y. FY/FZ		
I.A. =	0.					
1.	11.21	0.	30.	0.17		
0.03	11.22	0.	30.	0.02		
-0.97	11.22	0.	30.	-0.12		
-1.95	11.21	0.	30.	-0.23		
-3.96	11.19	0.	30.	-0.41		
-5.98	11.16	0.	30.	-0.56		
-7.97	11.12	0.	30.	-0.71		
I.A. =	10.02					
1.03	11.21	10.02	30.	0.07		
0.03	11.22	10.02	30.	-0.08		
-0.97	11.22	10.02	30.	-0.22		
-1.95	11.22	10.02	30.	-0.35		
-3.94	11.21	10.02	30.	-0.54		
-5.98	11.19	10.02	30.	-0.67		
-7.97	11.18	10.02	30.	-0.76		
I.A. =	20.07					
1.01	11.28	20.07	30.	-0.05		
0.03	11.3	20.07	30.	-0.17		
-0.95	11.31	20.07	30.	-0.3		
-1.95	11.31	20.07	30.	-0.42		
-3.94	11.31	20.07	30.	-0.58		
-5.96	11.3	20.07	30.	-0.72		
-7.97	11.29	20.07	30.	-0.8		
I.A. =	28.1					
1.01	11.38	28.1	30.	-0.14		
0.03	11.4	28.1	30.	-0.25		
-0.97	11.41	28.08	30.	-0.36		
-1.95	11.43	28.1	30.	-0.47		
-3.96	11.44	28.1	30.	-0.62		
-5.98	11.44	28.1	30.	-0.74		
-7.97	11.44	28.1	30.	-0.81		

18-3-6 S.A. DEG	18-3-6 F.Z. LB	18-3-6 F.Y LB	18-3-6 F.X. LB	18-3-6 M.X. FT-LB	18-3-6 M.Y. FT-LB	18-3-6 M.Z. FT-LB
I.A. =	0.					
1.	-142.	-31.	-3.	-1.1	0.6	5.2
0.03	-142.	-2.	-2.	-1.6	-0.3	5.
-0.97	-142.	27.	-3.	-2.2	0.9	2.9
-1.95	-144.	52.	-3.	-2.4	0.9	2.8
-3.96	-146.	84.	-2.	-2.1	-0.	3.7
-5.98	-143.	107.	-3.	-3.9	1.	4.7
-7.97	-142.	122.	-2.	-4.1	0.5	5.6
I.A. =	10.02					
1.03	-148.	-15.	-1.	-11.2	-1.1	7.
0.03	-151.	13.	-3.	-11.3	-0.1	5.
-0.95	-152.	42.	-2.	-14.5	-0.2	3.8
-1.95	-152.	63.	-2.	-15.2	-0.1	3.7
-3.96	-150.	93.	-4.	-13.9	0.9	3.8
-5.98	-147.	109.	-3.	-13.9	-0.2	4.6
-7.97	-147.	117.	-2.	-13.7	-0.4	5.5
I.A. =	20.07					
1.03	-150.	1.	-3.	-21.	-0.4	6.3
0.03	-155.	27.	-2.	-21.1	-1.6	5.6
-0.97	-157.	52.	-3.	-24.2	-0.7	4.8
-1.95	-154.	69.	-2.	-23.6	-1.5	4.4
-3.96	-152.	89.	-3.	-23.3	-0.5	4.7
-5.98	-154.	101.	-3.	-22.4	-0.5	4.6
-7.97	-151.	106.	-3.	-23.1	-0.5	4.6
I.A. =	28.1					
1.01	-159.	13.	-3.	-30.	-2.1	6.8
0.03	-163.	40.	-2.	-28.1	-1.8	5.6
-0.95	-160.	58.	-3.	-30.3	-1.2	4.7
-1.95	-159.	73.	-4.	-29.3	0.2	4.2
-3.96	-159.	86.	-2.	-30.9	-1.6	5.5
-5.98	-161.	92.	-3.	-30.1	-1.6	5.4
-7.97	-158.	100.	-3.	-29.8	-2.	5.2

18-3-6 S.A. DEG	18-3-6 P.L. IN	18-3-6 I.A. DEG	18-3-6 V MPH	18-3-6 N.F.Y. FY/FZ
I.A. =	0.			
1.	13.67	0.	30.	0.22
0.03	13.68	0.	30.	0.01
-0.97	13.67	0.	30.	-0.19
-1.95	13.66	0.	30.	-0.36
-3.96	13.65	0.	30.	-0.58
-5.98	13.63	0.	30.	-0.75
-7.97	13.62	0.	30.	-0.86
I.A. =	10.02			
1.03	13.68	10.02	30.	0.1
0.03	13.68	10.02	30.	-0.09
-0.95	13.68	10.02	30.	-0.27
-1.95	13.69	10.02	30.	-0.41
-3.96	13.69	10.02	30.	-0.62
-5.98	13.68	10.02	30.	-0.74
-7.97	13.68	10.02	30.	-0.8
I.A. =	20.07			
1.03	13.78	20.07	30.	-0.01
0.03	13.79	20.07	30.	-0.18
-0.97	13.79	20.07	30.	-0.33
-1.95	13.8	20.07	30.	-0.45
-3.96	13.8	20.07	30.	-0.58
-5.98	13.8	20.07	30.	-0.66
-7.97	13.8	20.07	30.	-0.7
I.A. =	28.1			
1.01	13.91	28.1	30.	-0.08
0.03	13.92	28.1	30.	-0.24
-0.95	13.94	28.1	30.	-0.36
-1.95	13.95	28.1	30.	-0.46
-3.96	13.95	28.1	30.	-0.54
-5.98	13.95	28.08	30.	-0.57
-7.97	13.95	28.1	30.	-0.63

19-3-6 S.A. DEG	19-3-6 F.Z. LB	19-3-6 F.Y. LB	19-3-6 F.X. LB	19-3-6 M.X. FT-LB	19-3-6 M.Y. FT-LB	19-3-6 M.Z. FT-LB
I.A. =	0.					
1.	-171.	-35.	-4.	1.2	1.	5.3
0.03	-171.	-4.	-3.	0.6	1.2	4.1
-0.97	-171.	29.	-3.	0.	0.9	2.9
-1.95	-172.	53.	-4.	-2.5	1.5	1.7
-3.96	-172.	92.	-5.	-2.7	2.5	1.6
-5.98	-173.	122.	-5.	-1.5	3.	2.6
-7.97	-174.	146.	-3.	-4.3	1.1	4.4
I.A. =	10.02					
1.03	-180.	-28.	-4.	-13.2	1.5	6.5
0.03	-182.	12.	-4.	-14.3	1.3	5.3
-0.97	-178.	45.	-4.	-13.9	1.4	3.1
-1.95	-178.	70.	-5.	-14.6	2.2	2.1
-3.96	-177.	106.	-4.	-16.	1.6	2.8
-5.98	-177.	134.	-5.	-16.7	2.	3.9
-7.97	-175.	158.	-4.	-17.3	1.1	5.7
I.A. =	20.07					
1.03	-185.	-3.	-4.	-23.3	0.1	7.6
0.03	-186.	25.	-5.	-22.6	1.4	5.8
-0.97	-186.	51.	-3.	-26.6	-0.2	5.
-1.95	-189.	76.	-4.	-26.3	0.2	3.9
-3.94	-188.	114.	-4.	-27.8	1.7	3.2
-5.98	-186.	139.	-3.	-27.4	-0.3	4.5
-7.97	-185.	158.	-4.	-28.7	-0.2	5.6
I.A. =	28.1					
1.01	-195.	17.	-3.	-31.4	-1.8	8.1
0.03	-193.	42.	-3.	-33.2	-2.	6.7
-0.97	-193.	66.	-4.	-32.7	0.	5.4
-1.95	-198.	87.	-3.	-33.4	-1.2	4.6
-3.96	-197.	117.	-3.	-33.8	-0.6	4.7
-5.98	-195.	135.	-4.	-33.9	0.4	5.2
-7.97	-196.	143.	-6.	-34.5	1.2	5.7

19-3-6 S.A. DEG	19-3-6 P.L. IN	19-3-6 I.A. DEG	19-3-6 V MPH	19-3-6 N.F.Y. FY/FZ
I.A. =	0.			
1.	13.62	0.	30.	0.2
0.03	13.63	0.	30.	0.02
-0.97	13.63	0.	30.	-0.17
-1.95	13.62	0.	30.	-0.31
-3.96	13.6	0.	30.	-0.54
-5.98	13.57	0.	30.	-0.7
-7.97	13.55	0.	30.	-0.84
I.A. =	10.02			
1.03	13.62	10.02	30.	0.11
0.03	13.63	10.02	30.	-0.07
-0.97	13.63	10.02	30.	-0.23
-1.95	13.64	10.02	30.	-0.39
-3.96	13.63	10.02	30.	-0.6
-5.98	13.62	10.02	30.	-0.76
-7.97	13.61	10.02	30.	-0.86
I.A. =	20.07			
1.03	13.71	20.07	30.	0.02
0.03	13.74	20.07	30.	-0.13
-0.97	13.74	20.07	30.	-0.27
-1.95	13.74	20.07	30.	-0.4
-3.94	13.74	20.07	30.	-0.61
-5.98	13.74	20.07	30.	-0.75
-7.97	13.74	20.07	30.	-0.84
I.A. =	28.1			
1.01	13.84	28.1	30.	-0.09
0.03	13.86	28.1	30.	-0.22
-0.97	13.87	28.08	30.	-0.34
-1.95	13.88	28.1	30.	-0.44
-3.96	13.89	28.08	30.	-0.6
-5.98	13.89	28.08	30.	-0.69
-7.97	13.89	28.08	30.	-0.73

Appendix C
Simulation Runs

This appendix contains output plots for all runs performed with the directional control test procedure in the simulation study. These data, together with information on a large number of other variables which are printed out by the computer, are the support for the summarized results given in the technical report volume. Table C-1 identifies each of the plots by motorcycle and test condition and references them to the simulation program run schedule.

All associated print-outs are on file at Calspan. Since this information is voluminous, it is not practical to include it in this report. Table C-2 lists the pertinent variables which are included in the print-out.

Table C-1: Data Plots

Figure Number	Simulation Run No.	Vehicle	Conditions (Nominal)		Remarks
			Speed (mph)	Lat. Acc. g	
C-1	23	Honda	40	.2	Normal configuration
C-2	05	360	40	.3	
C-3	11		40	.4	
C-4	05		40	.5	
C-5	23		20	.2	
C-6	19		20	.4	
C-7	19		60	.4	
C-8	22		5	.04	
C-9	27		20	.04	
C-10	27		40	.04	
C-11	34		40	.4	Medium rider
C-12	31		40	.4	Intermediate rider
C-13	33		40	.4	Low stiffness rider
C-14	17	Honda	40	.3	Normal configuration
C-15	13	125	40	.4	
C-16	17		40	.5	
C-17	20		60	.4	
C-18	18	Kawasaki	40	.3	Normal configuration
C-19	14	250	40	.4	
C-20	18		40	.5	
C-21	29	Yamaha	40	.3	Normal configuration
C-22	28	650	40	.4	
C-23	29		40	.5	
C-24	25		40	.3	Low C_{γ} rear tire
C-25	24		40	.4	
C-26	25		40	.5	
C-27	26		60	.4	
C-28	15	Norton	40	.3	Normal configuration
C-29	08	850	40	.4	
C-30	15		40	.5	

Table C-1: Data Plots
(Cont'd.)

Figure Number	Simulation Run No.	Vehicle	Conditions (Nominal)		Remarks
			Speed (mph)	Lat. Acc. g	
C-31	16	H-D 1200	40	.3	Normal configuration
C-32	12		40	.4	
C-33	16		40	.5	
C-34	C7		40	.3	Different tires;
C-35	C5		40	.4	different rider
C-36	C8		40	.5	representation
C-37	32		40	.4	Different tires Normal rider representation

Table C-2

Code Numbers, Names, Symbology, And Units For Program Variables

Code	Variable Name	Printing & Plotting Title	Units
1	Elapsed Time	TIME	SEC
2	Path Distance	DISTANCE	FT
3	Steer Angle	STR ANG	DEG
4	Rider Lean Angle	RDR ROLL	DEG
5	Rider Steering Torque	STR TORQ	LB IN
6	Rider Lean Torque	RDR TORQ	LB IN
7	X Location of Vehicle Origin in Space Fixed Coordinate System	X	FT
8	Y Location of Vehicle Origin in Space Fixed Coordinate System	Y	FT
9	Forward Velocity	VELOCITY	MPH
10	Vehicle Roll Angle	ROLL	DEG
11	Vehicle Sideslip Angle ( )	VEH SLIP	DEG
12	Command Roll Angle	COM ROLL	DEG
13	Vehicle Lateral Acceleration	LAT ACC	G'S
14	Vehicle Path Radius	PATH RAD	FT
15	Z Location of Vehicle Origin in Space Fixed Coordinate System	Z	IN
16	Vehicle Pitch Angle	PITCH	DEG
17	Vehicle Yaw Angle	YAW	DEG
18	Vehicle Roll Velocity	ROLL VEL	DEG/SEC
19	Vehicle Pitch Velocity	PTCH VEL	DEG/SEC
20	Vehicle Yaw Velocity	YAW VEL	DEG/SEC
21	Total Yaw Moment	YAW MOM	LB FT
22	Front Normal Force/Total Normal Force	FNF/TNF	
23	Total Side Force/Total Normal Force	TSF/TNF	
24	Total Side Force Components/Total Normal Force	TSFP/TNF	
25	Total Tractive Force Components/Total Normal Force	TTFP/TNF	
26	Front Tire Slip Angle	FT SLIP	DEG
27	Front Tire Inclination Angle	FT INCL	DEG
28	Front Normal Force	FT NF	LB
29	Front Side Force	FT SF	LB
30	Front Side Force Component	FT SFP	LB
31	Front Tractive Force Component	FT TFP	LB
32	Rear Tire Slip Angle	RR SLIP	DEG
33	Rear Tire Inclination Angle	RR INCL	DEG
34	Rear Normal Force	RRNF	LB
35	Rear Side Force Component	RRSF	LB
36	Rear Side Force Component	RRSFP	LB
37	Rear Tractive Force Component	RRTFP	LB

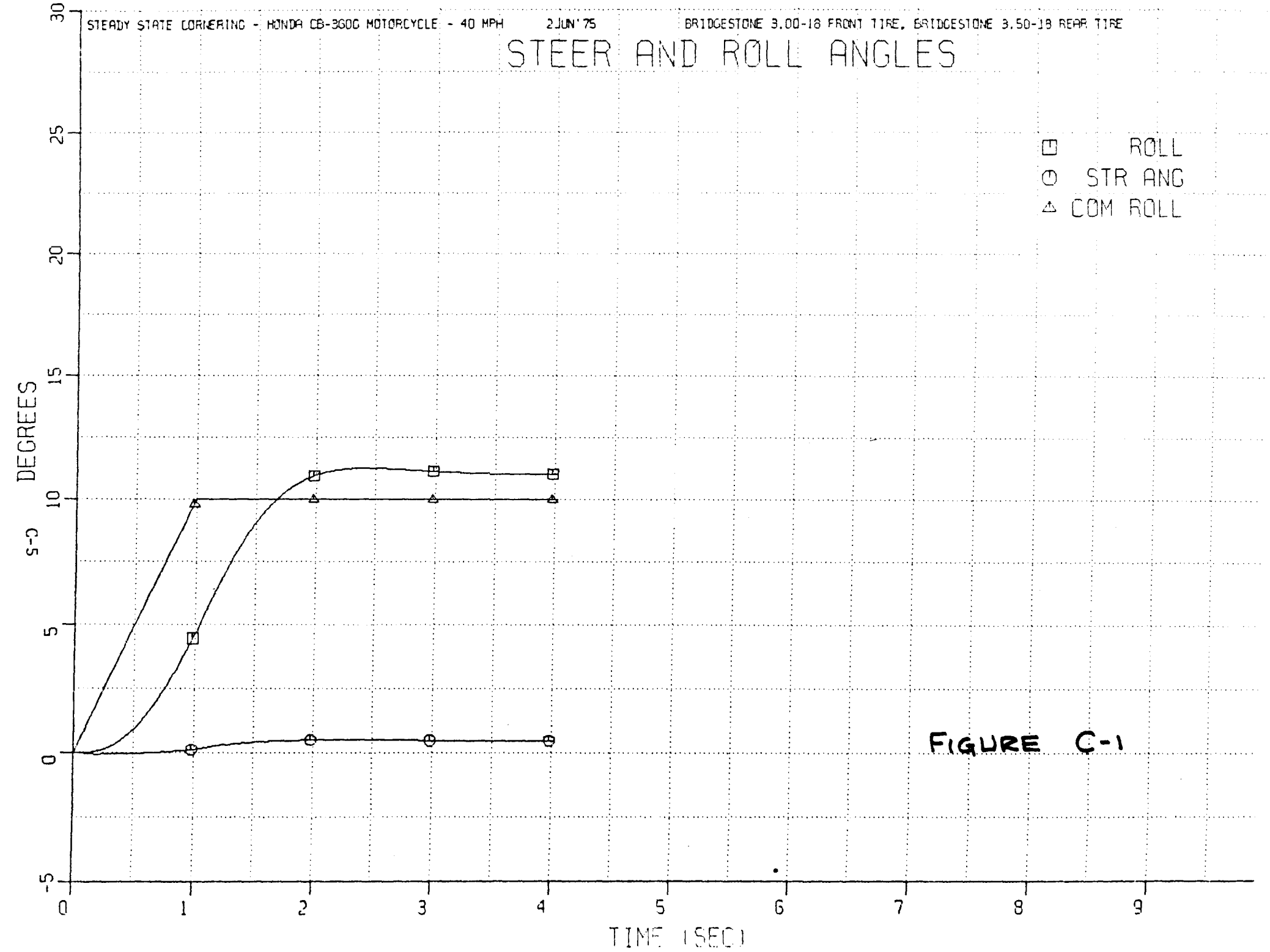

STEADY STATE CORNERING - HONDA CB-360C MOTORCYCLE - 40 MPH 2JUN'75 BRIDGESTONE 3.00-18 FRONT TIRE, BRIDGESTONE 3.50-18 REAR TIRE
STEER AND ROLL ANGLES
ROLL
STR ANG
COM ROLL
DEGREES
TIME (SEC)
30
25
20
15
10
5
0
-5
0
1
2
3
4
5
6
7
8
9

FIGURE C-1

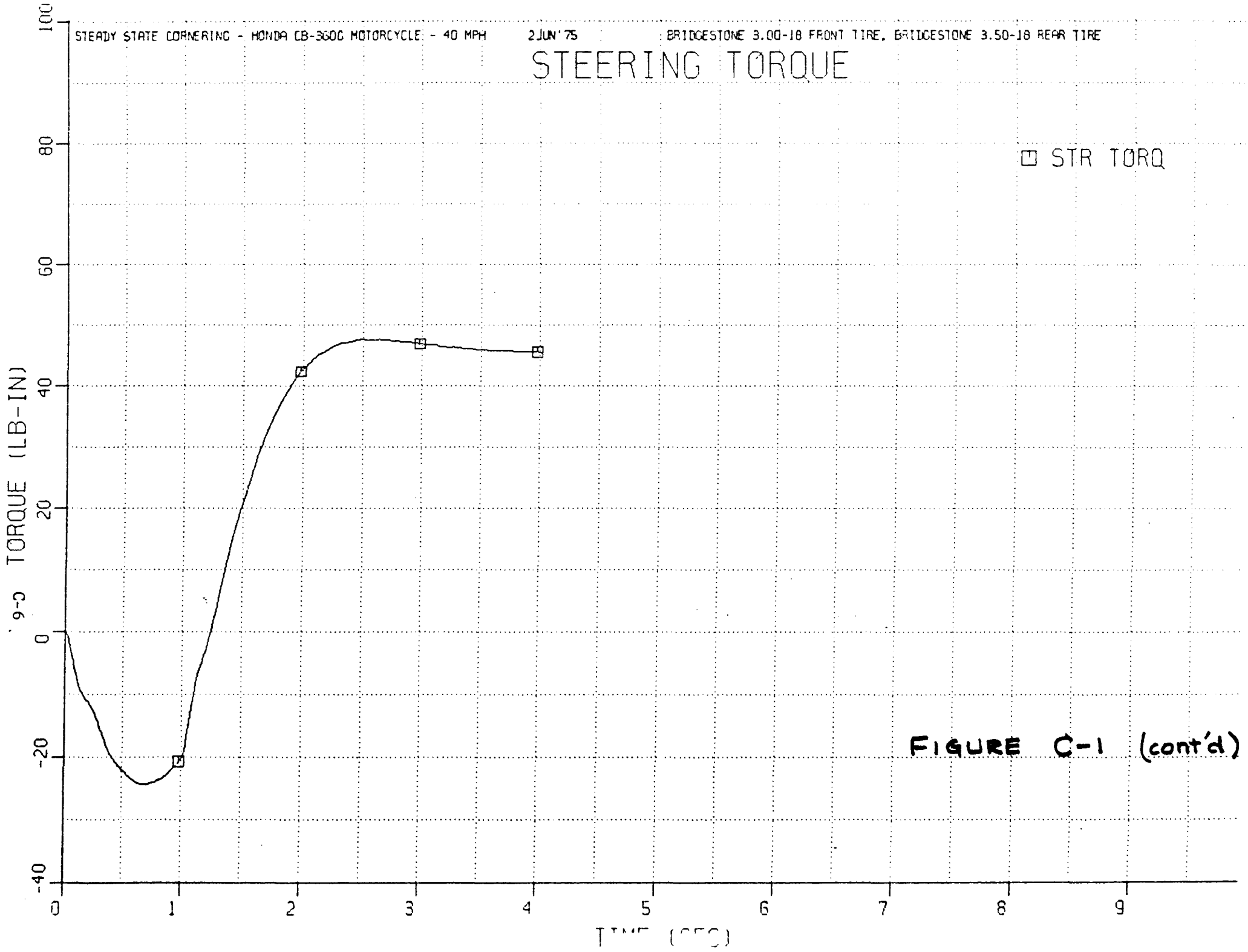


FIGURE C-1 (cont'd)

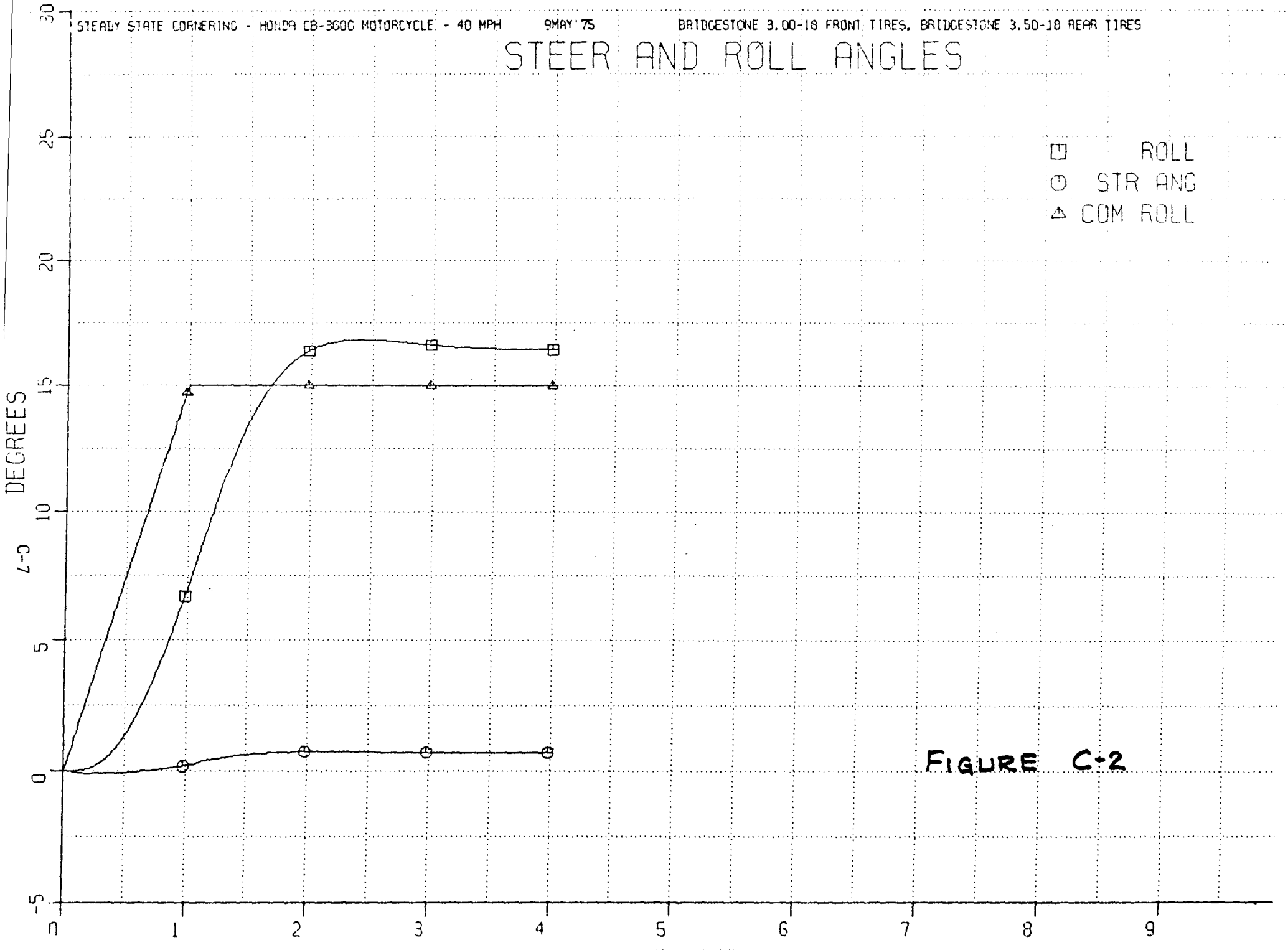

STEADY STATE CORNERING - HONDA CB-360C MOTORCYCLE - 40 MPH 9MAY'75
BRIDGESTONE 3.00-18 FRONT TIRES, BRIDGESTONE 3.50-18 REAR TIRES
STEER AND ROLL ANGLES
ROLL
STR ANG
COM ROLL
DEGREES
C-7
30
25
20
15
10
5
0
-5
0
1
2
3
4
5
6
7
8
9

FIGURE C-2

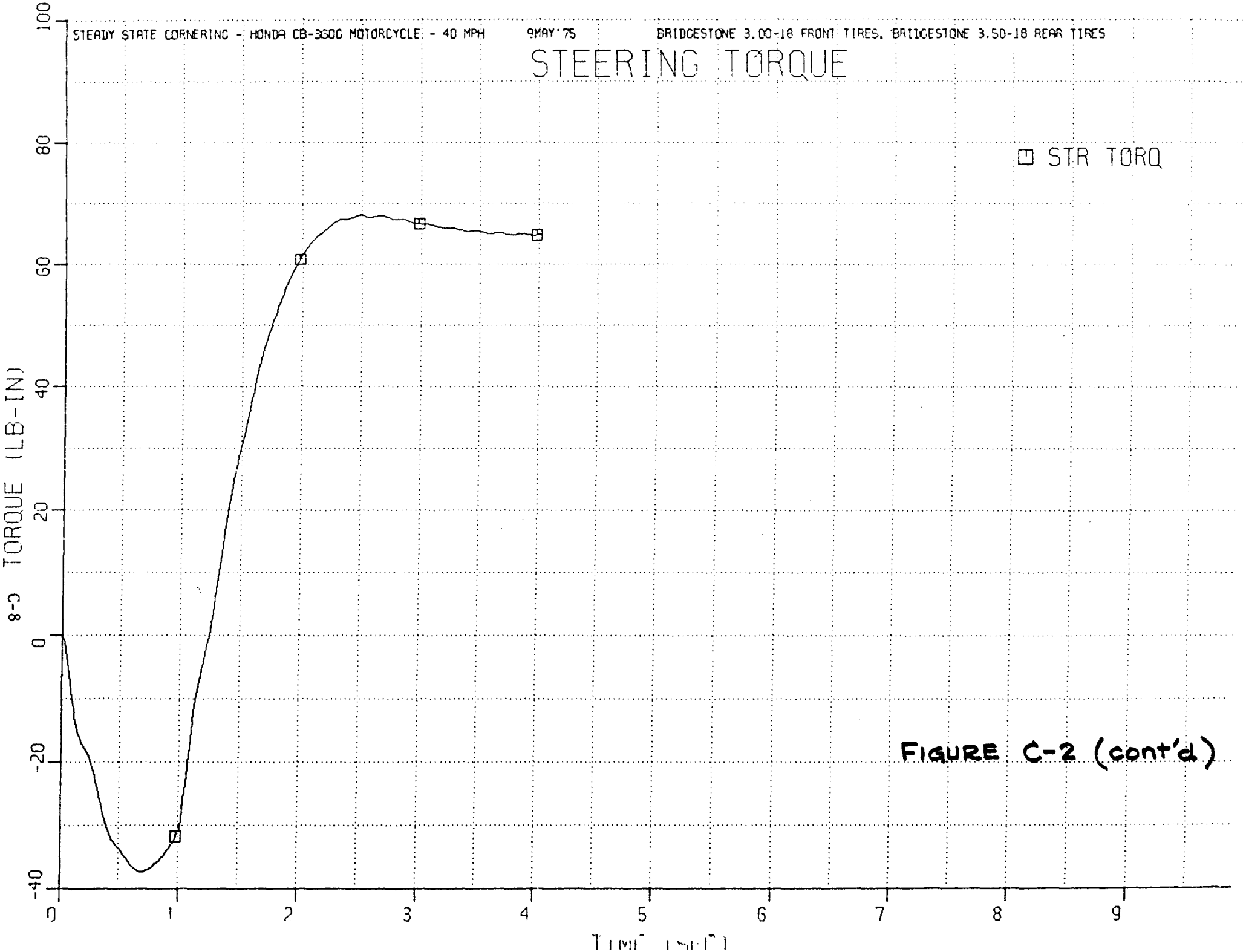


FIGURE C-2 (cont'd)

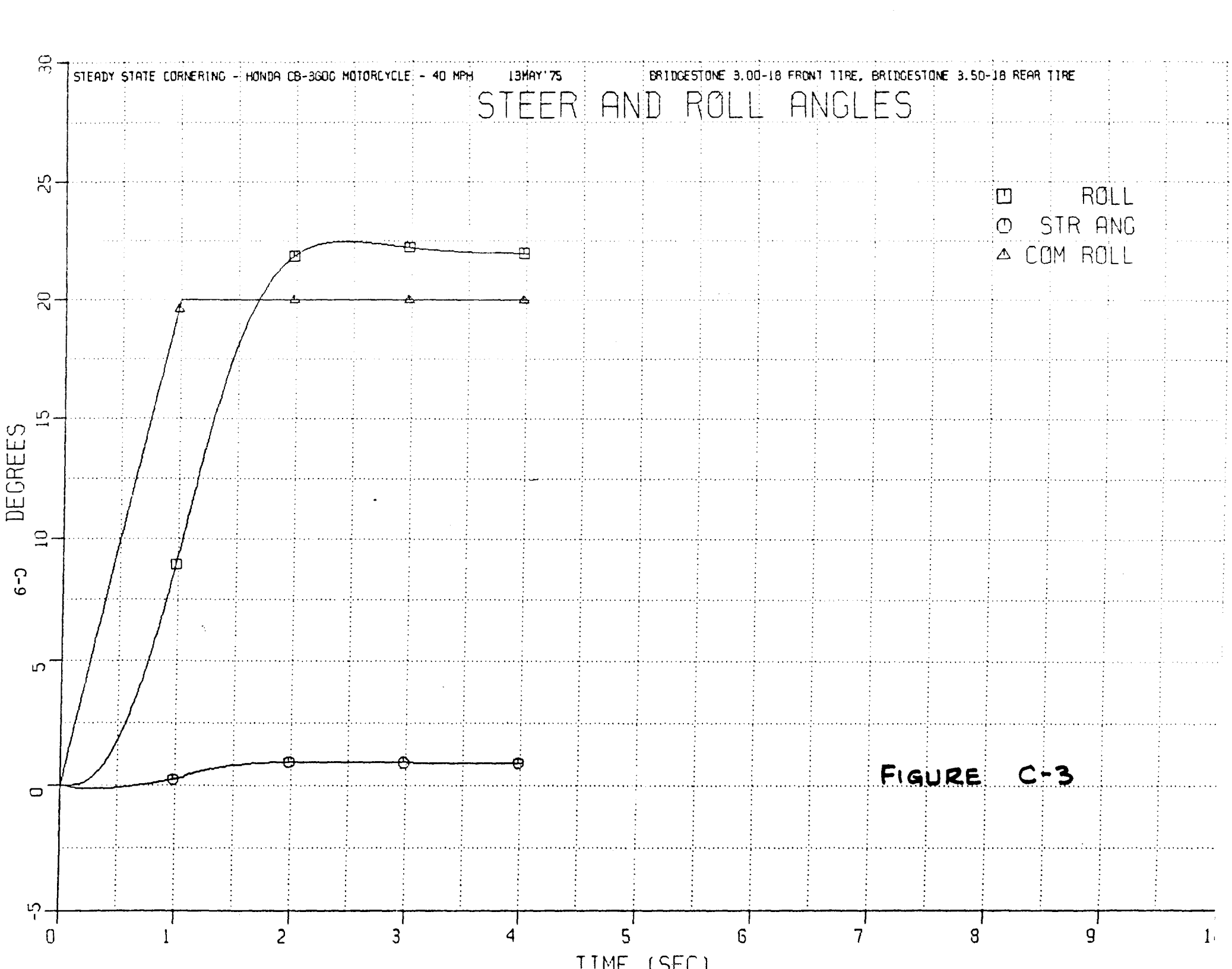

STEADY STATE CORNERING - HONDA CB-360C MOTORCYCLE - 40 MPH 13MAY'75
BRIDGESTONE 3.00-18 FRONT TIRE, BRIDGESTONE 3.50-18 REAR TIRE
STEER AND ROLL ANGLES
ROLL
STR ANG
COM ROLL
DEGREES
TIME (SEC)
30
25
20
15
10
5
0
-5
0
1
2
3
4
5
6
7
8
9

FIGURE C-3

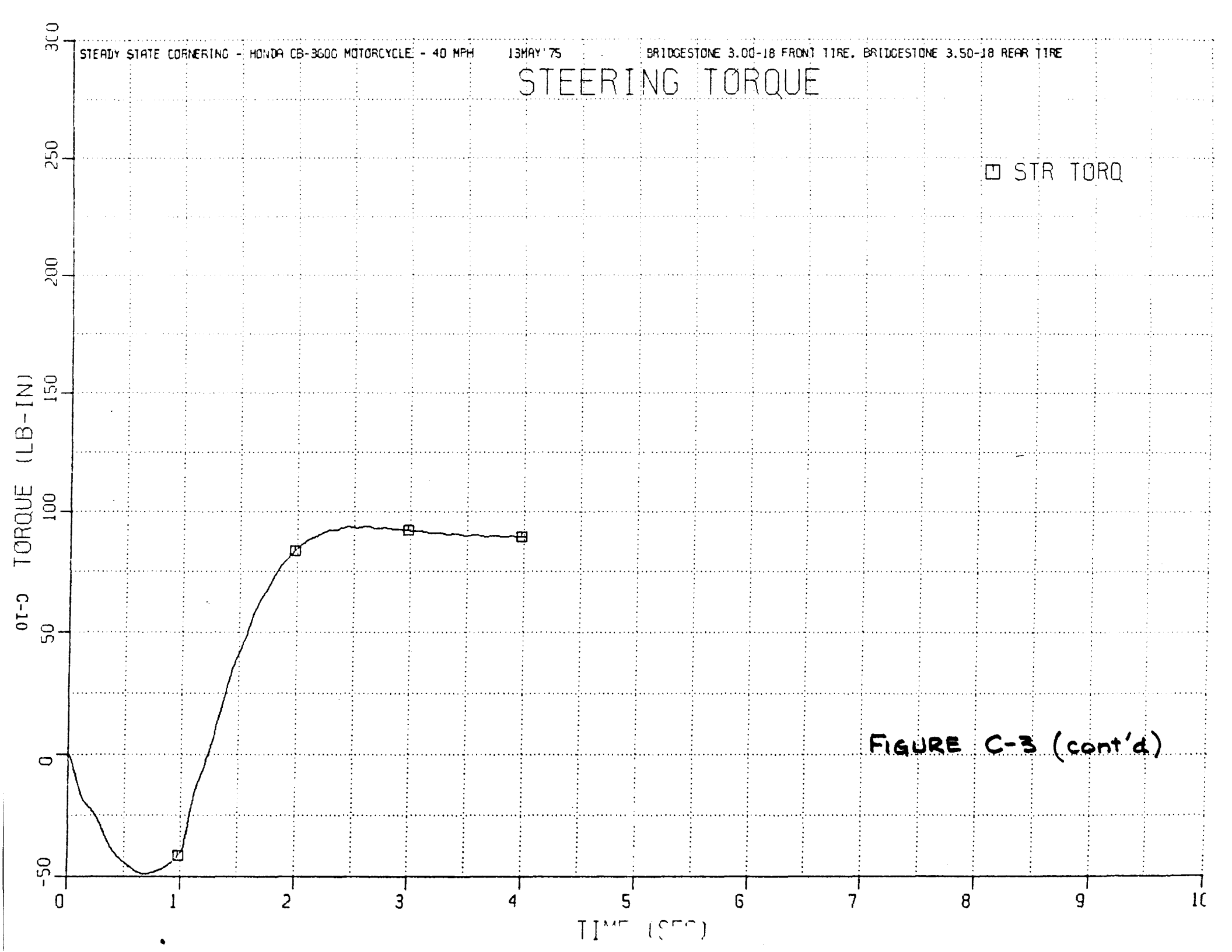


FIGURE C-3 (cont'd)

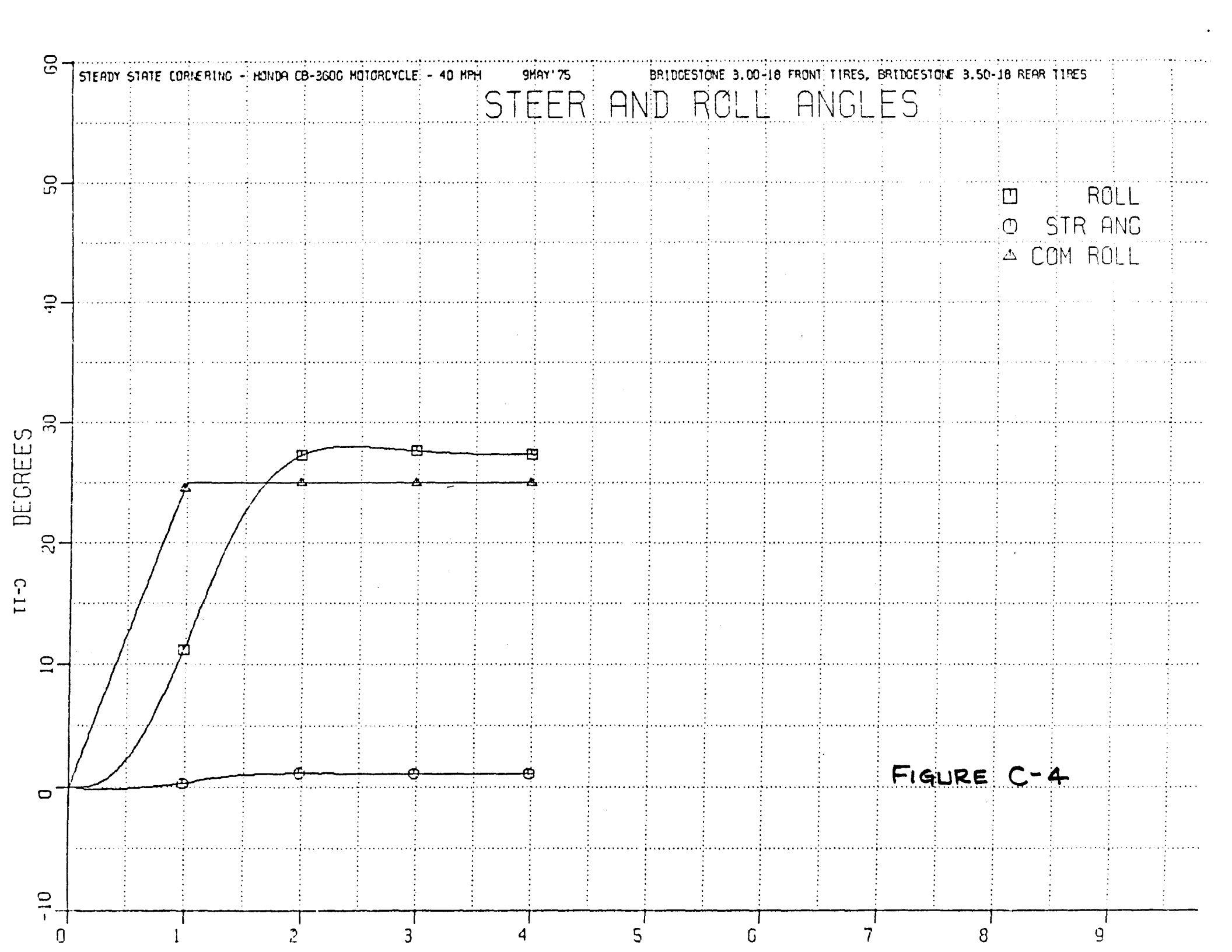

STEADY STATE CORNERING - HONDA CB-360G MOTORCYCLE - 40 MPH 9MAY'75 BRIDGESTONE 3.00-18 FRONT TIRES, BRIDGESTONE 3.50-18 REAR TIRES
STEER AND ROLL ANGLES
ROLL
STR ANG
COM ROLL
DEGREES
60
50
40
30
20
10
0
-10
0
1
2
3
4
5
6
7
8
9

FIGURE C-4

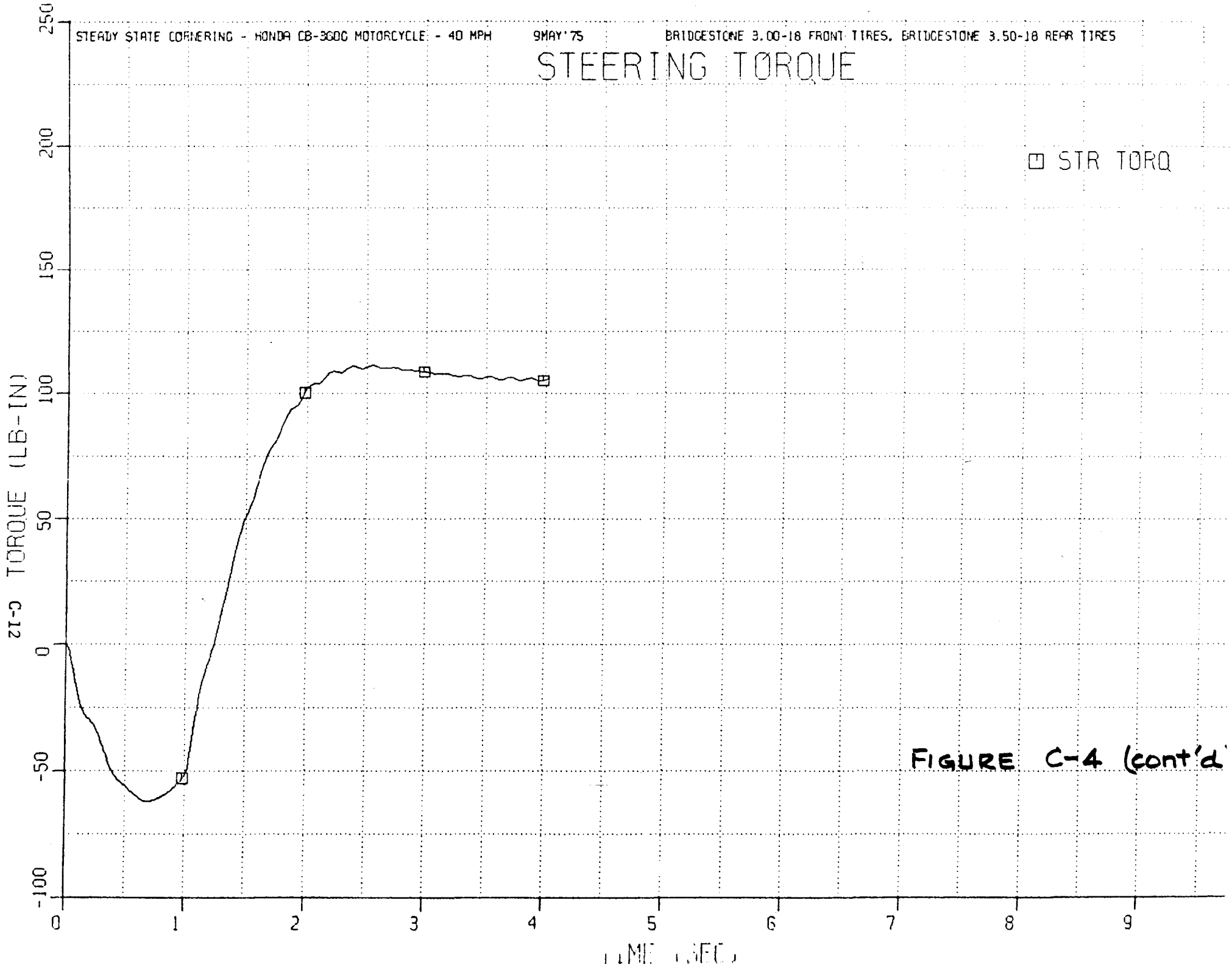


FIGURE C-4 (cont'd

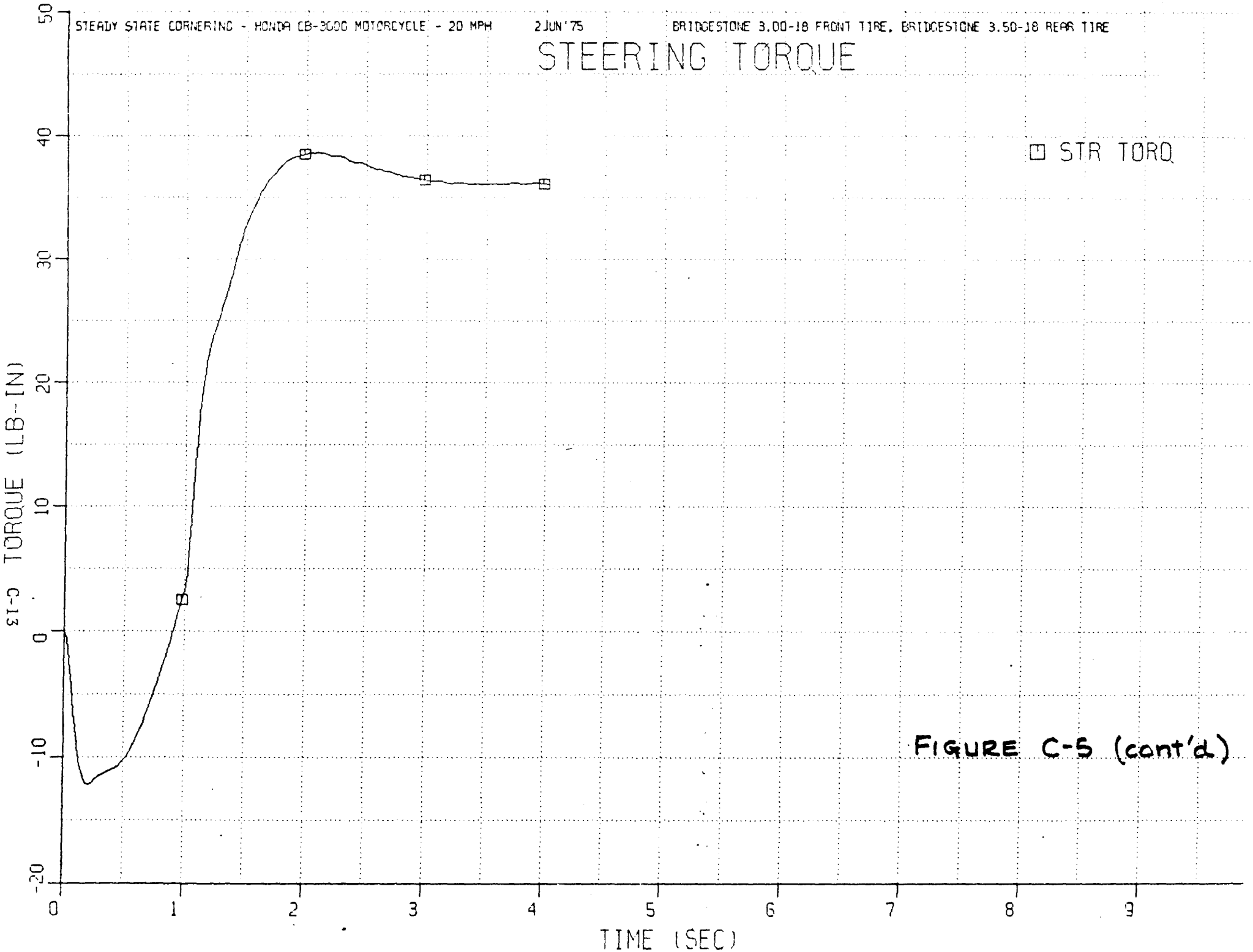


FIGURE C-5 (cont'd)

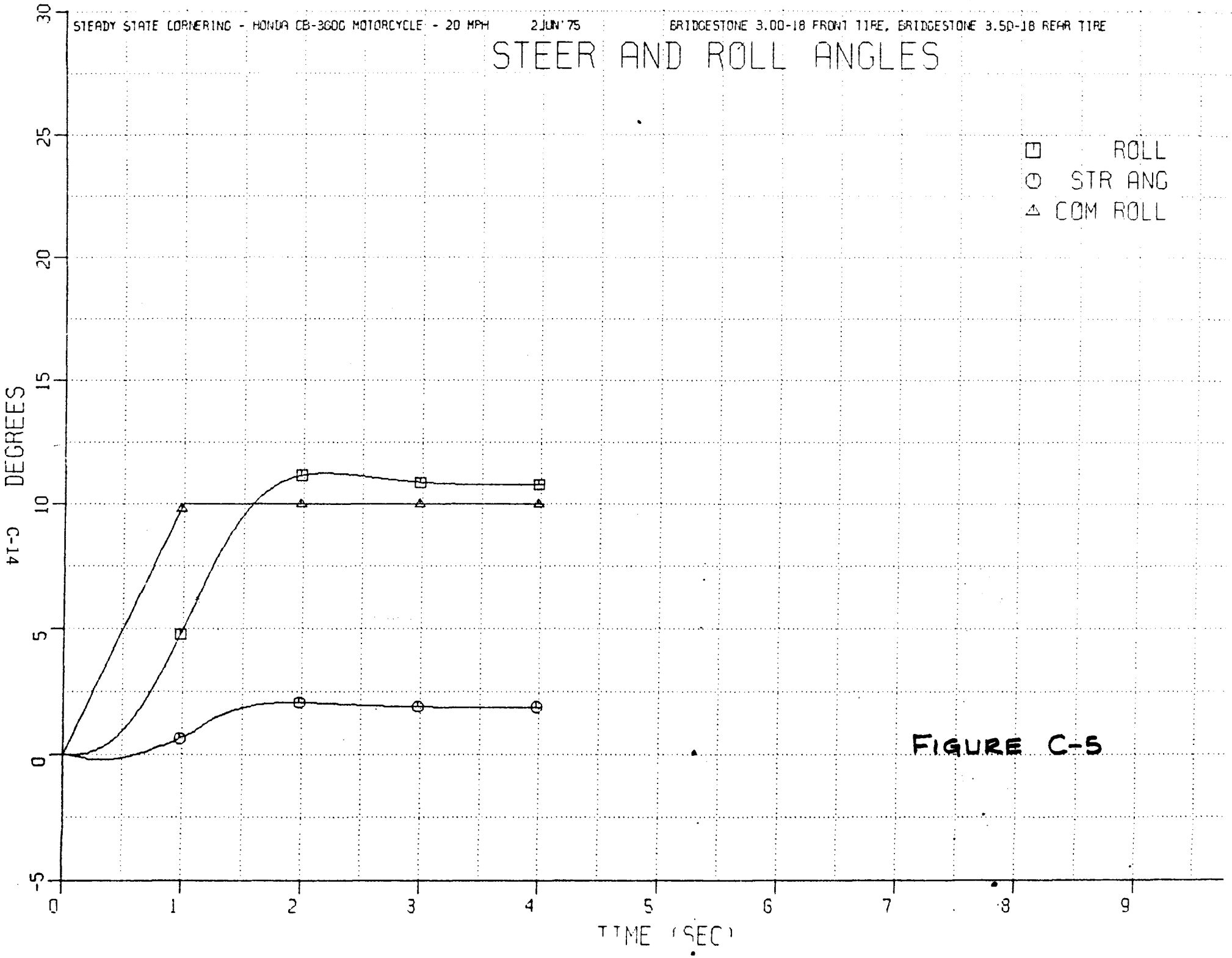

STEADY STATE CORNERING - HONDA CB-360C MOTORCYCLE - 20 MPH 2JUN'75 BRIDGESTONE 3.00-18 FRONT TIRE, BRIDGESTONE 3.50-18 REAR TIRE
STEER AND ROLL ANGLES
ROLL
STR ANG
COM ROLL
DEGREES
TIME (SEC)
30
25
20
15
10
5
0
-5
0
1
2
3
4
5
6
7
8
9

FIGURE C-5

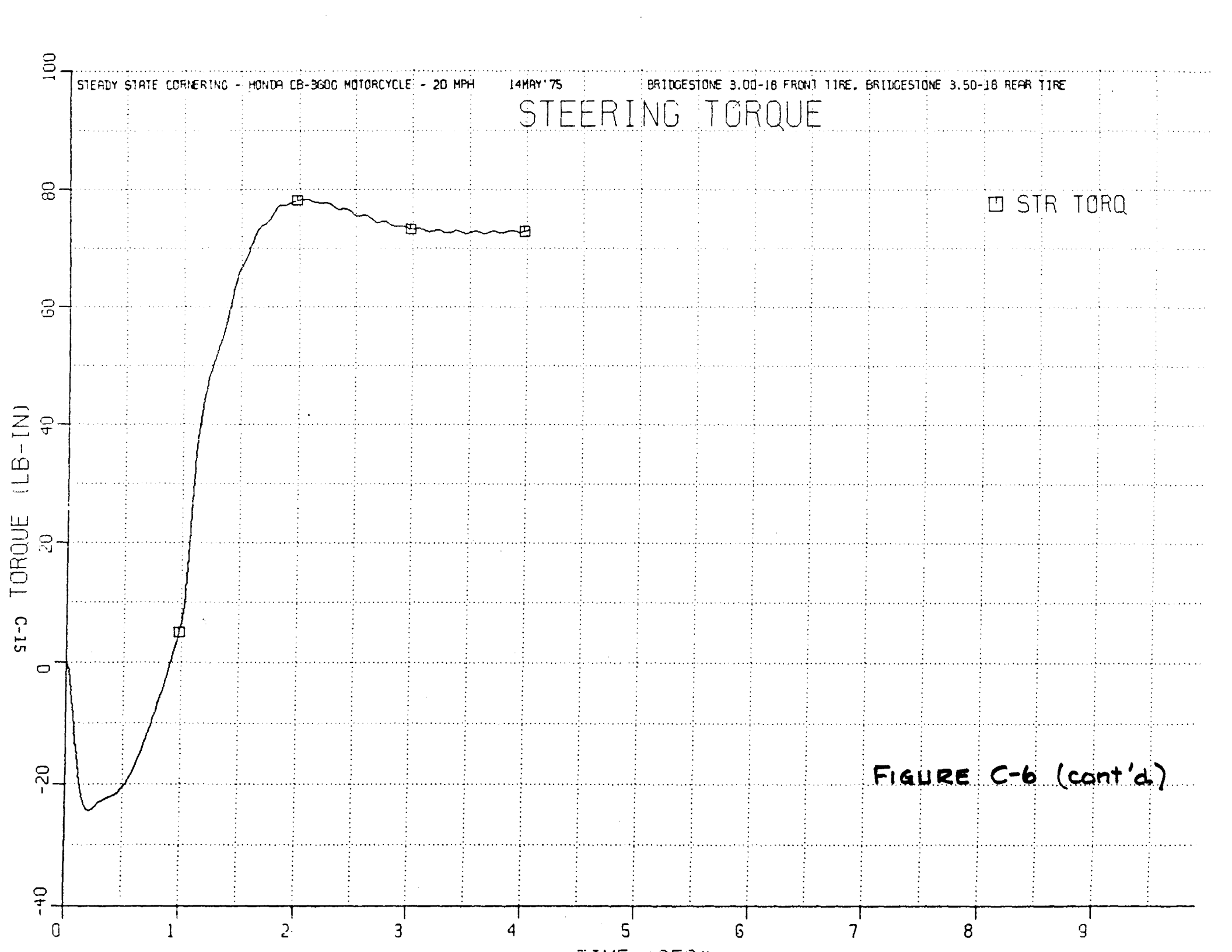


FIGURE C-6 (cont'd)

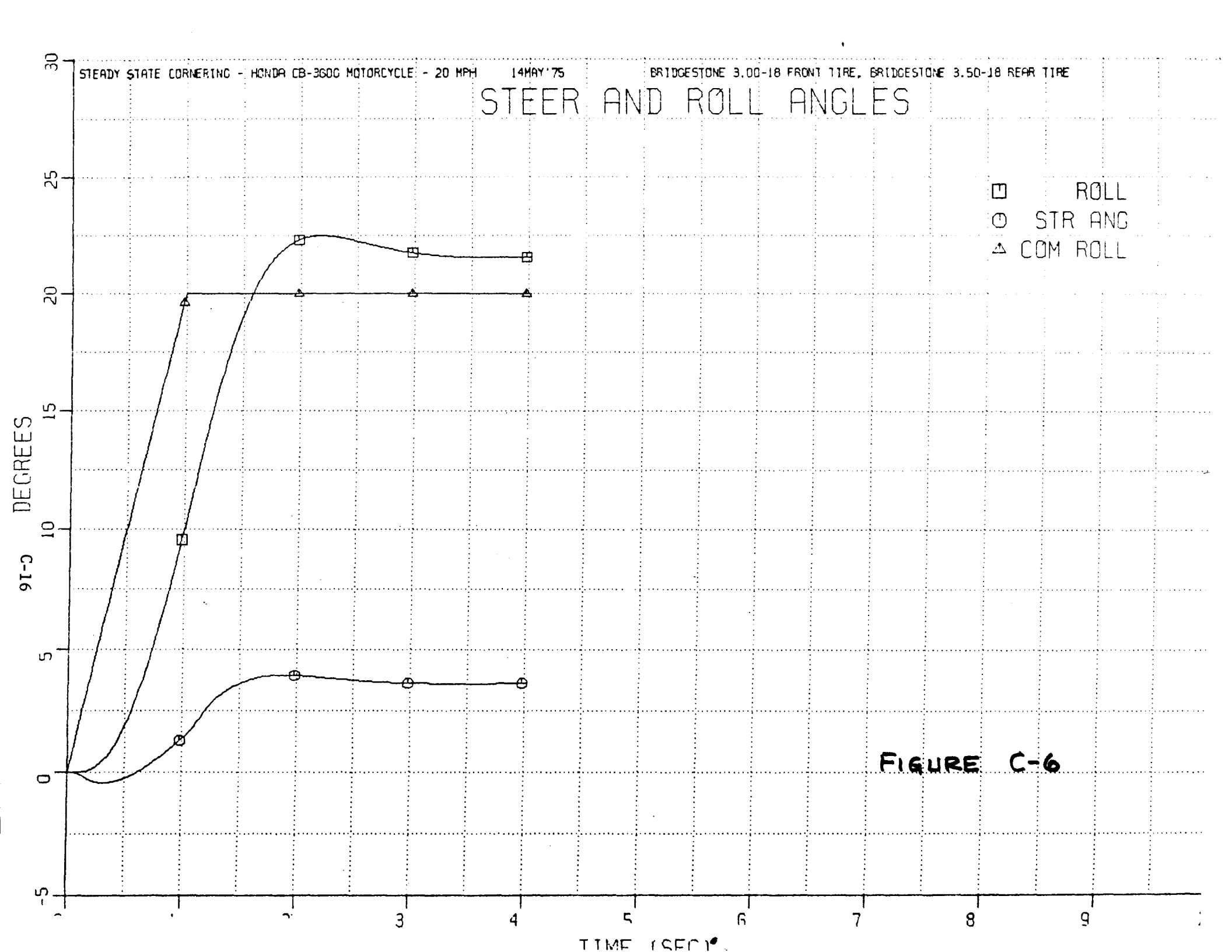

STEADY STATE CORNERING - HONDA CB-360C MOTORCYCLE - 20 MPH 14MAY'75
BRIDGESTONE 3.00-18 FRONT TIRE, BRIDGESTONE 3.50-18 REAR TIRE
STEER AND ROLL ANGLES
ROLL
STR ANG
COM ROLL
DEGREES
TIME (SEC)
30
25
20
15
10
5
0
-5
3
4
5
6
7
8
9

FIGURE C-6

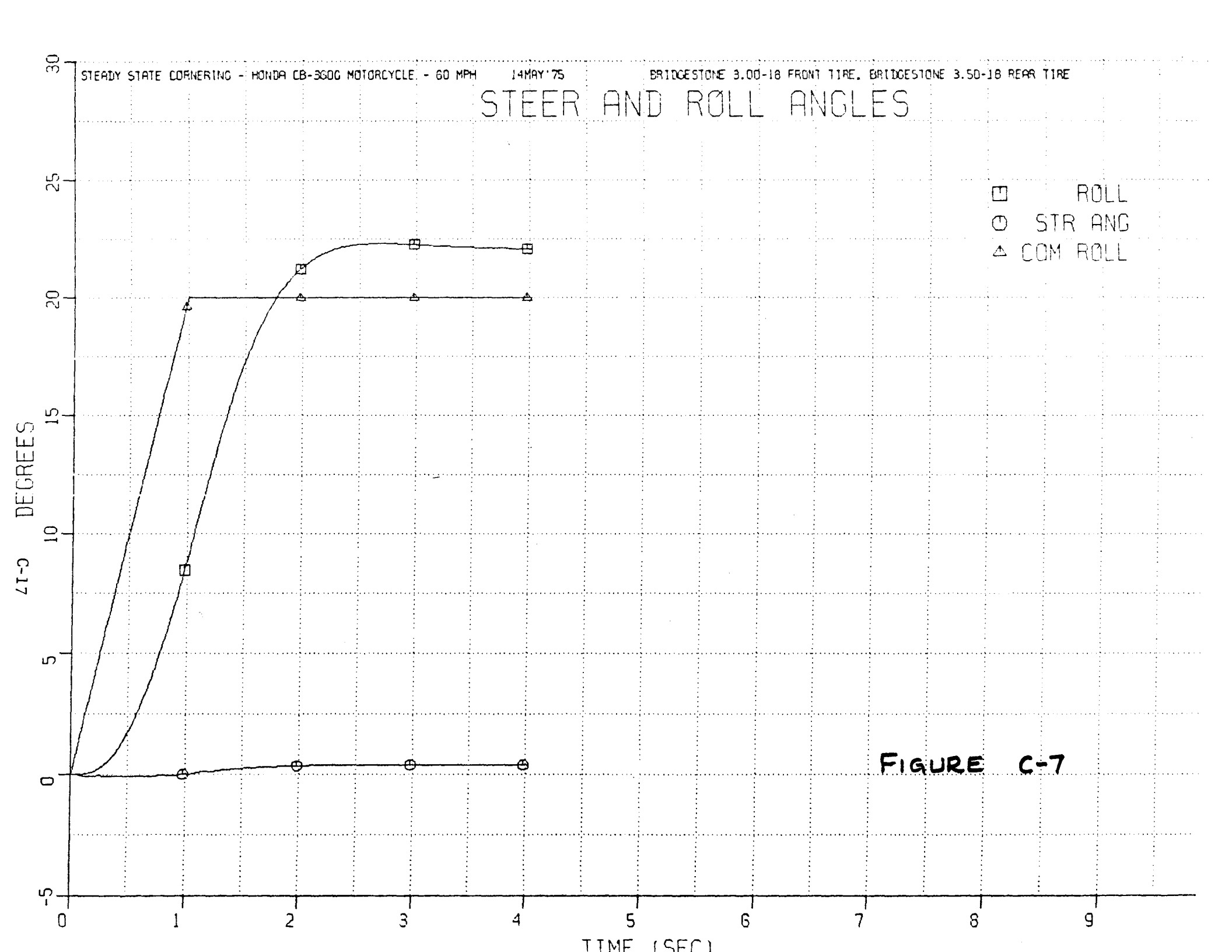

STEADY STATE CORNERING - HONDA CB-360G MOTORCYCLE - 60 MPH 14MAY'75 BRIDGESTONE 3.00-18 FRONT TIRE, BRIDGESTONE 3.50-18 REAR TIRE
STEER AND ROLL ANGLES
ROLL
STR ANG
COM ROLL
DEGREES
TIME (SEC)
30
25
20
15
10
5
0
-5
0
1
2
3
4
5
6
7
8
9

FIGURE C-7

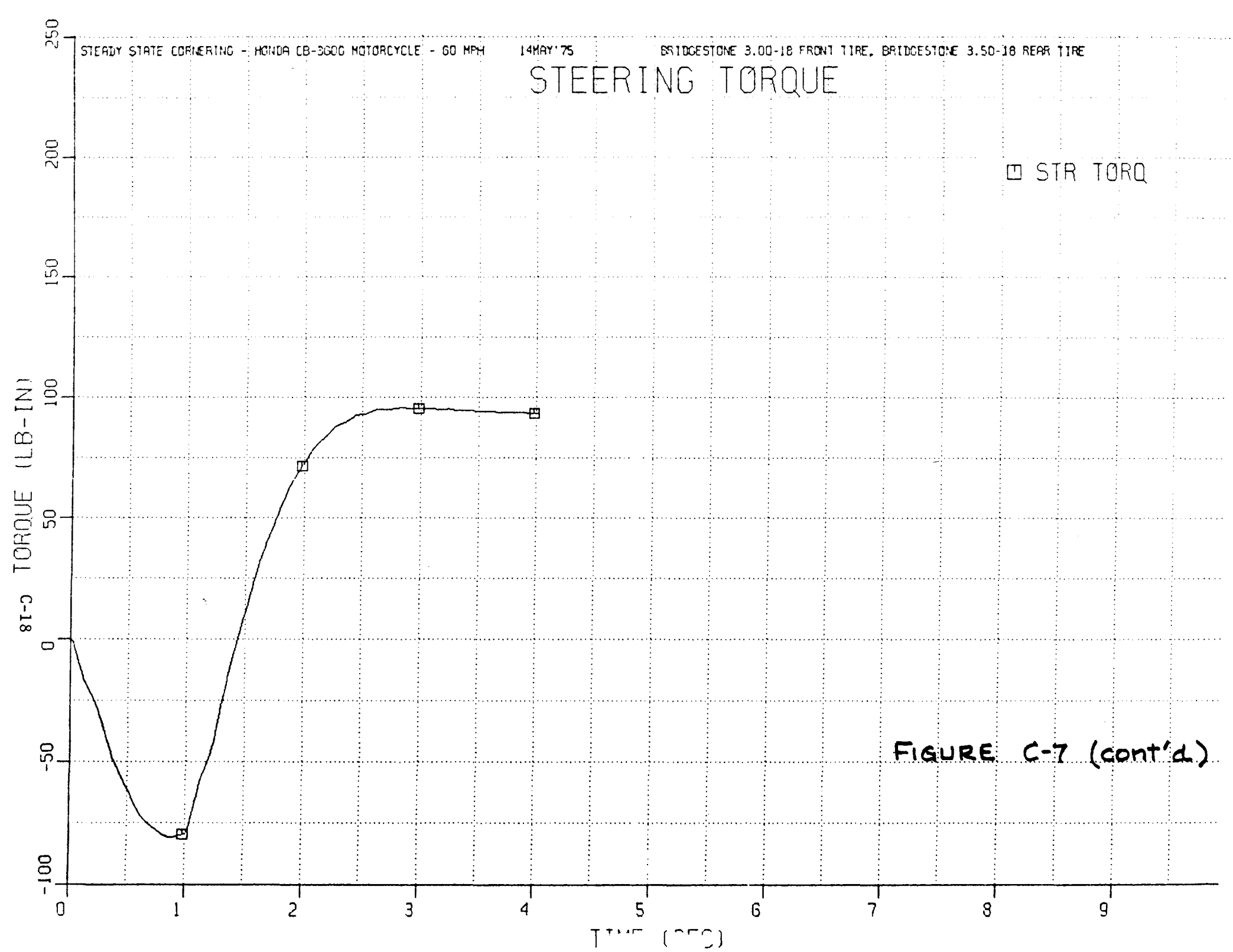


FIGURE C-7 (cont'd.)

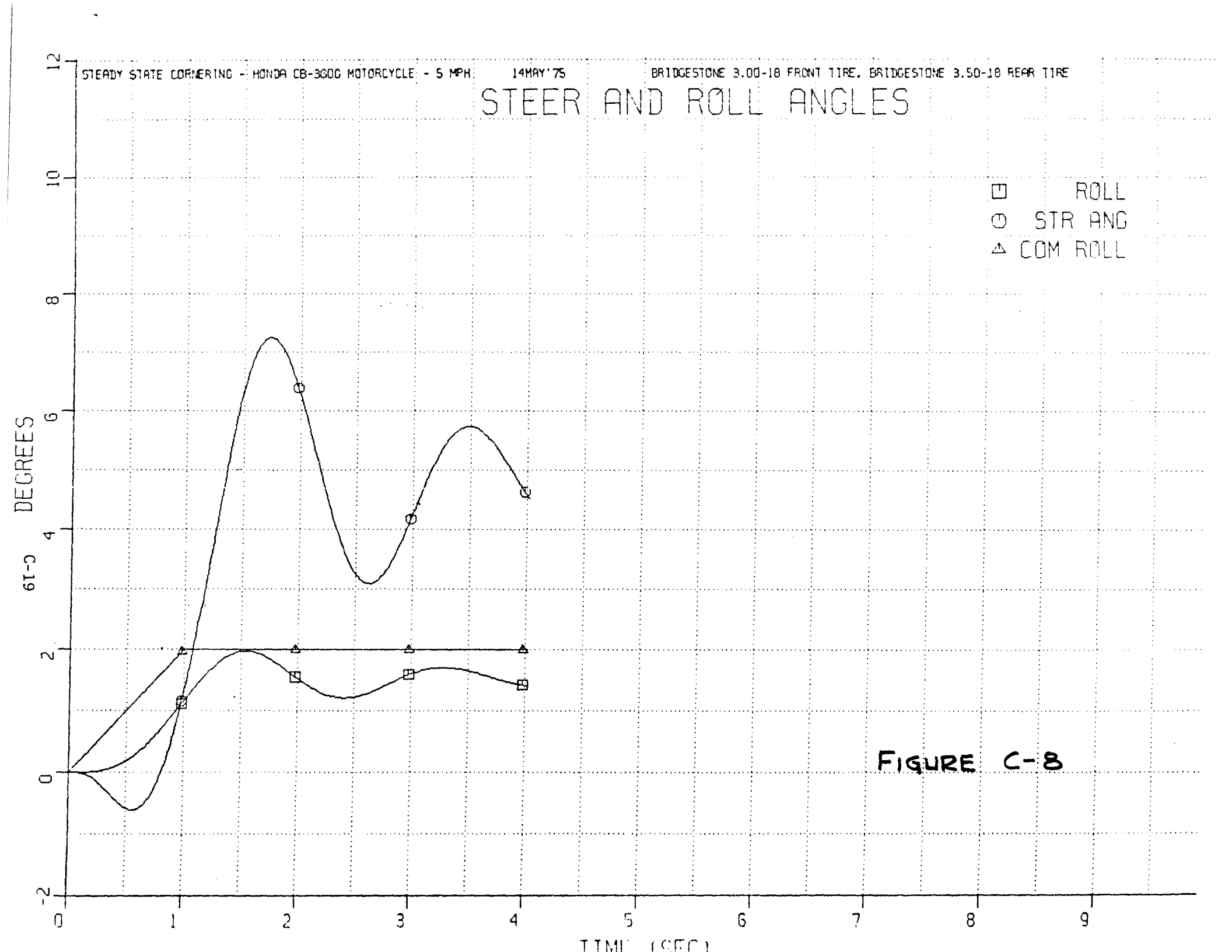

STEADY STATE CORNERING - HONDA CB-360G MOTORCYCLE - 5 MPH 14MAY'75 BRIDGESTONE 3.00-18 FRONT TIRE, BRIDGESTONE 3.50-18 REAR TIRE
STEER AND ROLL ANGLES
ROLL
STR ANG
COM ROLL
DEGREES
TIME (SEC)
12
10
8
6
4
2
0
-2
0
1
2
3
4
5
6
7
8
9

FIGURE C-8

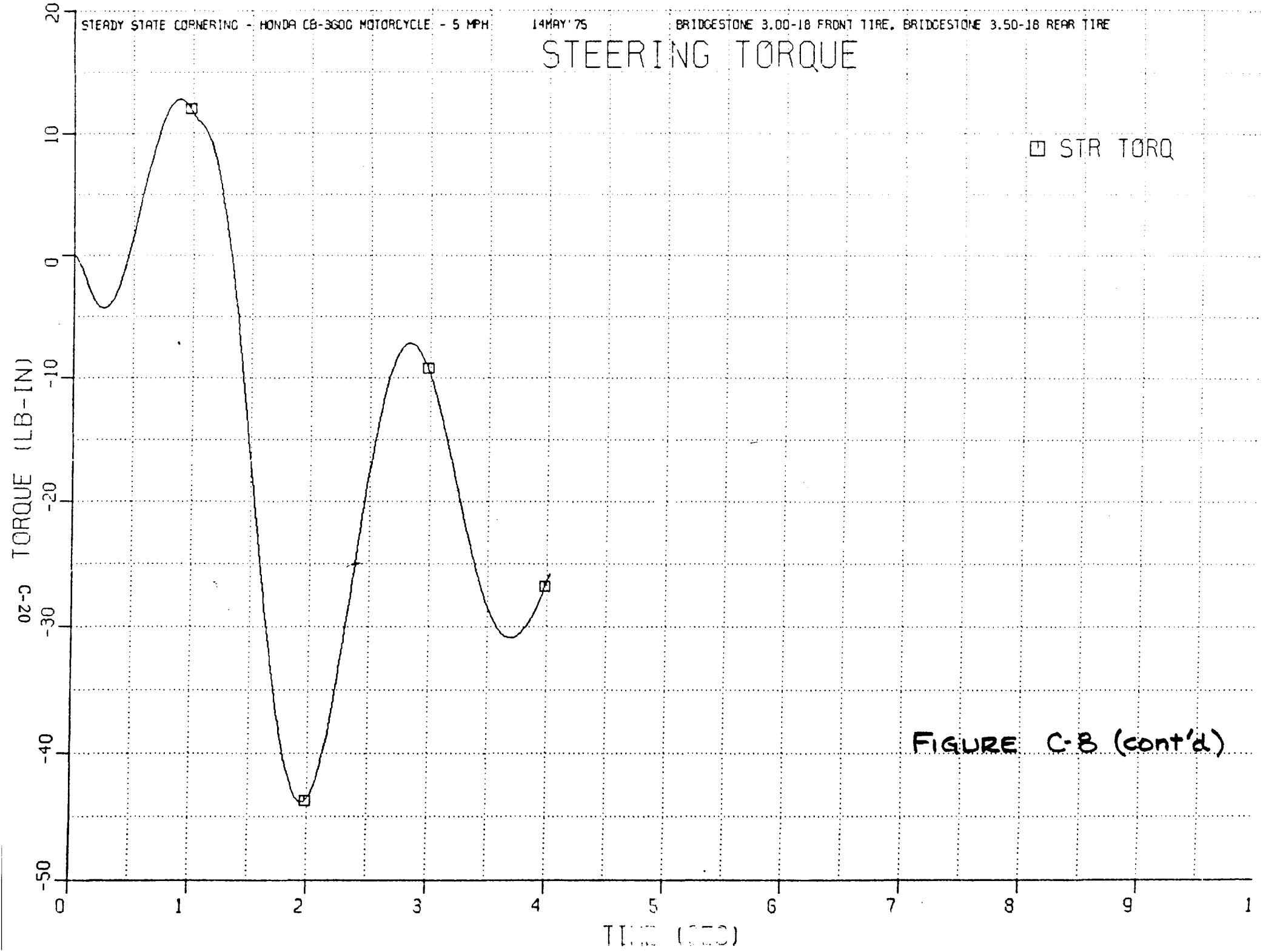


FIGURE C-8 (cont'd)

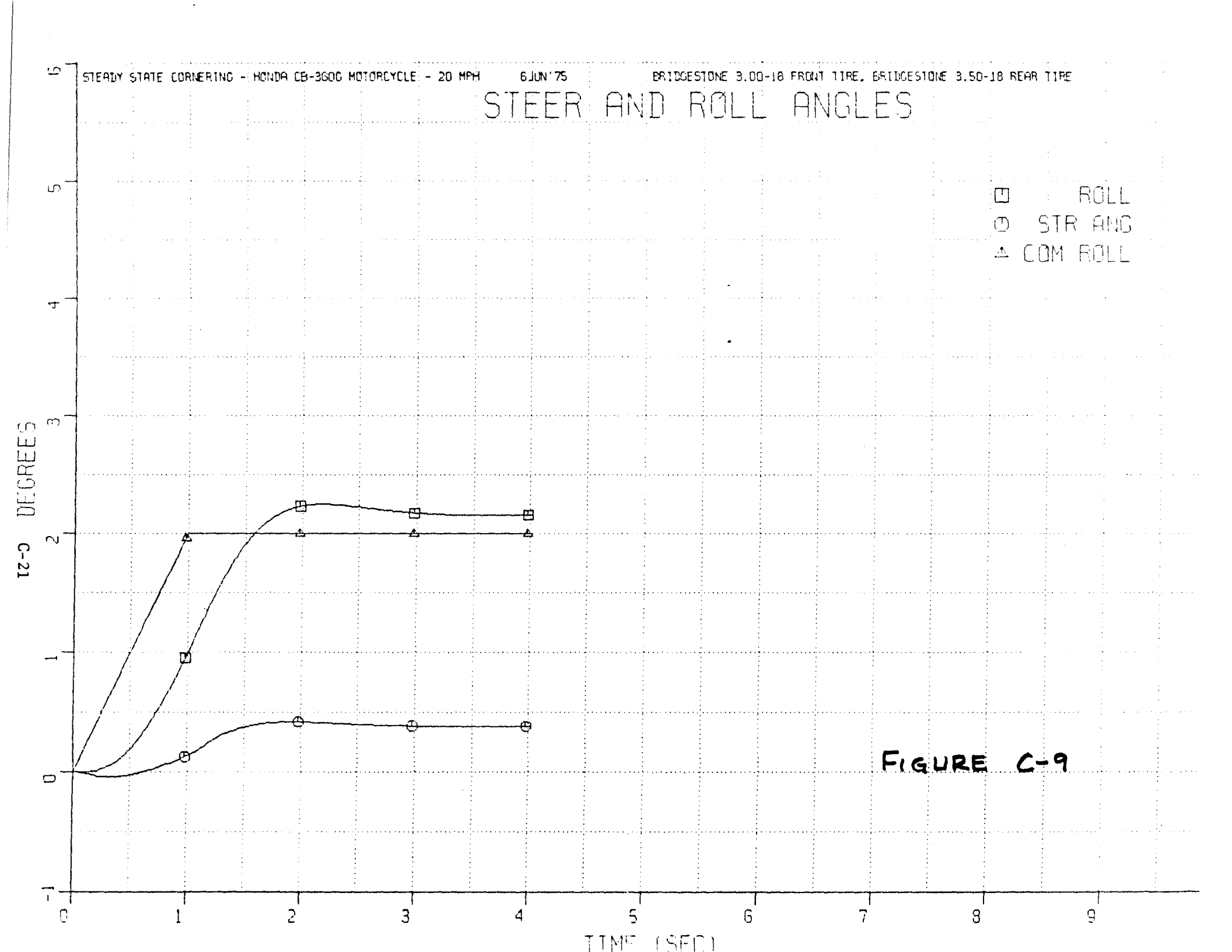

STEADY STATE CORNERING - HONDA CB-360C MOTORCYCLE - 20 MPH 6JUN'75 BRIDGESTONE 3.00-18 FRONT TIRE, BRIDGESTONE 3.50-18 REAR TIRE
STEER AND ROLL ANGLES
ROLL
STR ANG
COM ROLL
DEGREES
TIME (SEC)
6
5
4
3
2
1
0
-1
0
1
2
3
4
5
6
7
8
9

FIGURE C-9

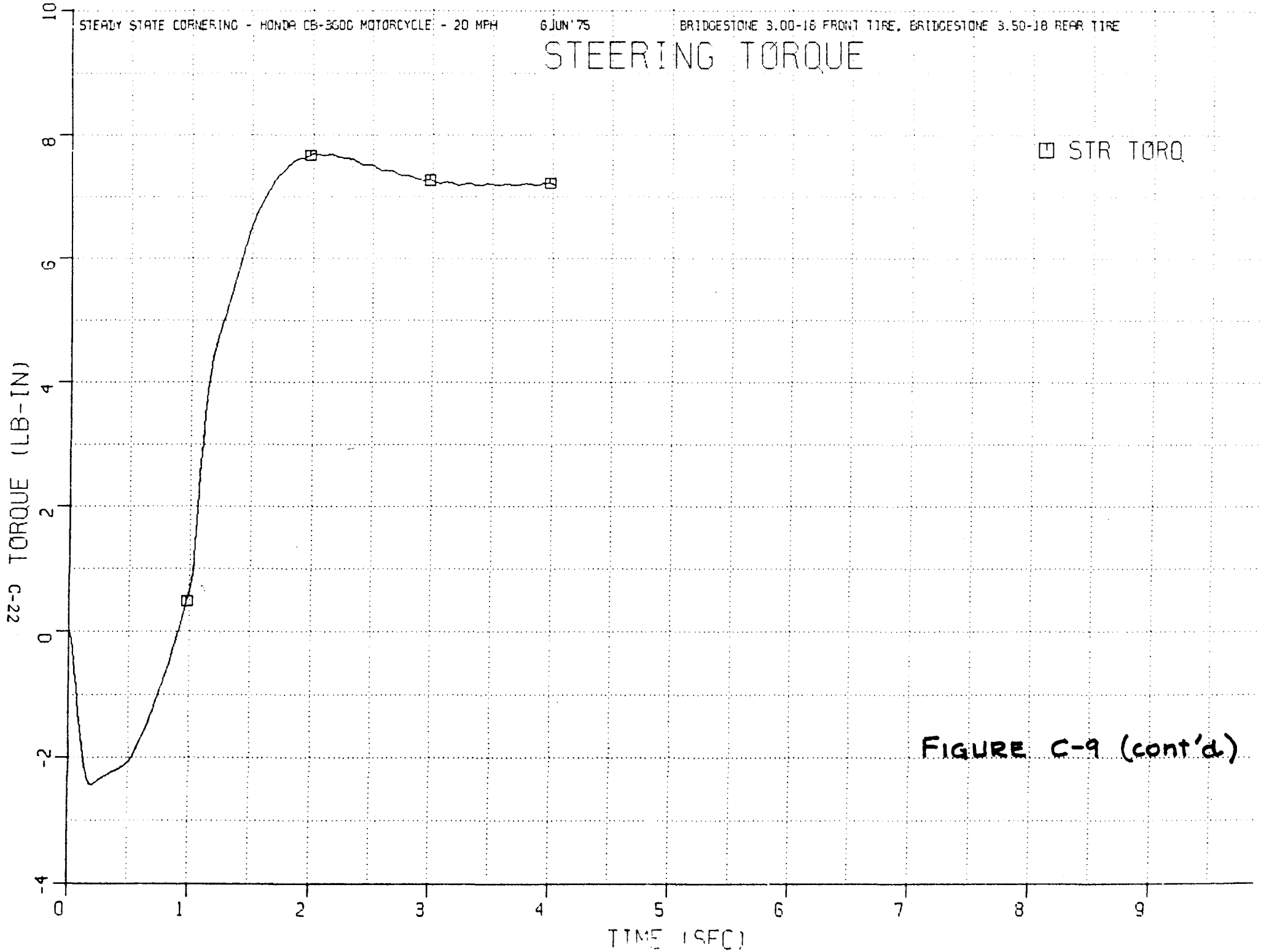


FIGURE C-9 (cont'd.)

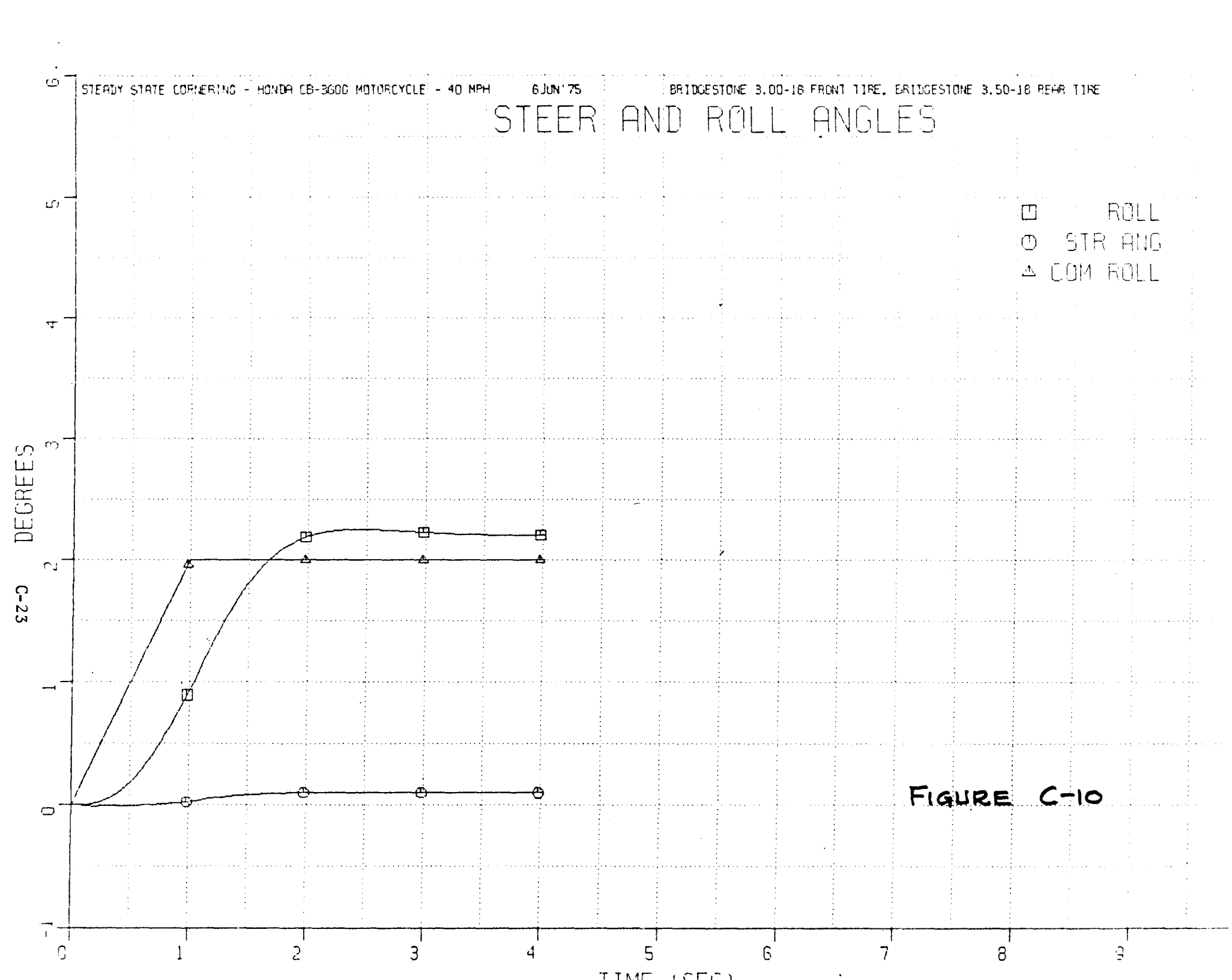

STEADY STATE CORNERING - HONDA CB-360C MOTORCYCLE - 40 MPH 6JUN'75 BRIDGESTONE 3.00-16 FRONT TIRE, BRIDGESTONE 3.50-18 REAR TIRE
STEER AND ROLL ANGLES
ROLL
STR ANG
COM ROLL
DEGREES
TIME (SEC)
6
5
4
3
2
1
0
-1
0
1
2
3
4
5
6
7
8
9

FIGURE C-10

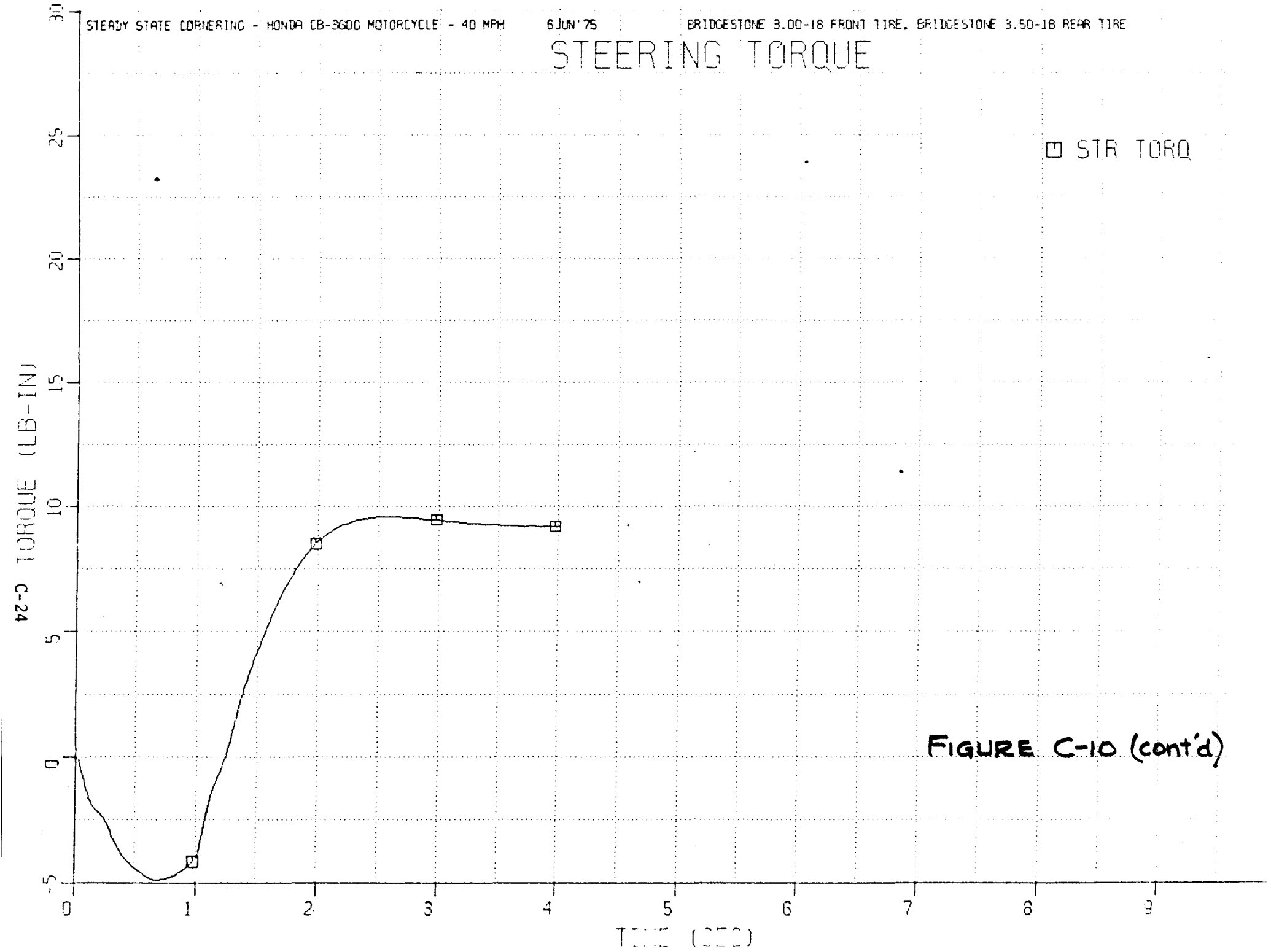


FIGURE C-10 (cont'd)

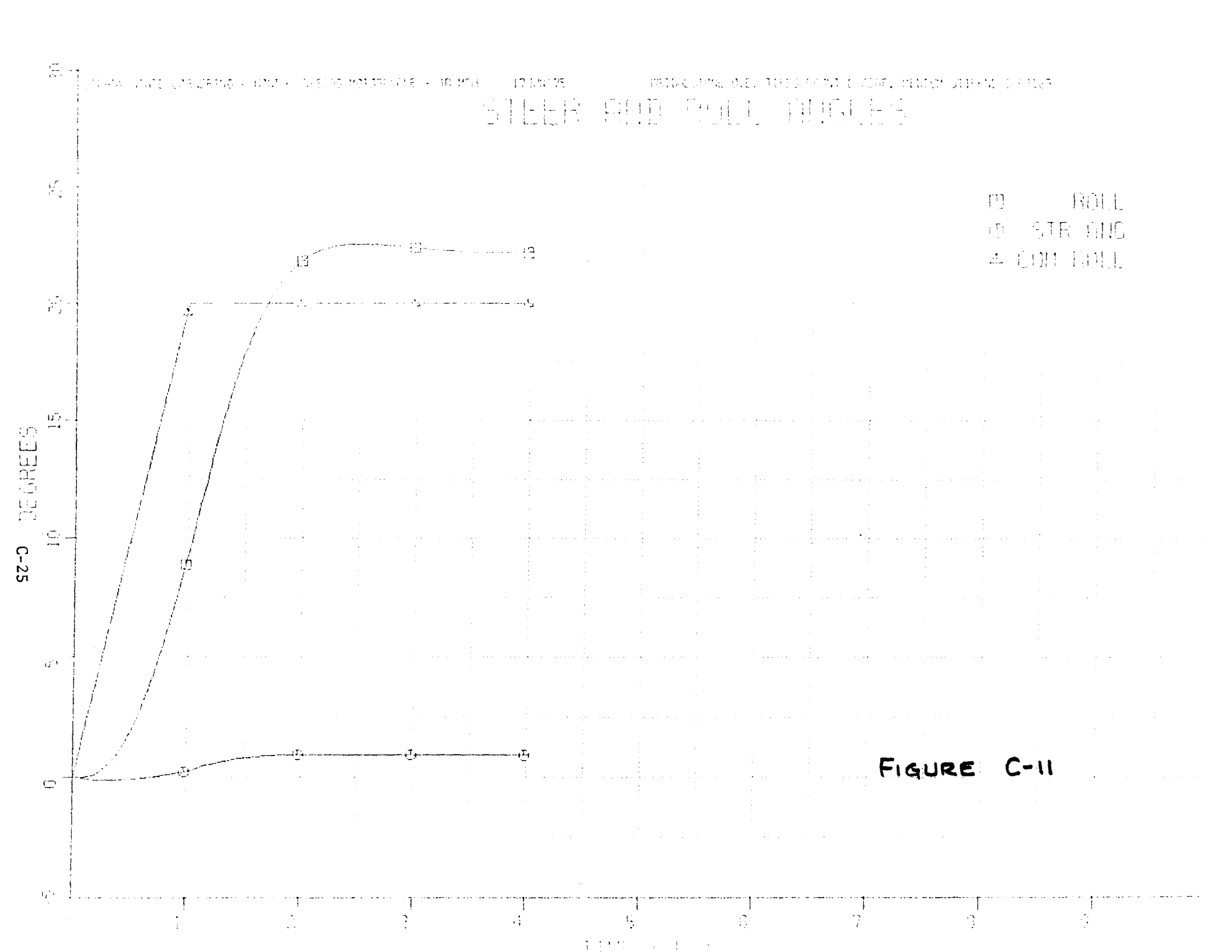

STEER AND ROLL ANGLES
ROLL
STR WND
COM WHL
DEGREES
0
5
10
15
20
25
30

FIGURE C-11

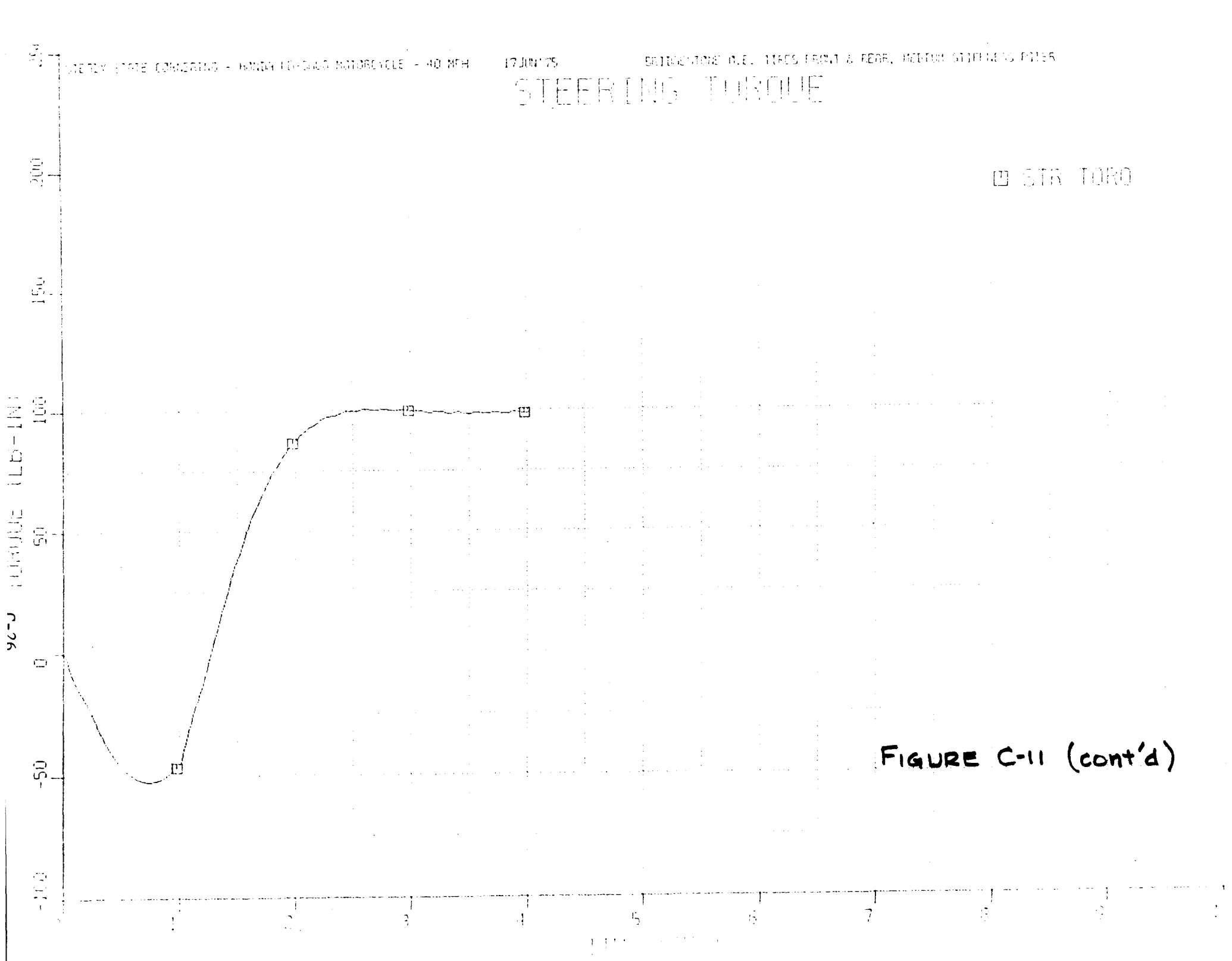


FIGURE C-11 (cont'd)

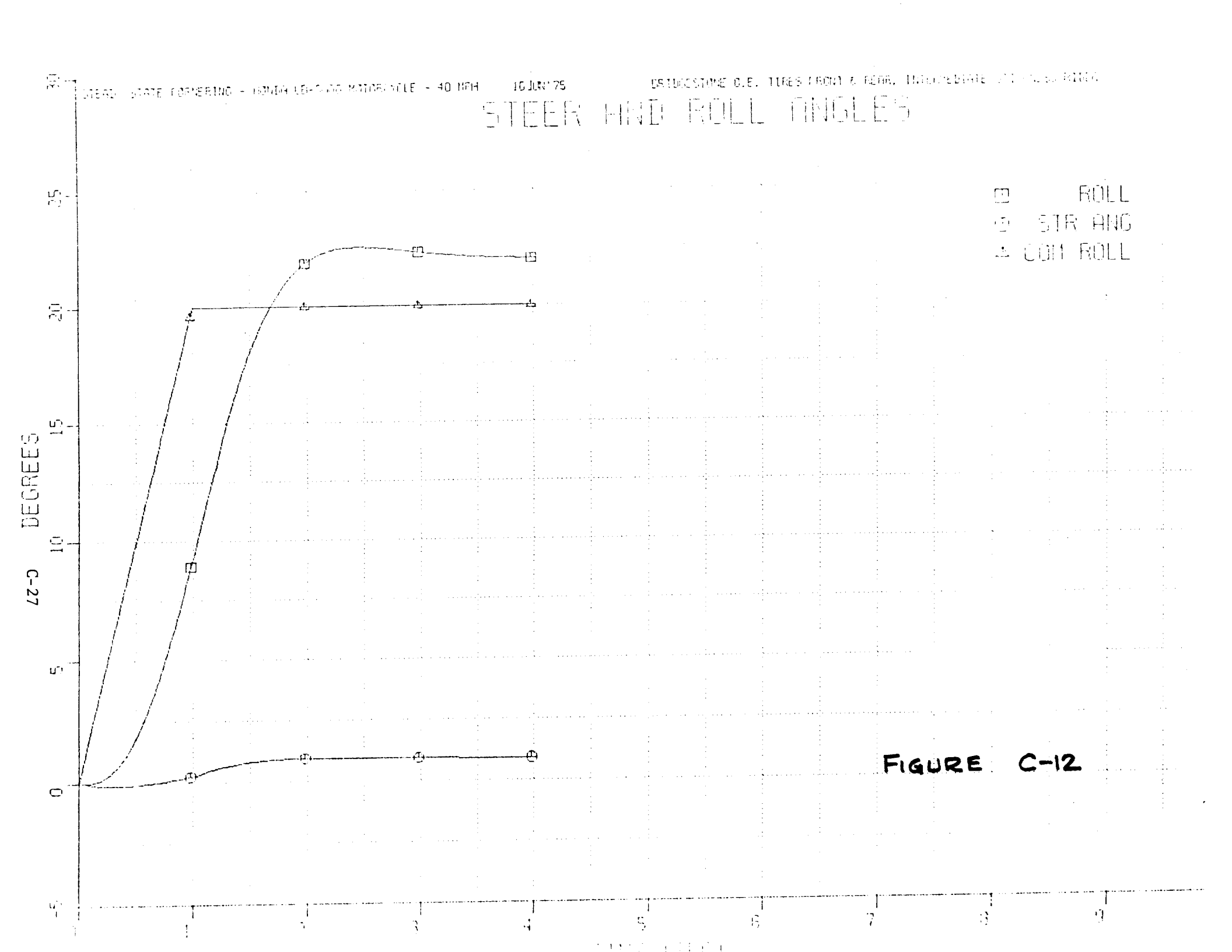

STEER AND ROLL ANGLES
10 JUN '75
ROLL
STR ANG
COM ROLL
DEGREES
30
25
20
15
10
5
0
-5
1
2
3
4
5
6
7
8
9

FIGURE C-12

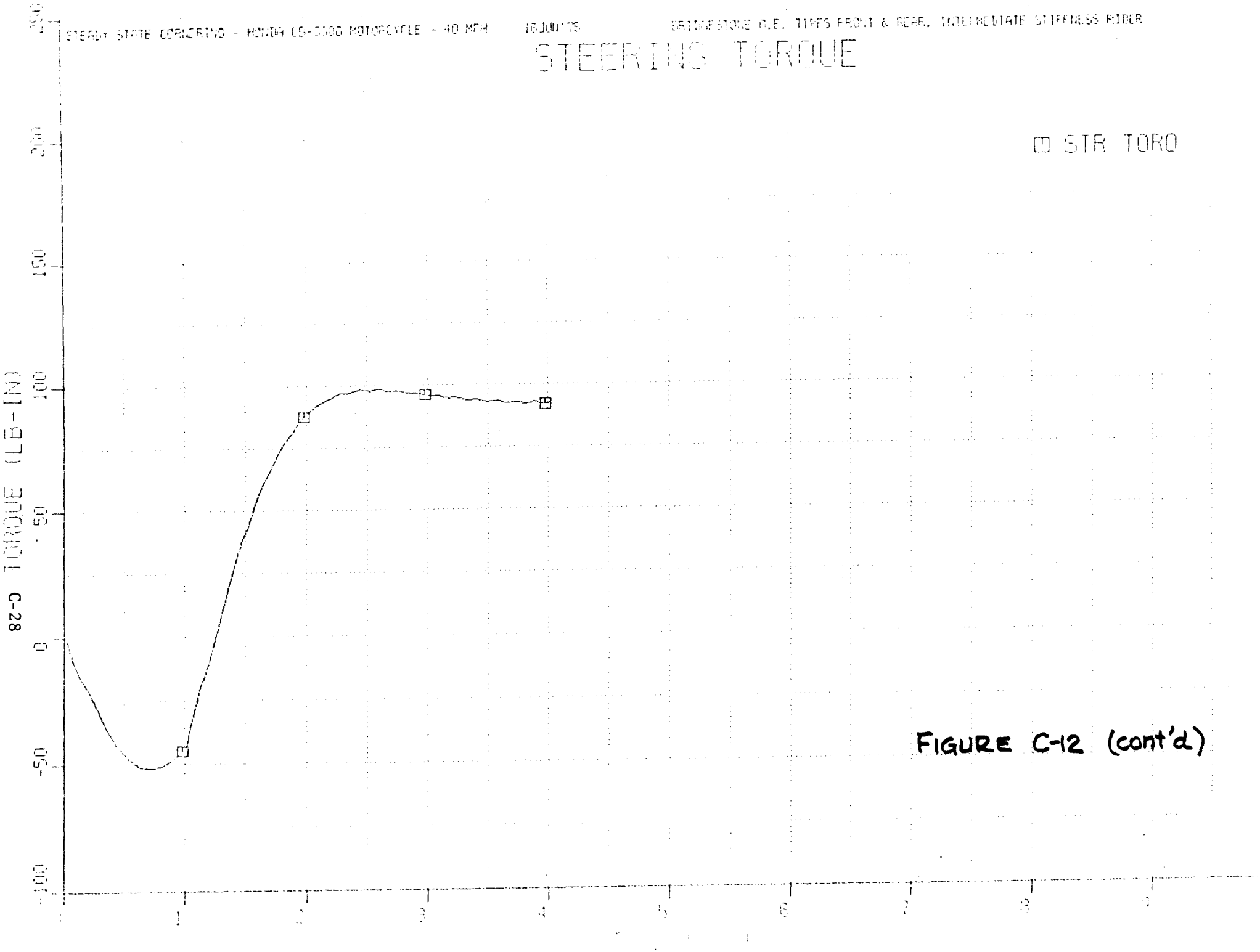


FIGURE C-12 (cont'd)

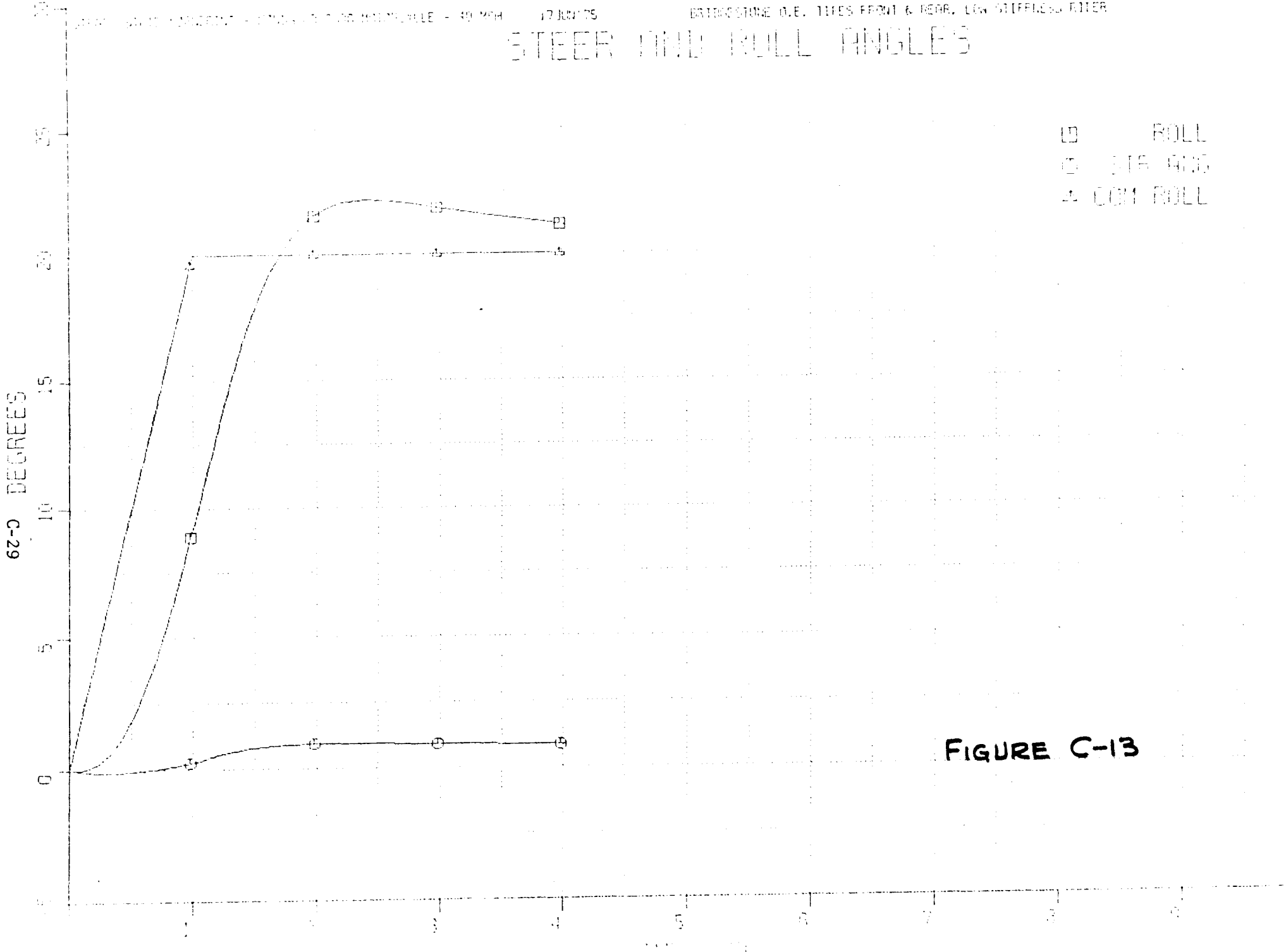

BRIDGESTONE O.E. TIRES FRONT & REAR, LOW STIFFNESS RATER
STEER AND ROLL ANGLES
ROLL
DEGREES
0
5
10
15
20
25

FIGURE C-13

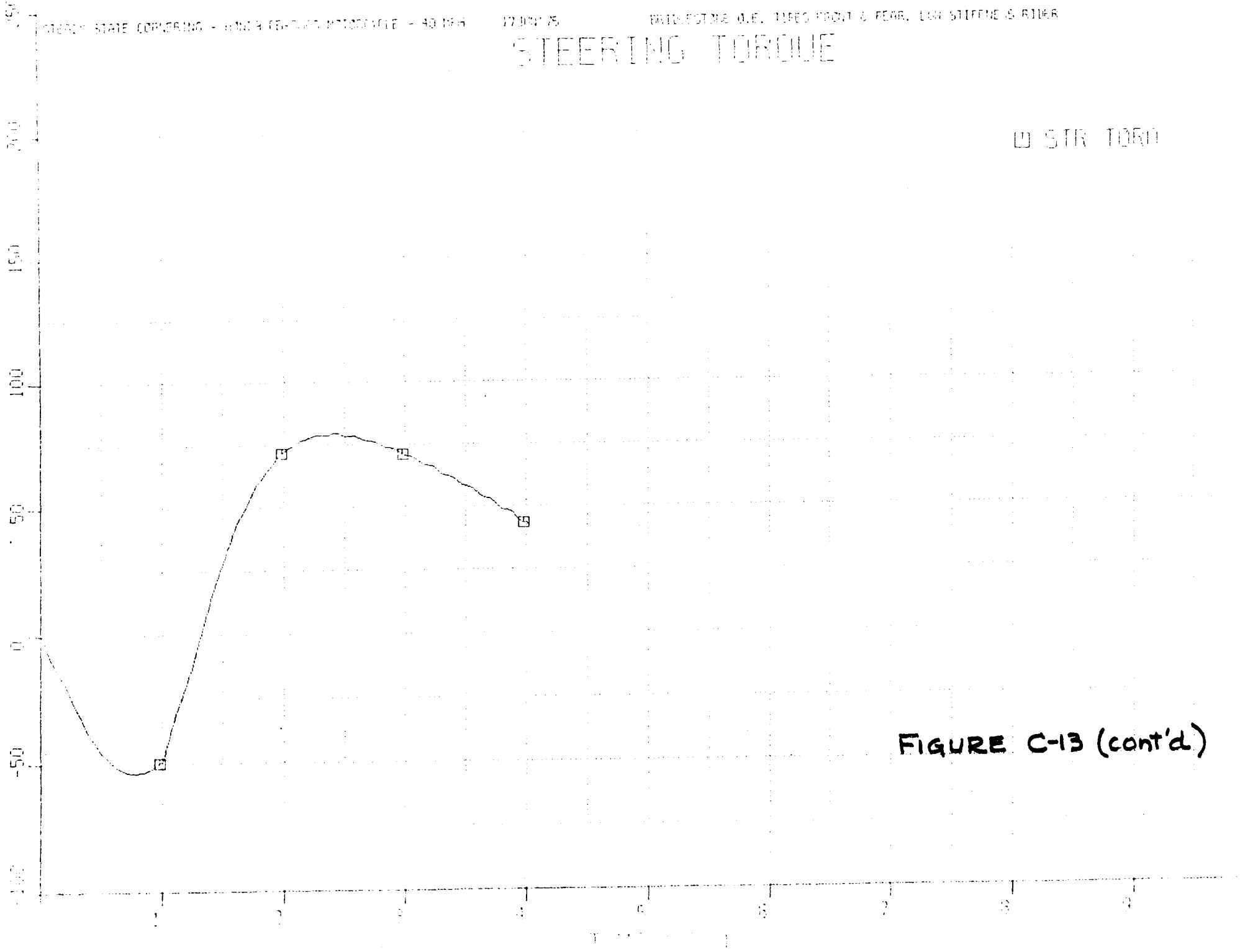


FIGURE C-13 (cont'd)

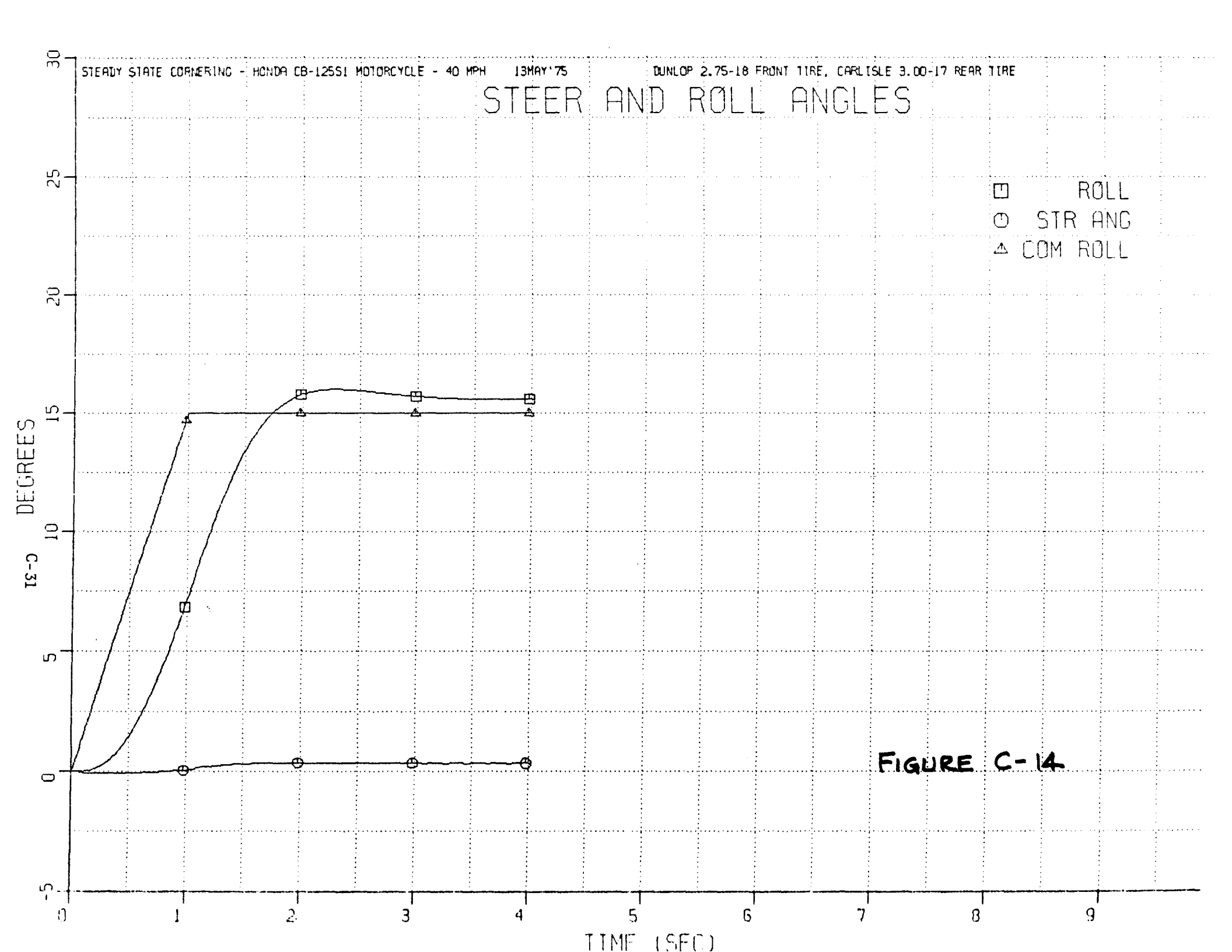

STEADY STATE CORNERING - HONDA CB-125S1 MOTORCYCLE - 40 MPH 13MAY'75
DUNLOP 2.75-18 FRONT TIRE, CARLISLE 3.00-17 REAR TIRE
STEER AND ROLL ANGLES
ROLL
STR ANG
COM ROLL
DEGREES
TIME (SEC)
30
25
20
15
10
5
0
-5
0
1
2
3
4
5
6
7
8
9

FIGURE C-14

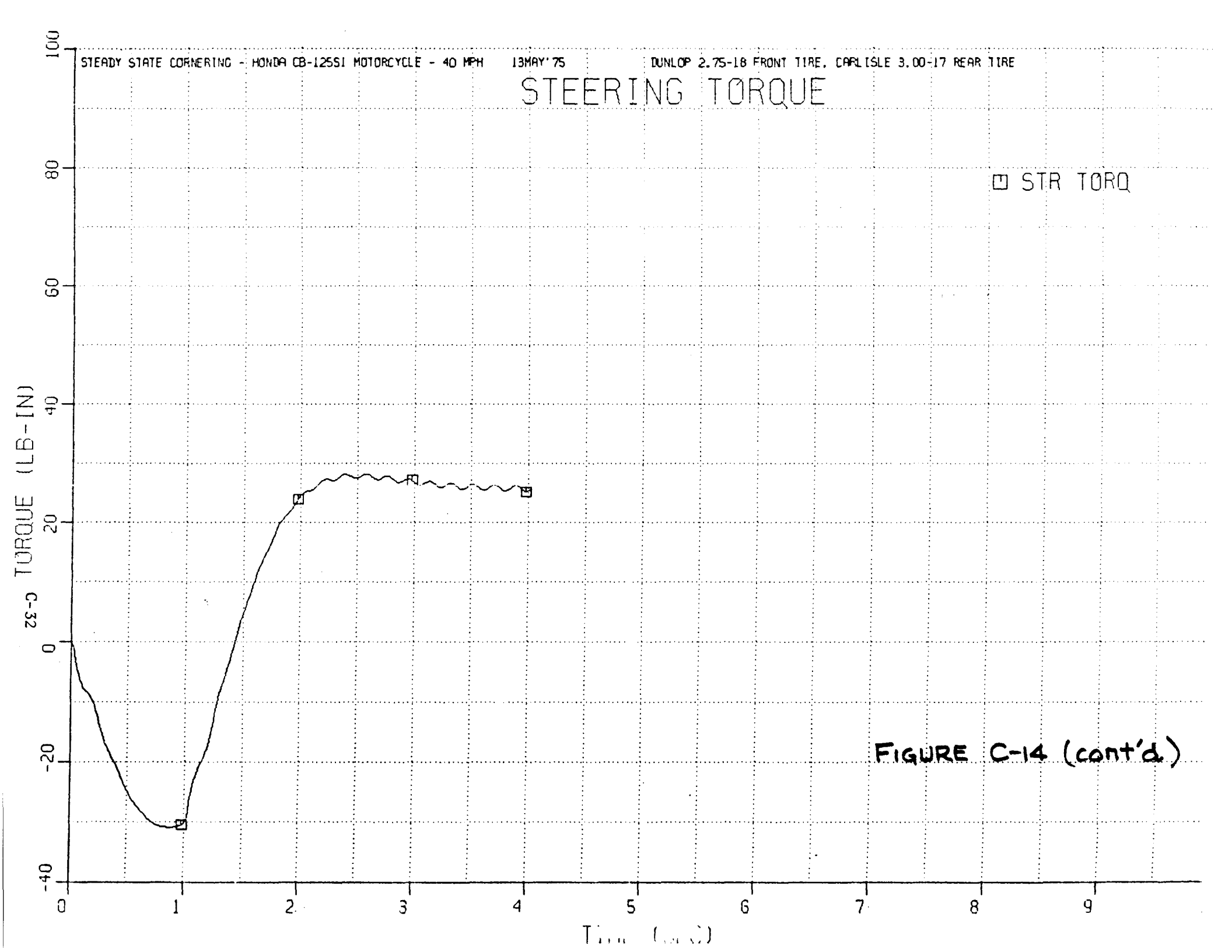


FIGURE C-14 (cont'd.)

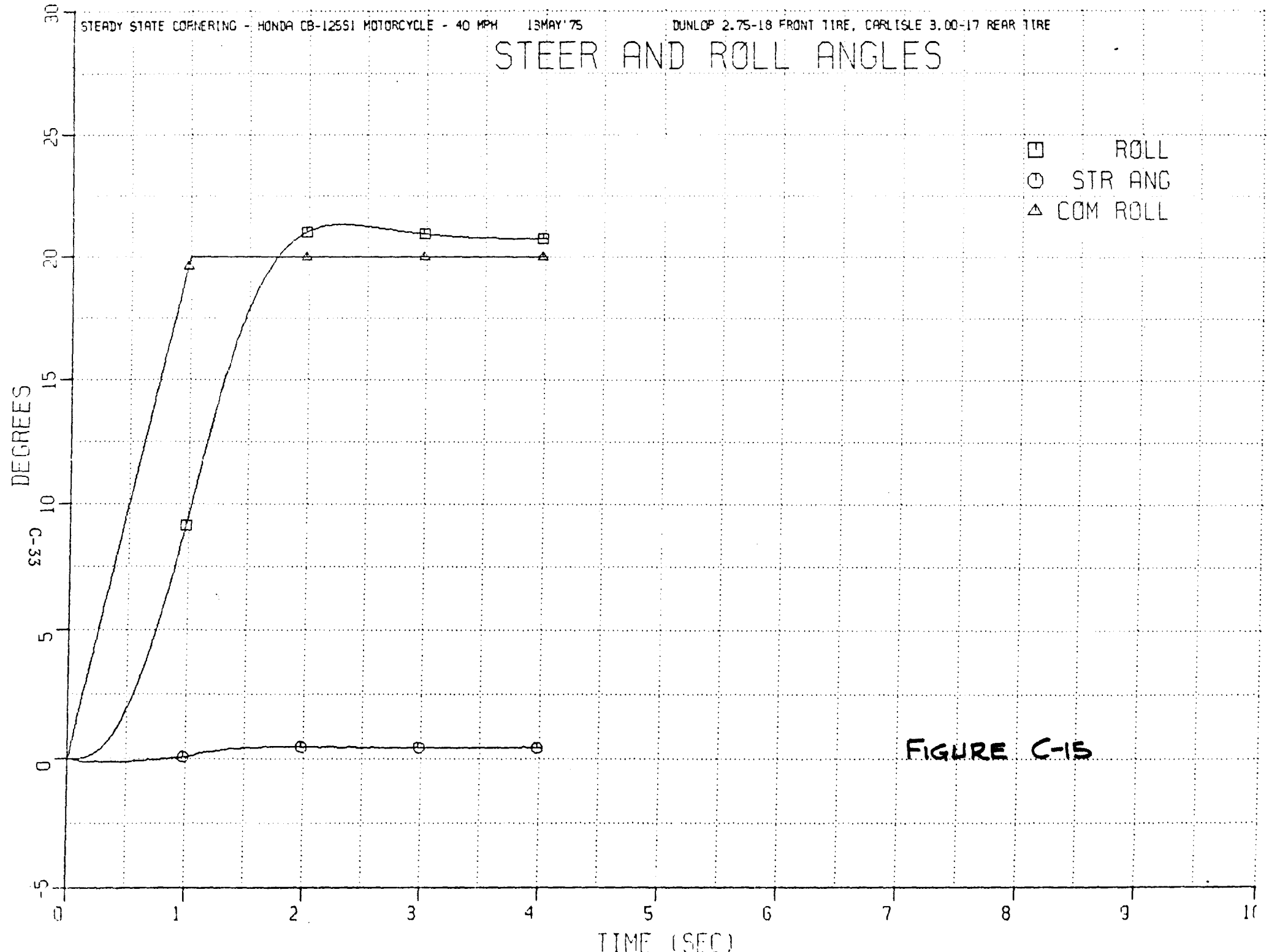

STEADY STATE CORNERING - HONDA CB-125S1 MOTORCYCLE - 40 MPH 13MAY'75
DUNLOP 2.75-18 FRONT TIRE, CARLISLE 3.00-17 REAR TIRE
STEER AND ROLL ANGLES
ROLL
STR ANG
COM ROLL
DEGREES
TIME (SEC)
30
25
20
15
10
5
0
-5
0
1
2
3
4
5
6
7
8
9
10

FIGURE C-15

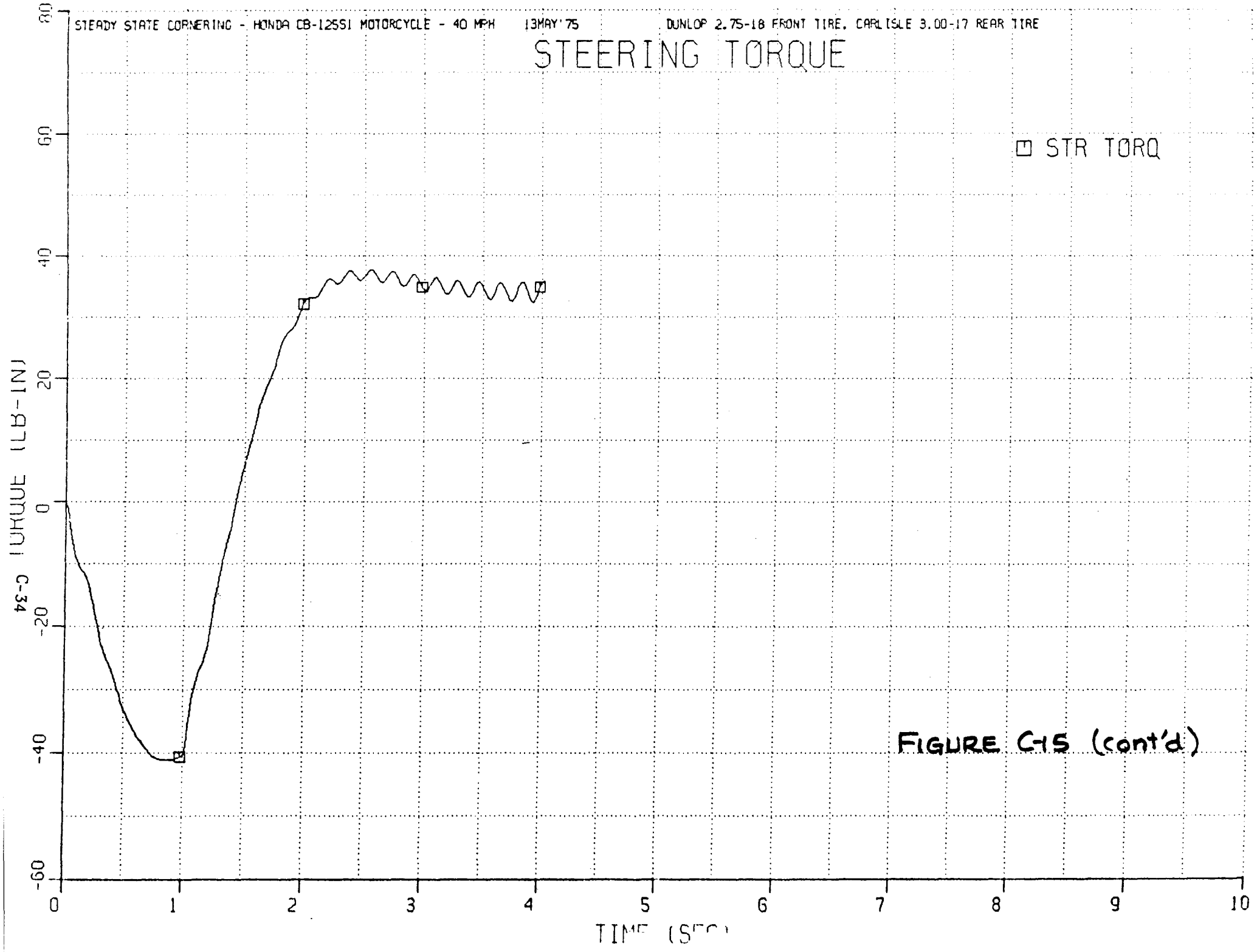


FIGURE C-15 (cont'd)

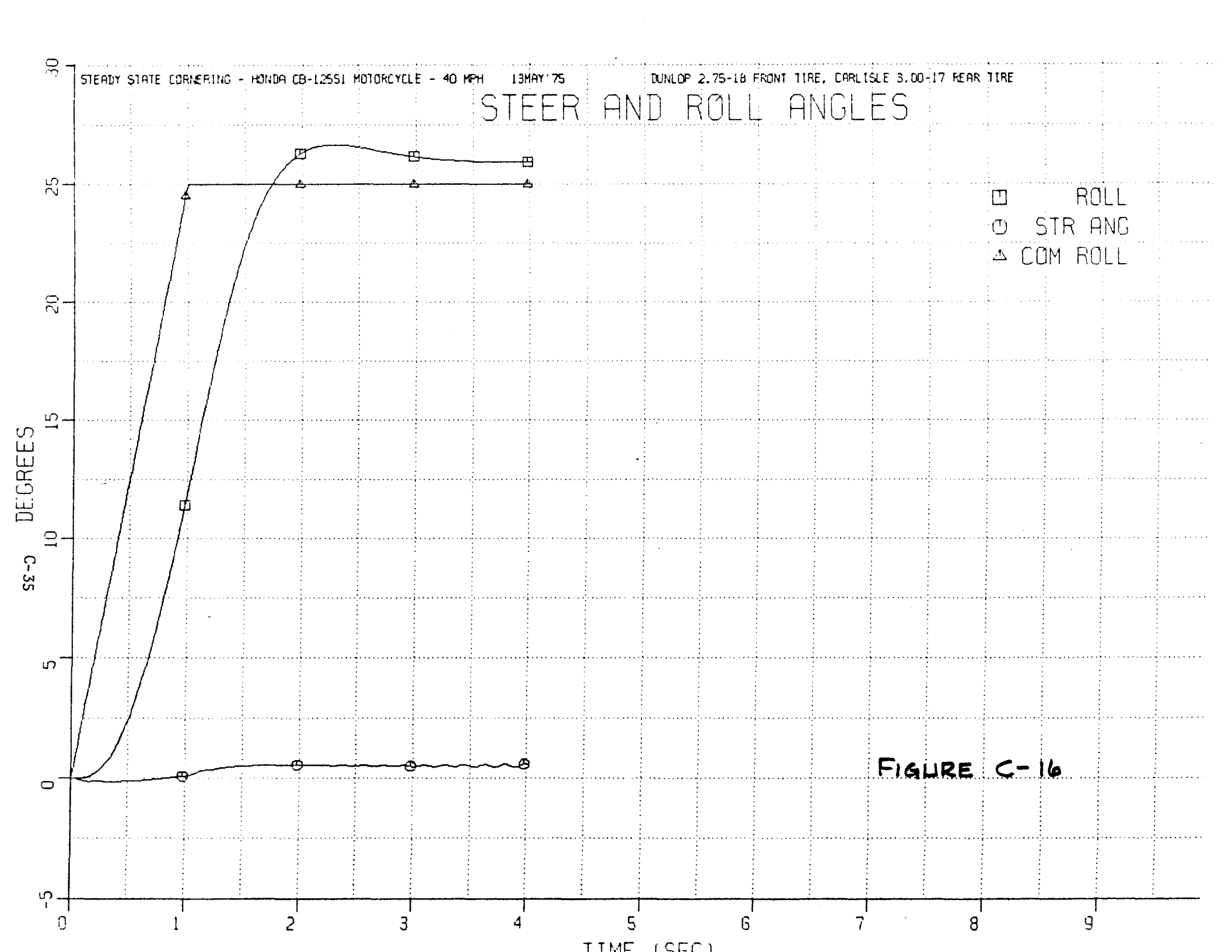

STEADY STATE CORNERING - HONDA CB-125S1 MOTORCYCLE - 40 MPH 13MAY'75
DUNLOP 2.75-18 FRONT TIRE, CARLISLE 3.00-17 REAR TIRE
STEER AND ROLL ANGLES
ROLL
STR ANG
COM ROLL
DEGREES
TIME (SEC)
30
25
20
15
10
5
0
-5
0
1
2
3
4
5
6
7
8
9

FIGURE C-16

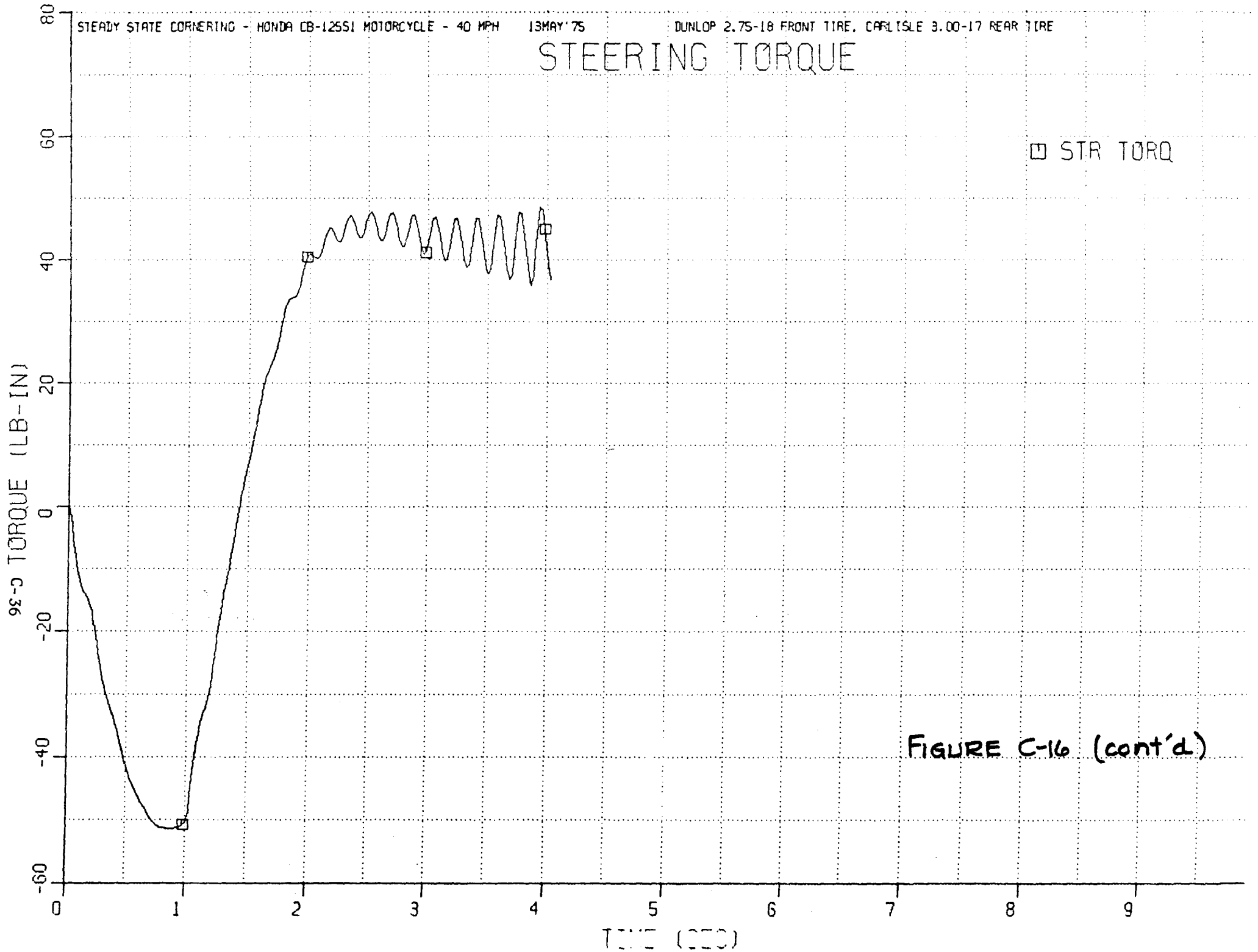


FIGURE C-16 (cont'd)

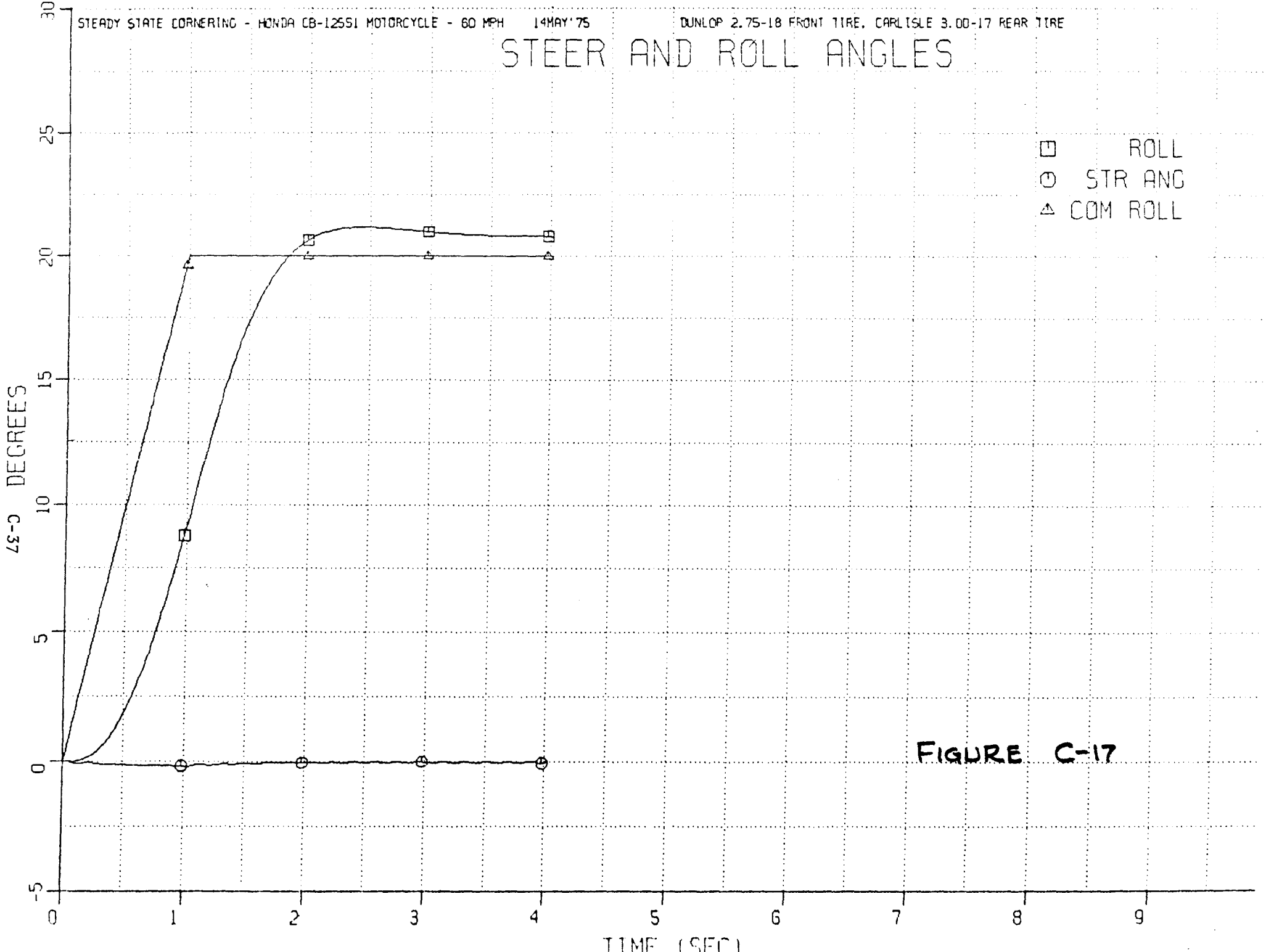

STEADY STATE CORNERING - HONDA CB-125S1 MOTORCYCLE - 60 MPH 14MAY'75
DUNLOP 2.75-18 FRONT TIRE, CARLISLE 3.00-17 REAR TIRE
STEER AND ROLL ANGLES
ROLL
STR ANG
COM ROLL
DEGREES
TIME (SEC)
30
25
20
15
10
5
0
-5
0
1
2
3
4
5
6
7
8
9

FIGURE C-17

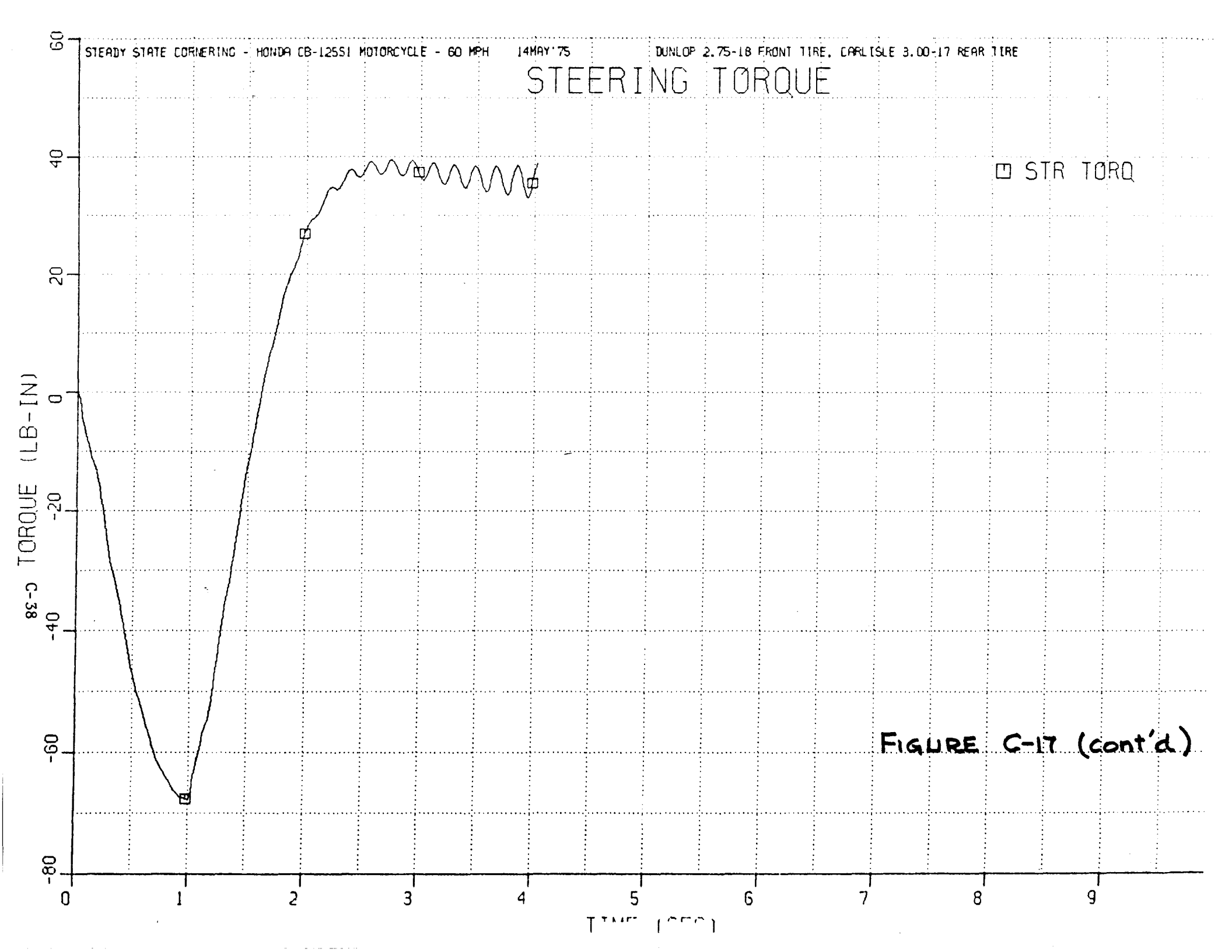


FIGURE C-17 (cont'd)

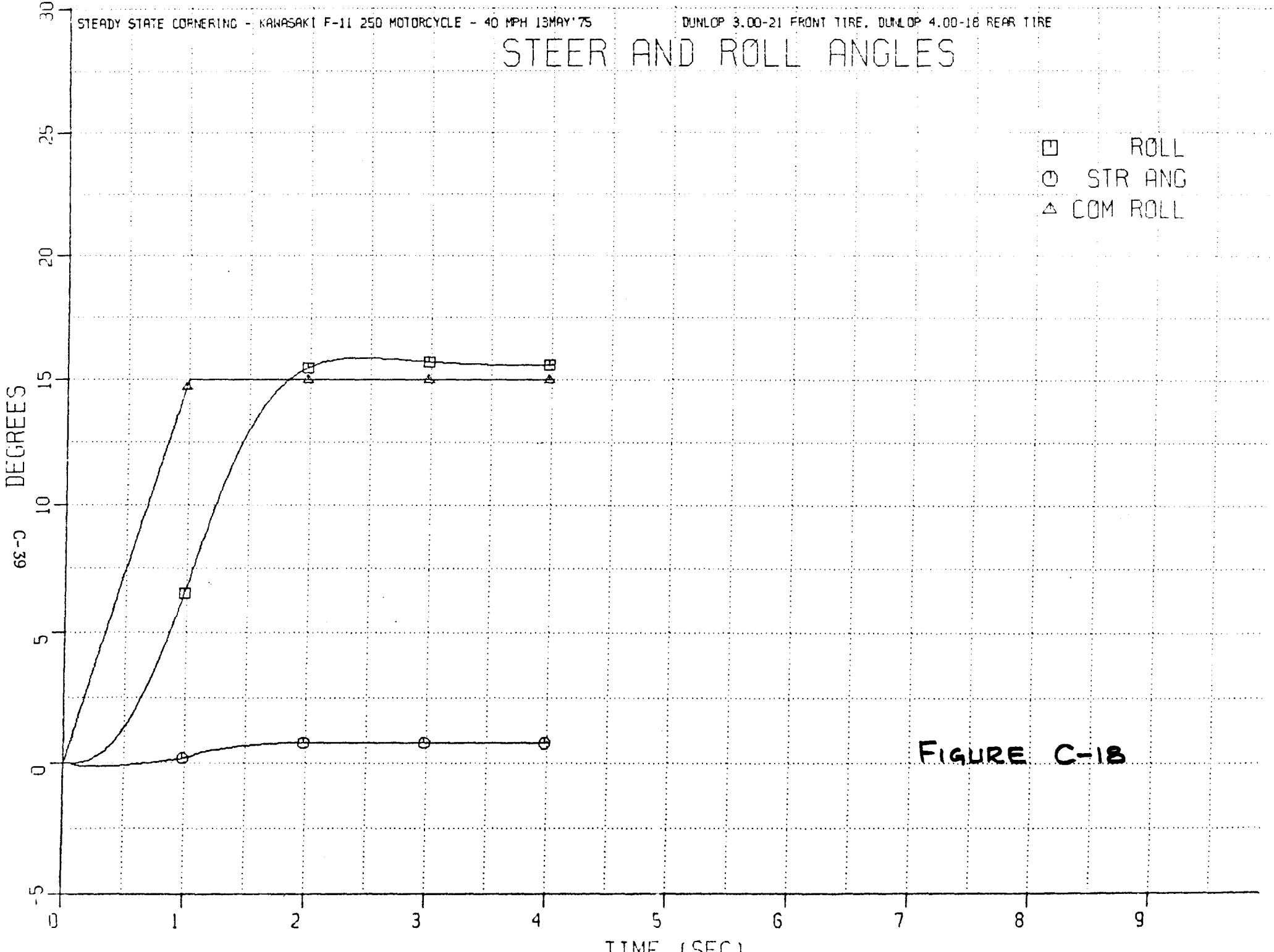

STEADY STATE CORNERING - KAWASAKI F-11 250 MOTORCYCLE - 40 MPH 13MAY'75
DUNLOP 3.00-21 FRONT TIRE, DUNLOP 4.00-18 REAR TIRE
STEER AND ROLL ANGLES
ROLL
STR ANG
COM ROLL
DEGREES
TIME (SEC)
30
25
20
15
10
5
0
-5
0
1
2
3
4
5
6
7
8
9

FIGURE C-18

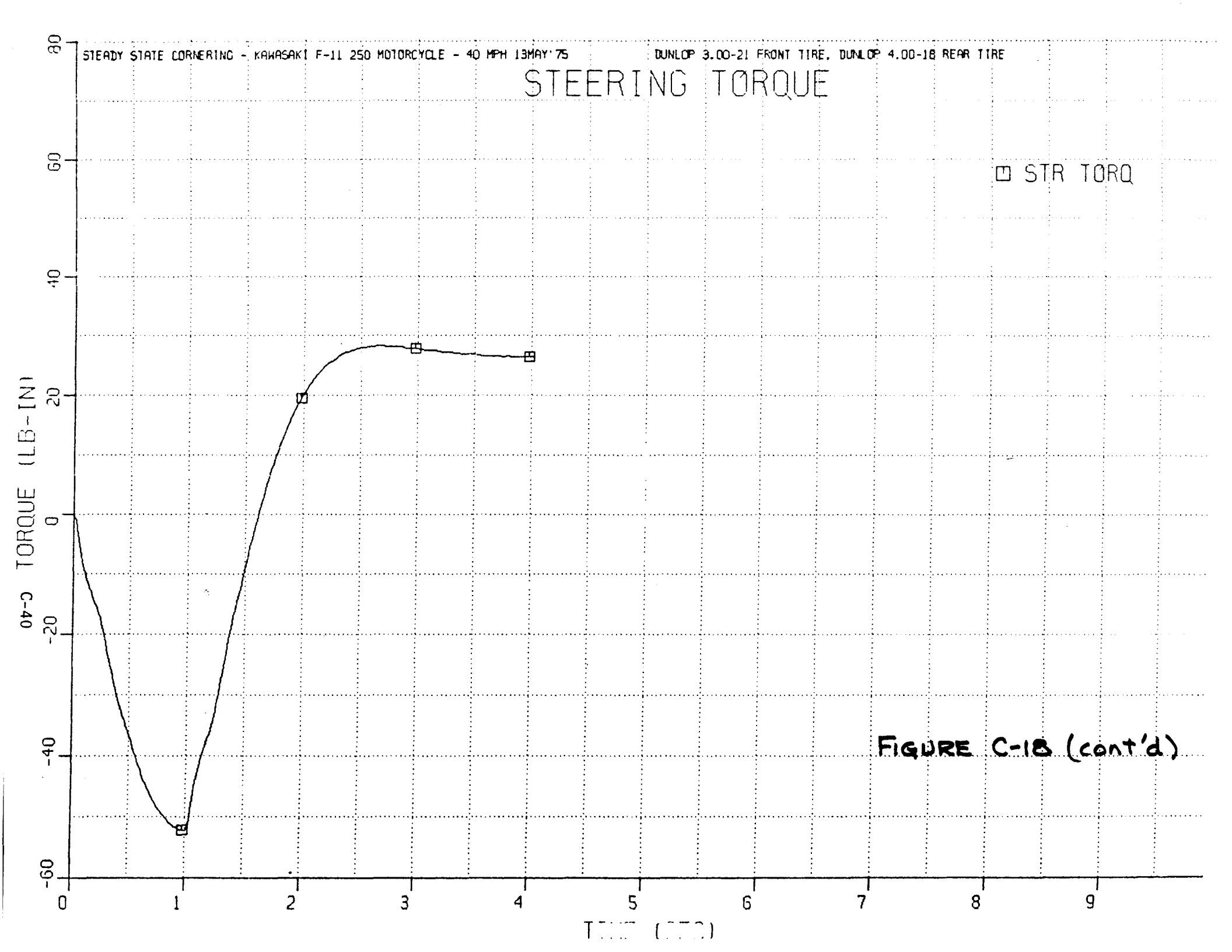


FIGURE C-18 (cont'd)

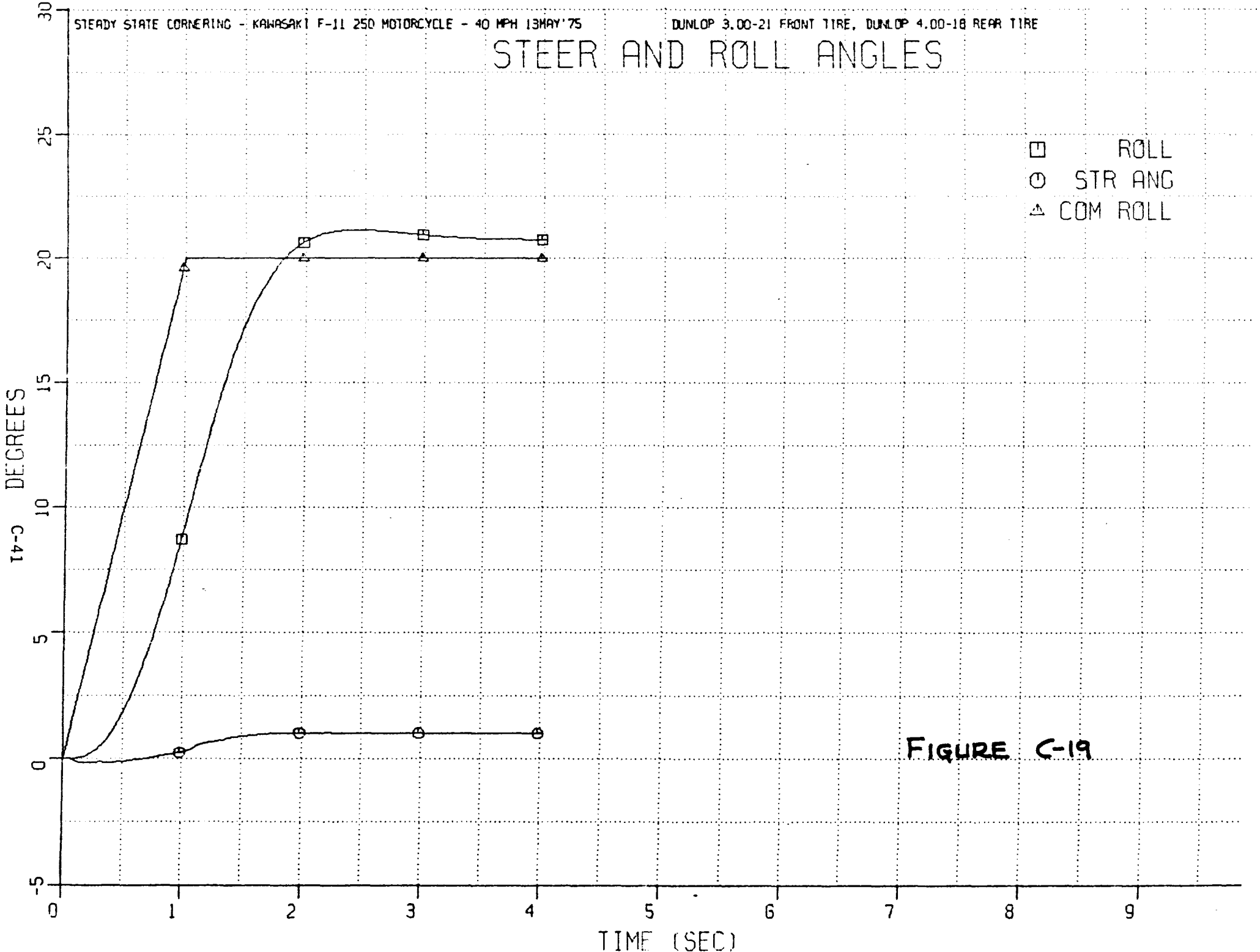

STEADY STATE CORNERING - KAWASAKI F-11 250 MOTORCYCLE - 40 MPH 13MAY'75
DUNLOP 3.00-21 FRONT TIRE, DUNLOP 4.00-18 REAR TIRE
STEER AND ROLL ANGLES
ROLL
STR ANG
COM ROLL
DEGREES
TIME (SEC)
30
25
20
15
10
5
0
-5
0
1
2
3
4
5
6
7
8
9

FIGURE C-19

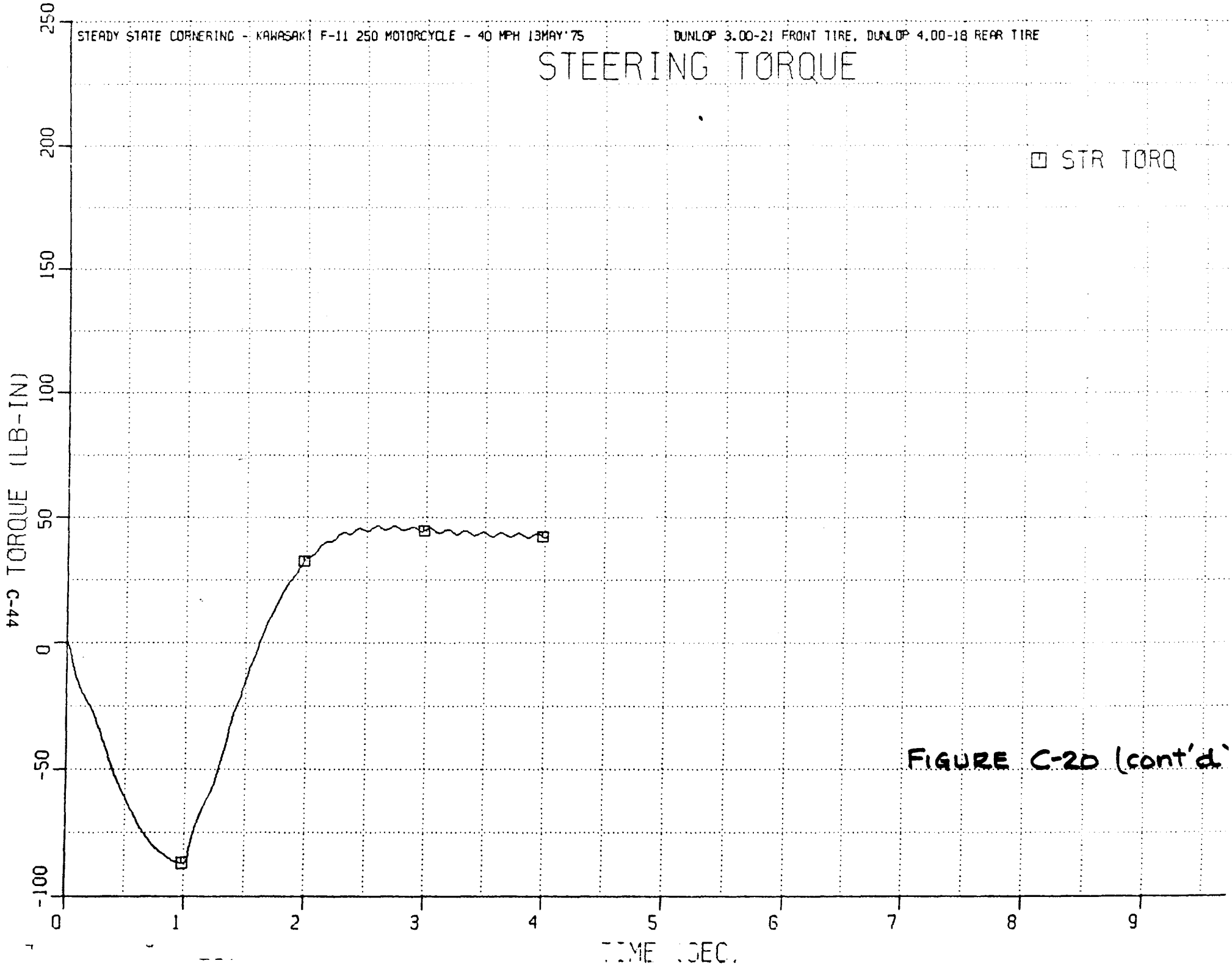


FIGURE C-20 (cont'd)

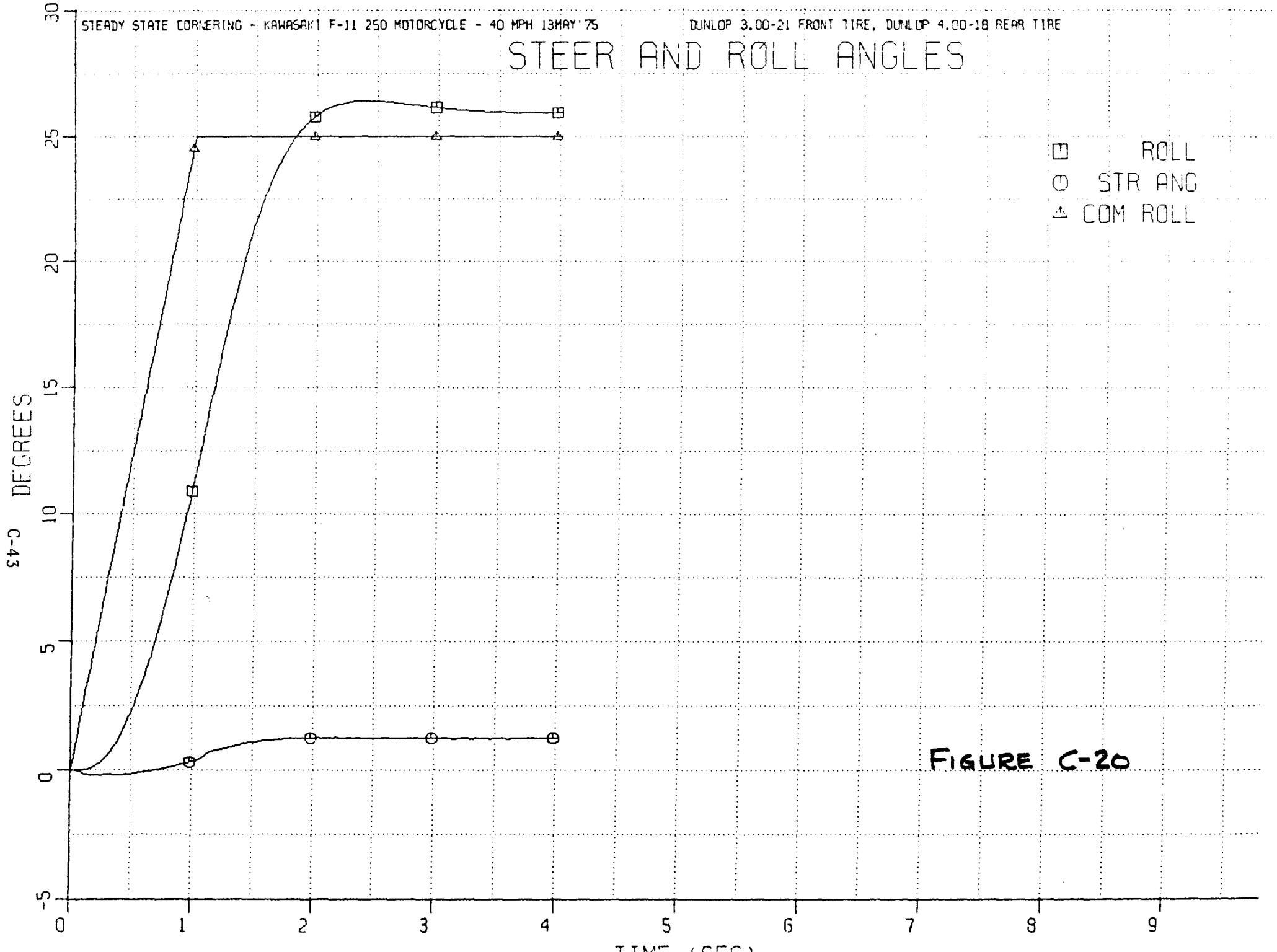

STEADY STATE CORNERING - KAWASAKI F-11 250 MOTORCYCLE - 40 MPH 13MAY'75
DUNLOP 3.00-21 FRONT TIRE, DUNLOP 4.00-18 REAR TIRE
STEER AND ROLL ANGLES
ROLL
STR ANG
COM ROLL
DEGREES
TIME (SEC)
30
25
20
15
10
5
0
-5
0
1
2
3
4
5
6
7
8
9

FIGURE C-20

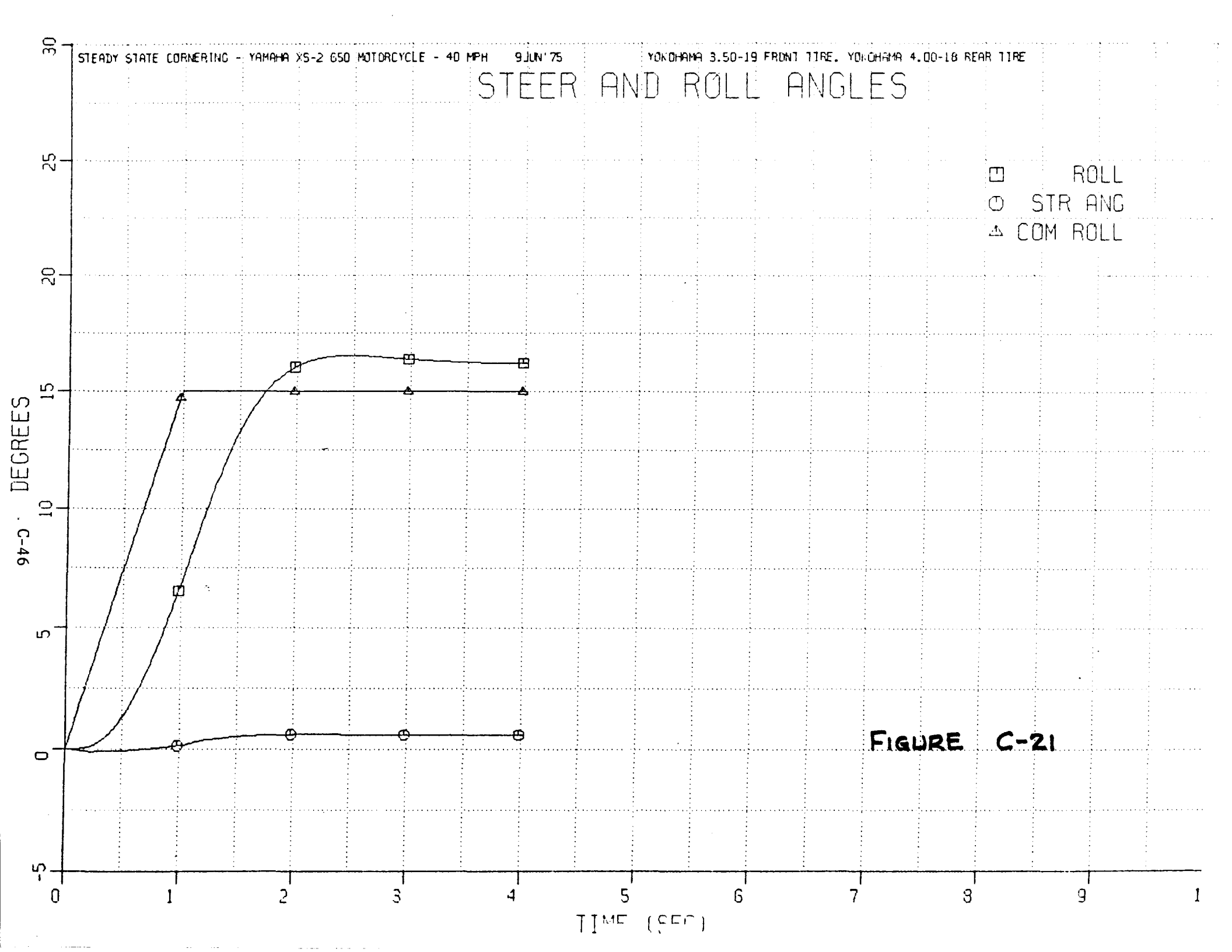

STEADY STATE CORNERING - YAMAHA XS-2 650 MOTORCYCLE - 40 MPH 9JUN'75
YOKOHAMA 3.50-19 FRONT TIRE. YOKOHAMA 4.00-18 REAR TIRE
STEER AND ROLL ANGLES
ROLL
STR ANG
COM ROLL
DEGREES
TIME (SEC)
30
25
20
15
10
5
0
-5
0
1
2
3
4
5
6
7
8
9
1

FIGURE C-21

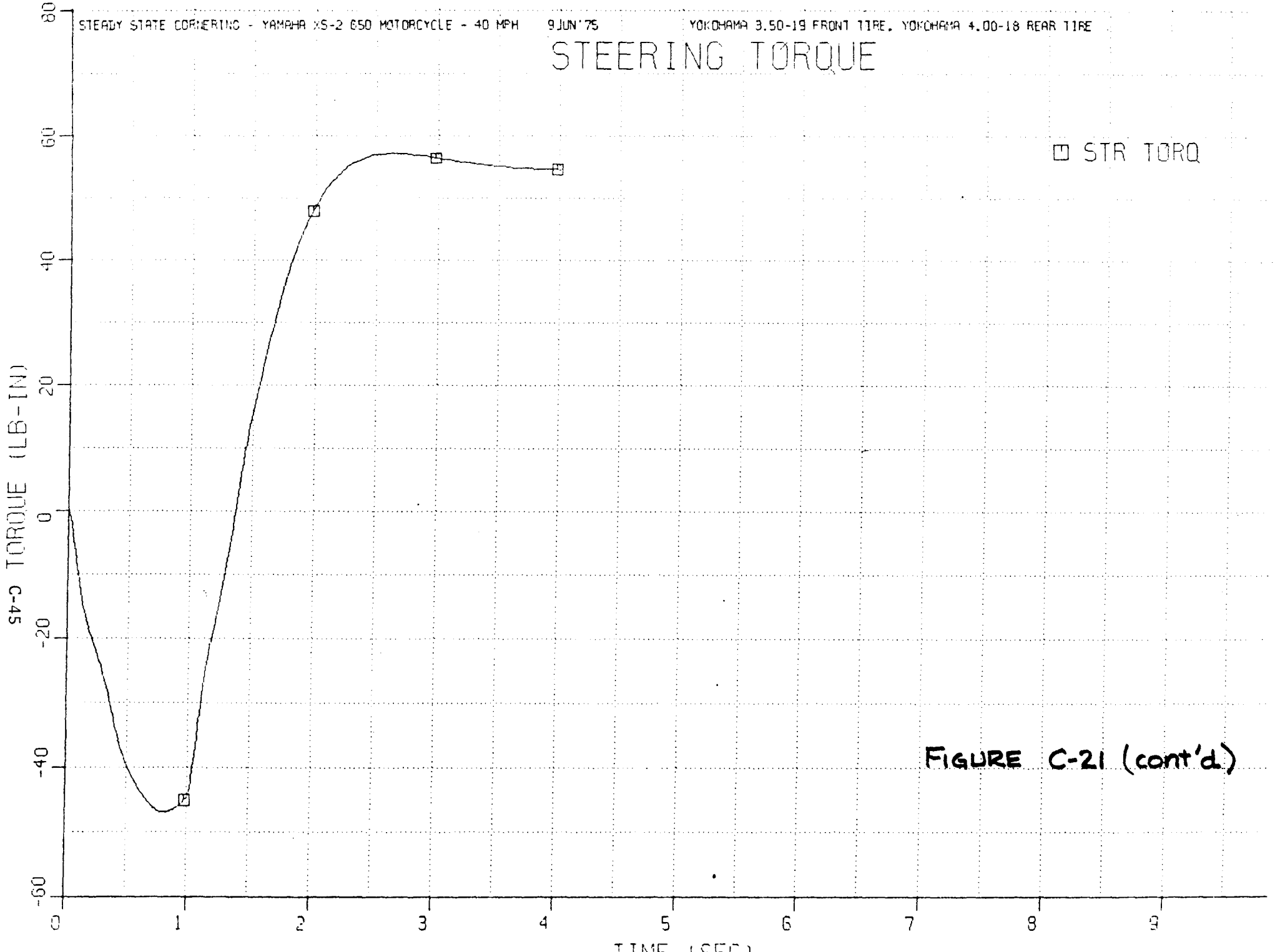


FIGURE C-21 (cont'd.)

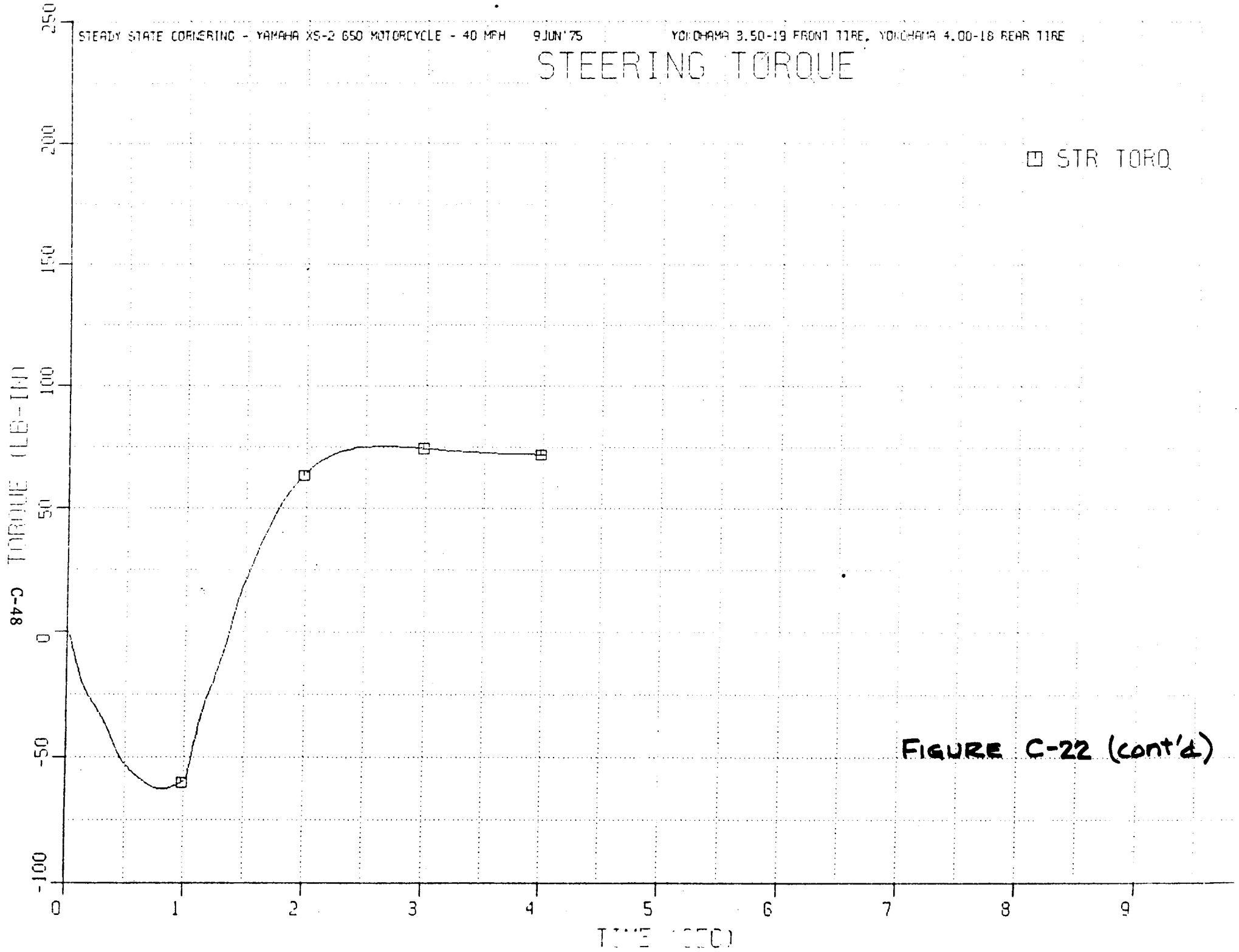


FIGURE C-22 (cont'd)

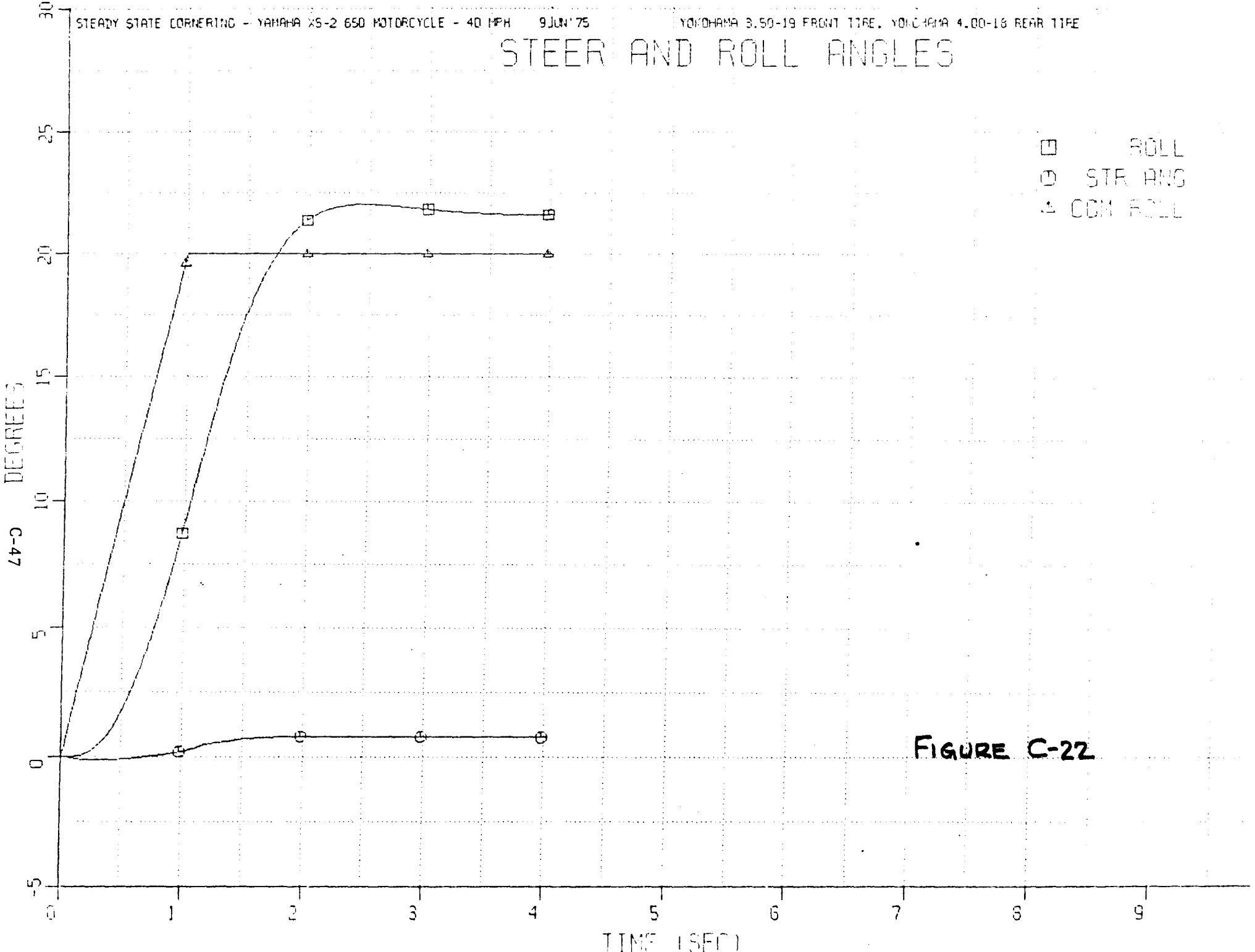

STEADY STATE CORNERING - YAMAHA XS-2 650 MOTORCYCLE - 40 MPH 9JUN'75
YOKOHAMA 3.50-19 FRONT TIRE, YOKOHAMA 4.00-18 REAR TIRE
STEER AND ROLL ANGLES
ROLL
STR ANG
COM ROLL
DEGREES
TIME (SEC)
30
25
20
15
10
5
0
-5
0
1
2
3
4
5
6
7
8
9

FIGURE C-22

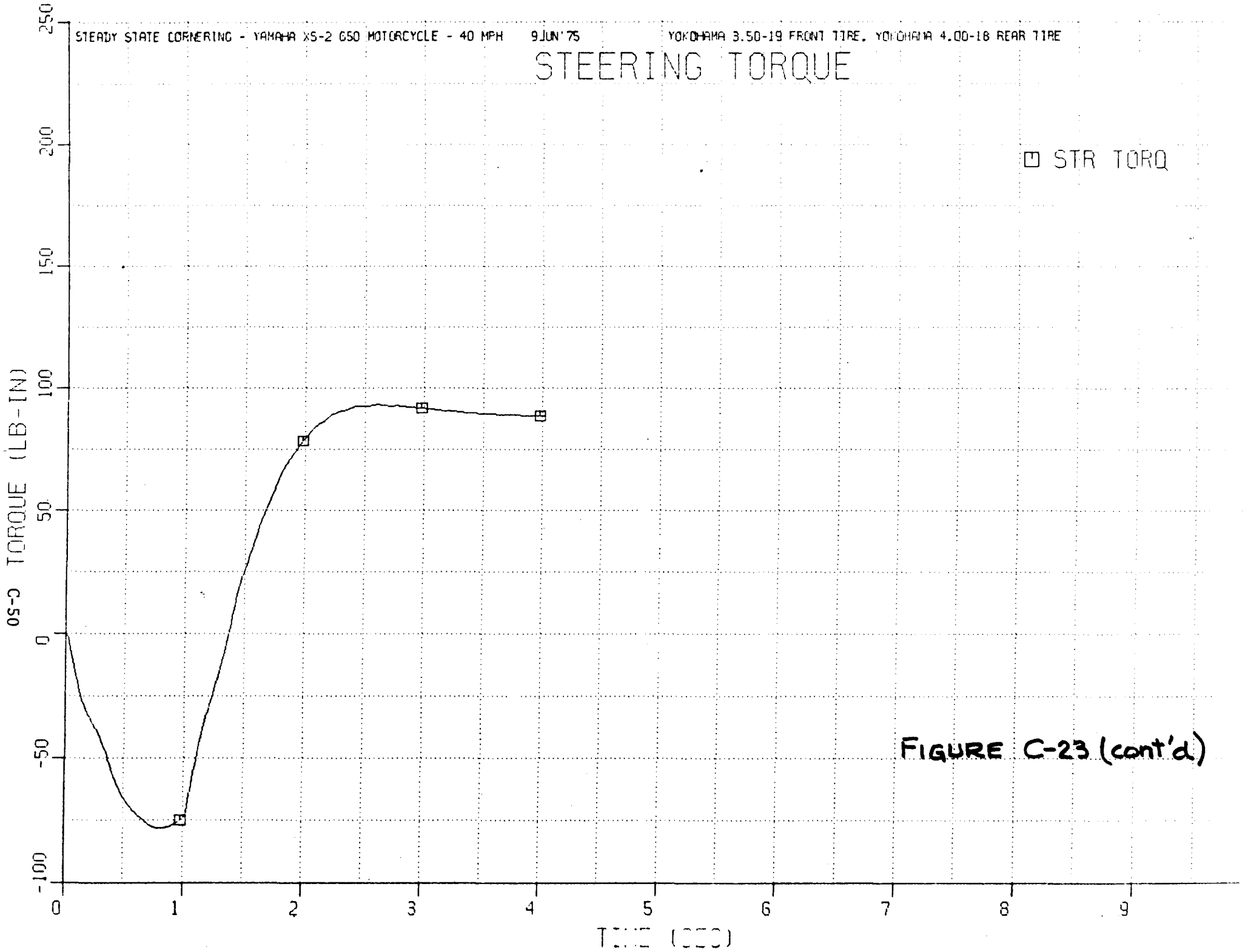


FIGURE C-23 (cont'd)

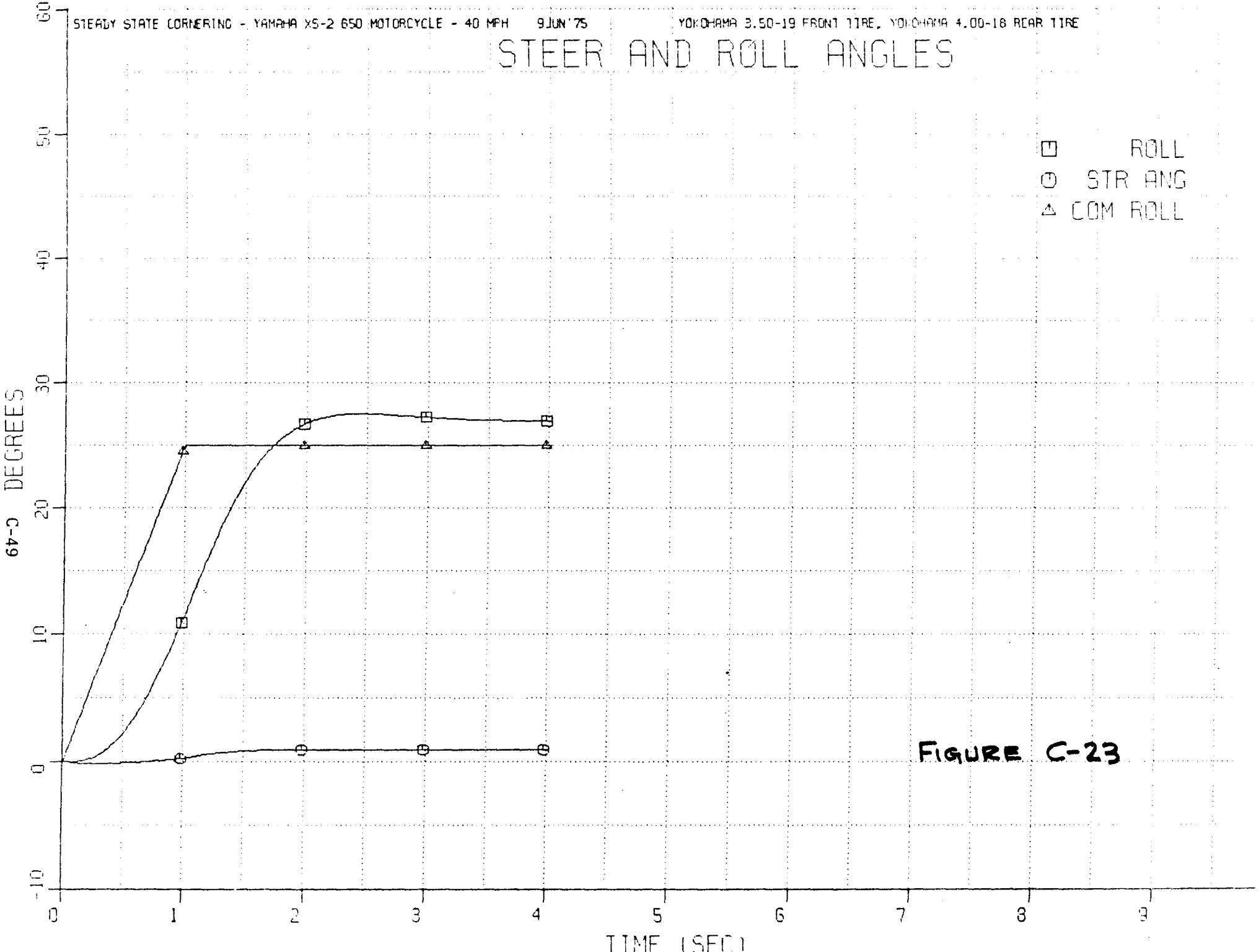

STEADY STATE CORNERING - YAMAHA XS-2 650 MOTORCYCLE - 40 MPH 9JUN'75
YOKOHAMA 3.50-19 FRONT TIRE, YOKOHAMA 4.00-18 REAR TIRE
STEER AND ROLL ANGLES
ROLL
STR ANG
COM ROLL
DEGREES
TIME (SEC)
60
50
40
30
20
10
0
-10
0
1
2
3
4
5
6
7
8
9

FIGURE C-23

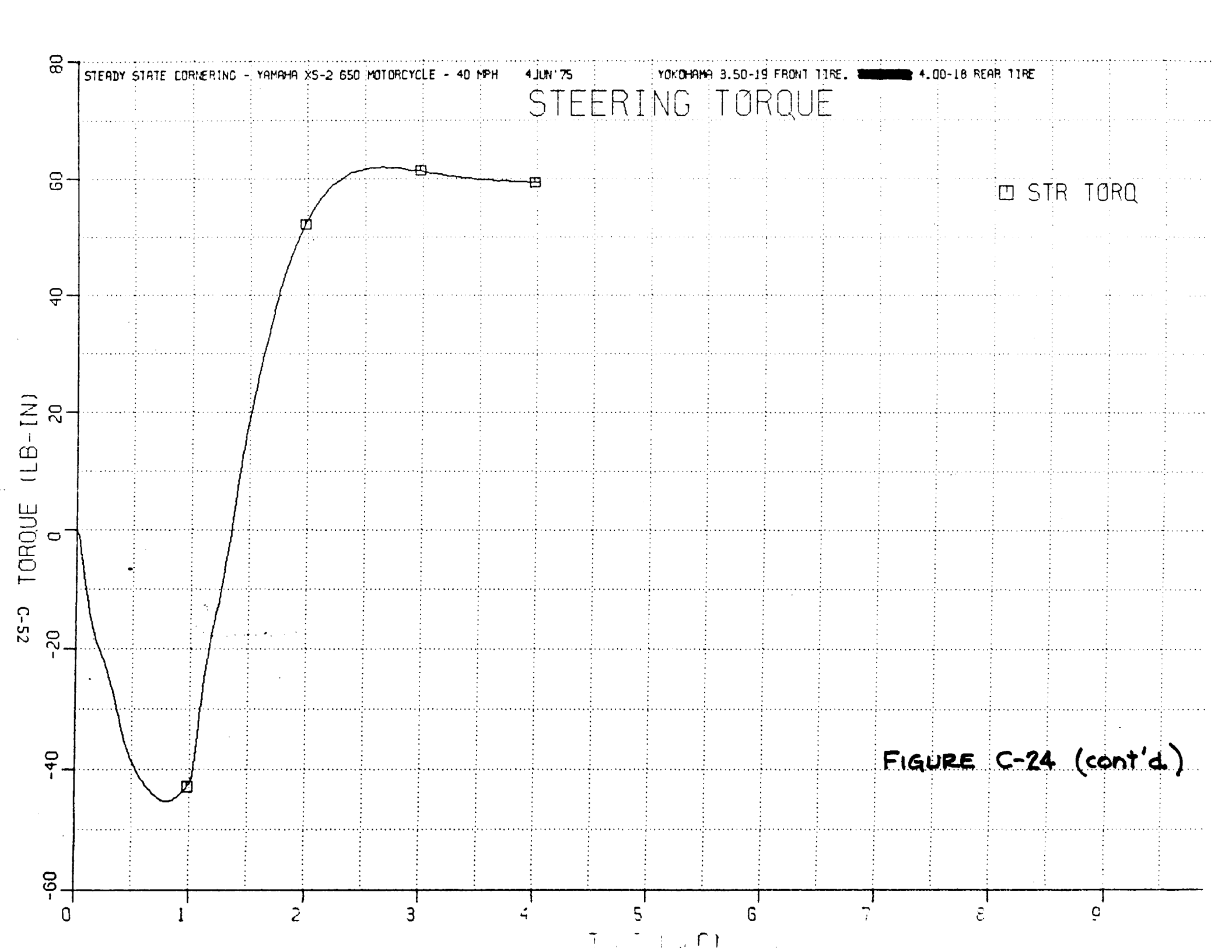


FIGURE C-24 (cont'd.)

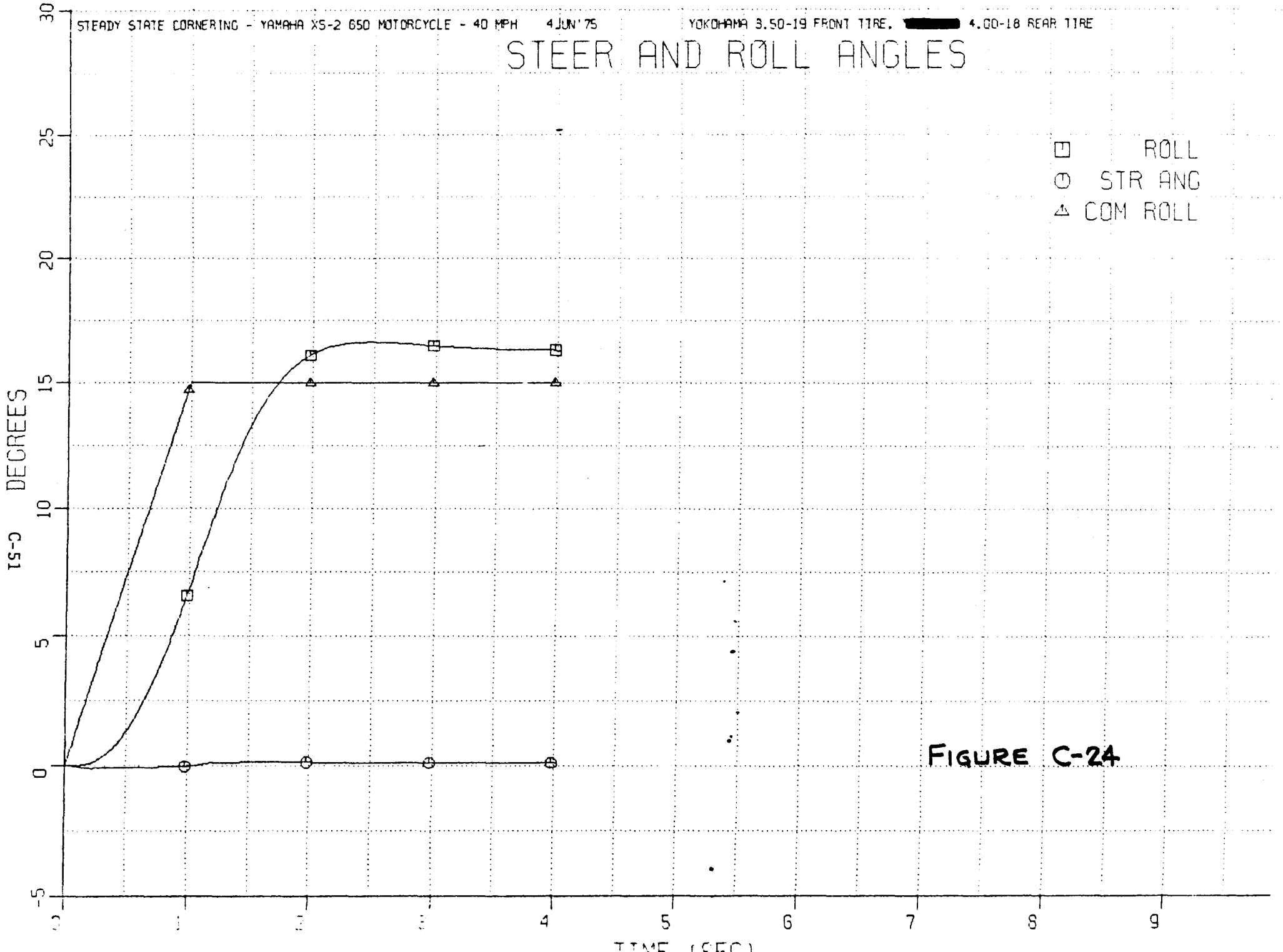

STEADY STATE CORNERING - YAMAHA XS-2 650 MOTORCYCLE - 40 MPH 4 JUN '75
YOKOHAMA 3.50-19 FRONT TIRE, [redacted] 4.00-18 REAR TIRE
STEER AND ROLL ANGLES
ROLL
STR ANG
COM ROLL
DEGREES
C-51
30
25
20
15
10
5
0
-5
0
1
2
3
4
5
6
7
8
9
TIME (SEC)

FIGURE C-24

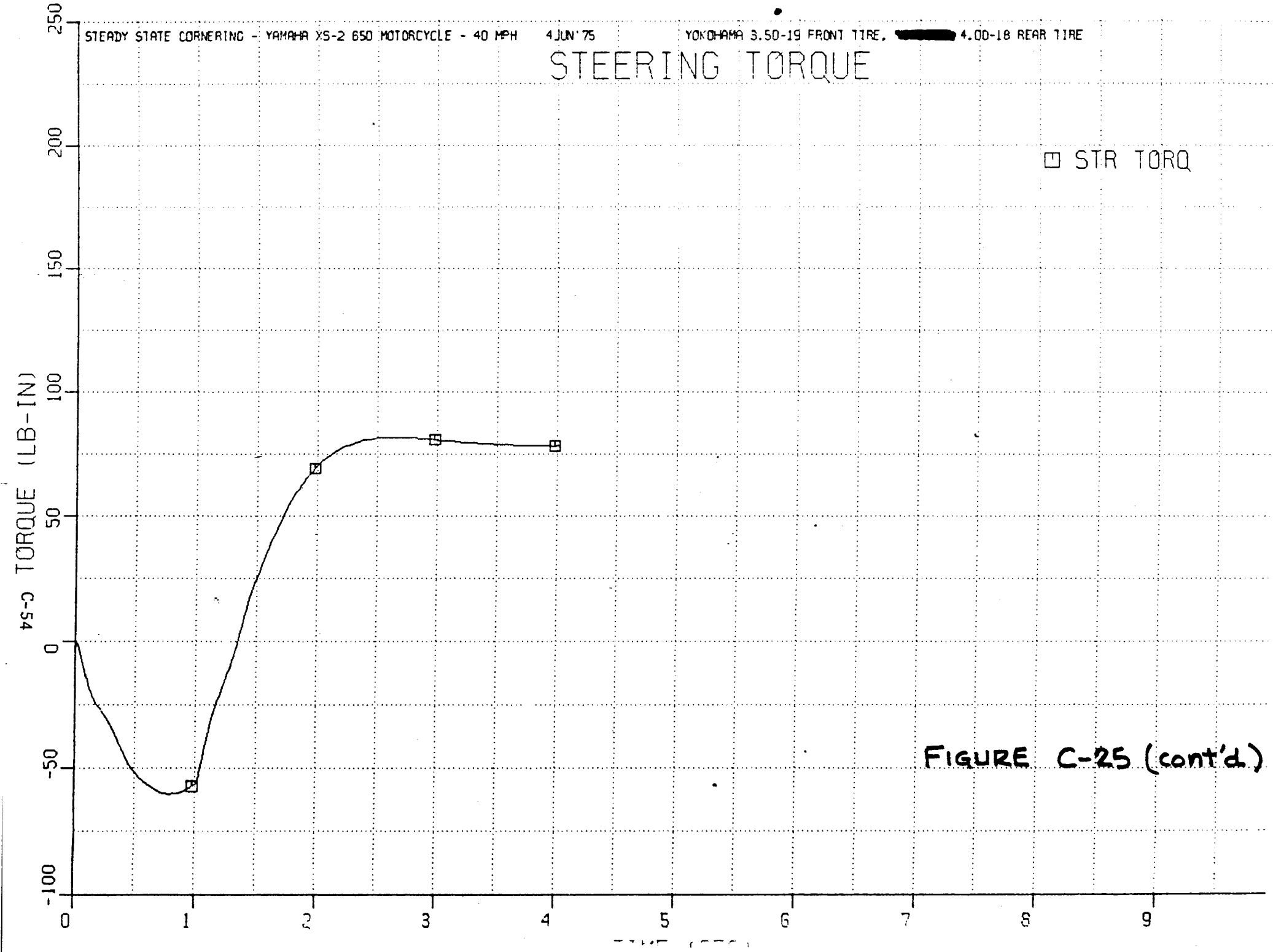


FIGURE C-25 (cont'd.)

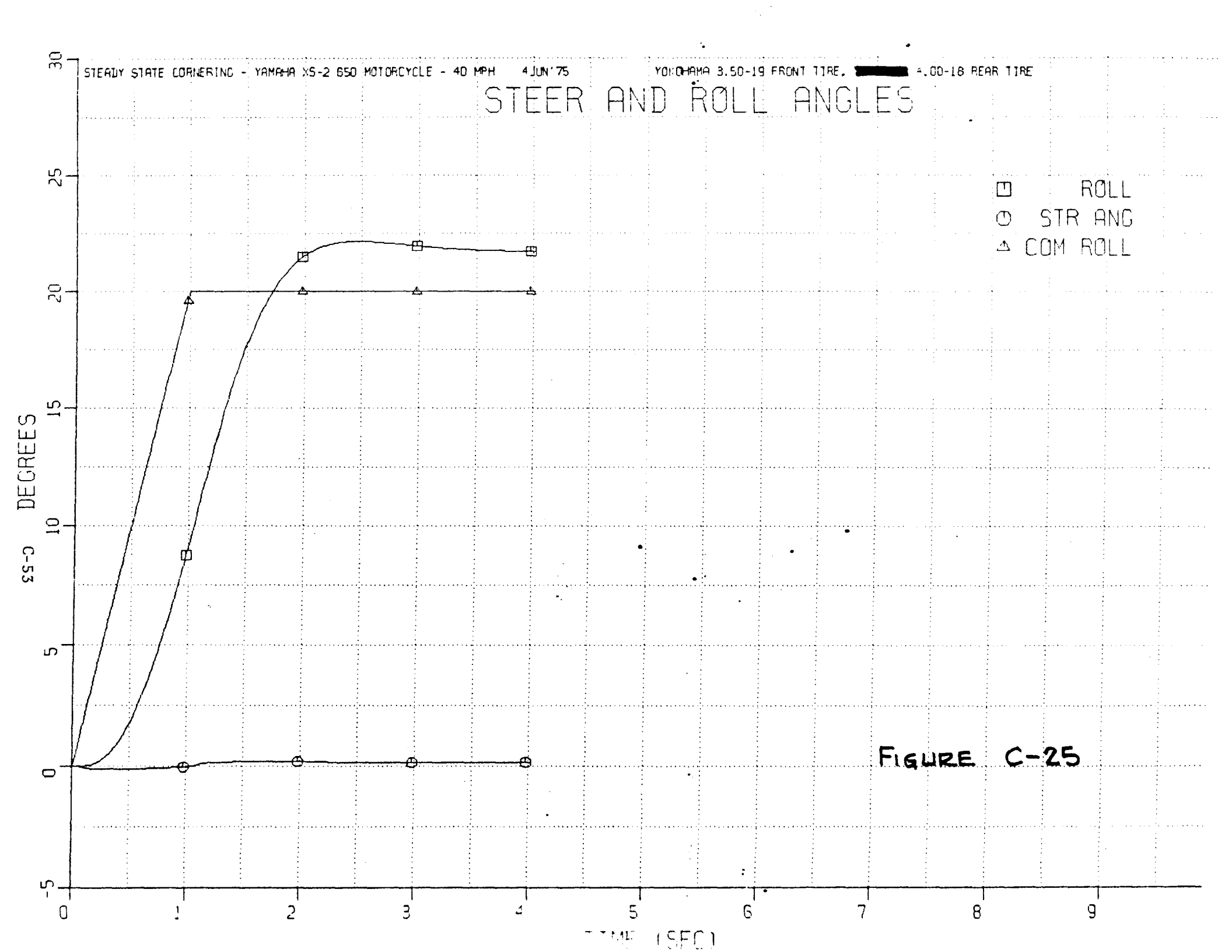

STEADY STATE CORNERING - YAMAHA XS-2 650 MOTORCYCLE - 40 MPH 4 JUN '75
YOKOHAMA 3.50-19 FRONT TIRE, [redacted] 4.00-18 REAR TIRE
STEER AND ROLL ANGLES
ROLL
STR ANG
COM ROLL
DEGREES
C-53
30
25
20
15
10
5
0
-5
0
1
2
3
4
5
6
7
8
9
TIME (SEC)

FIGURE C-25

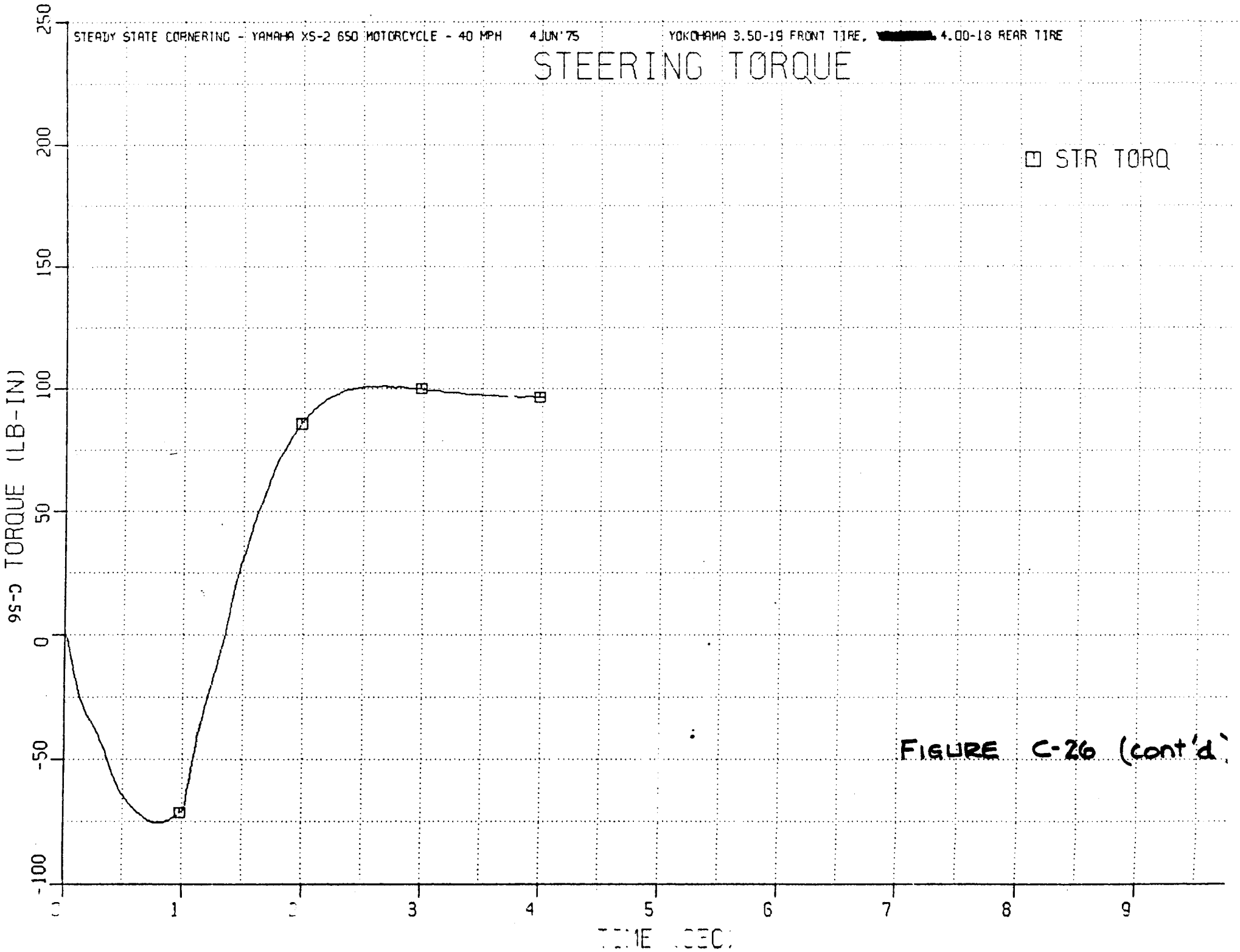


FIGURE C-26 (cont'd)

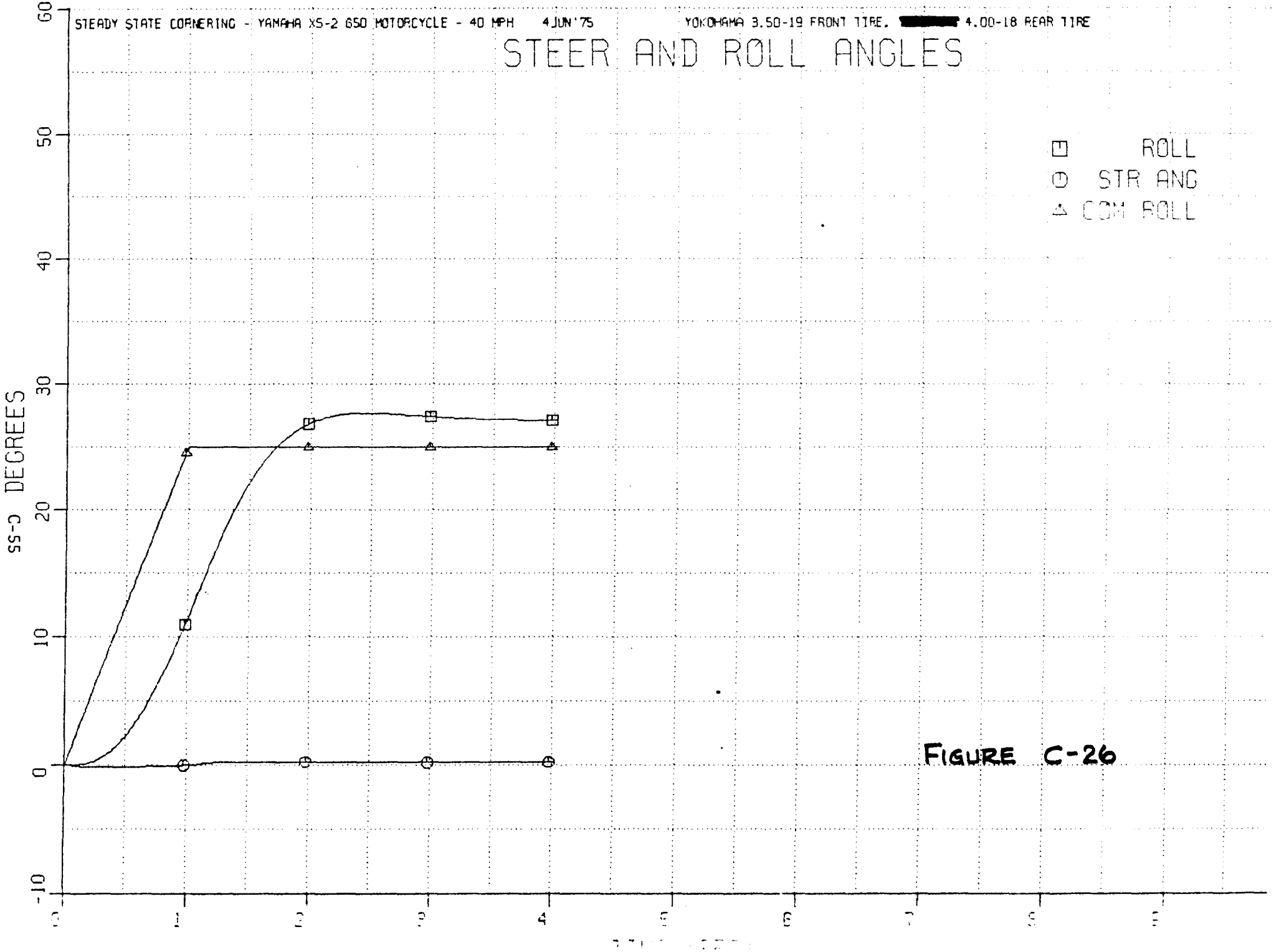

STEADY STATE CORNERING - YAMAHA XS-2 650 MOTORCYCLE - 40 MPH 4 JUN '75
YOKOHAMA 3.50-19 FRONT TIRE. [redacted] 4.00-18 REAR TIRE
STEER AND ROLL ANGLES
ROLL
STR ANG
COM ROLL
SS-D DEGREES
60
50
40
30
20
10
0
-10
0
1
2
3
4
5
6
7
8
9

FIGURE C-26

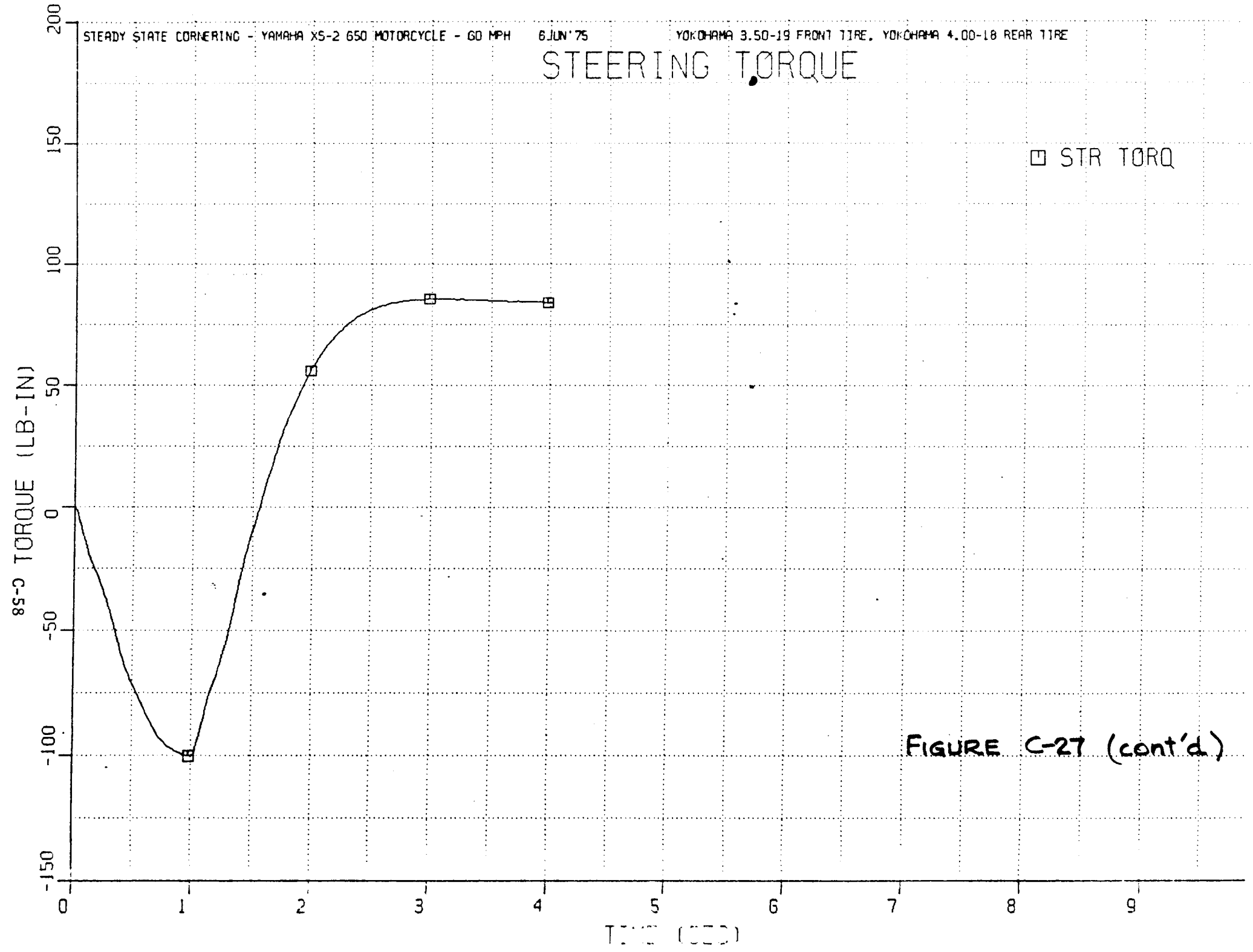


FIGURE C-27 (cont'd.)

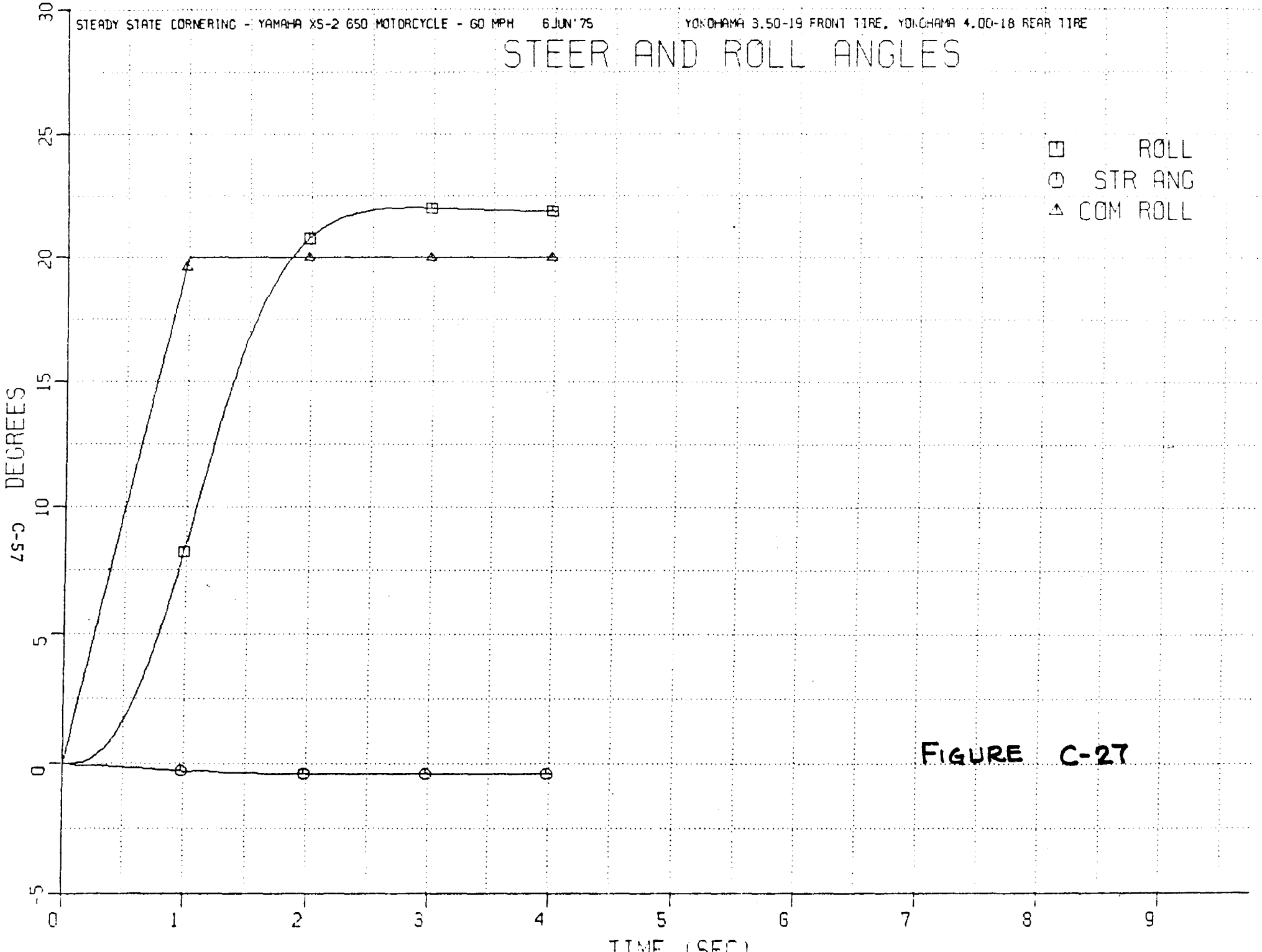

STEADY STATE CORNERING - YAMAHA XS-2 650 MOTORCYCLE - 60 MPH 6JUN'75
YOKOHAMA 3.50-19 FRONT TIRE, YOKOHAMA 4.00-18 REAR TIRE
STEER AND ROLL ANGLES
ROLL
STR ANG
COM ROLL
DEGREES
TIME (SEC)
30
25
20
15
10
5
0
-5
0
1
2
3
4
5
6
7
8
9

FIGURE C-27

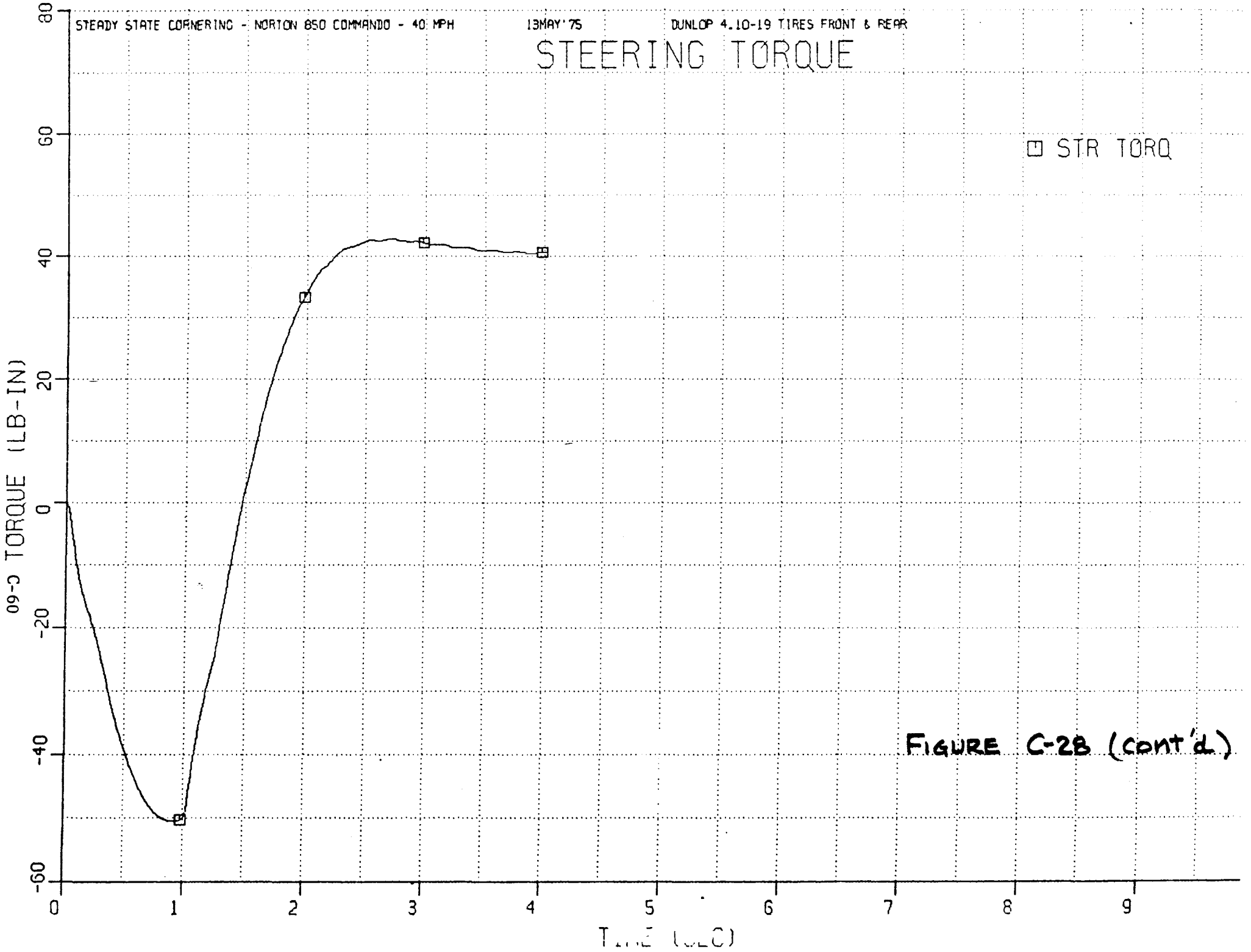


FIGURE C-28 (cont'd.)

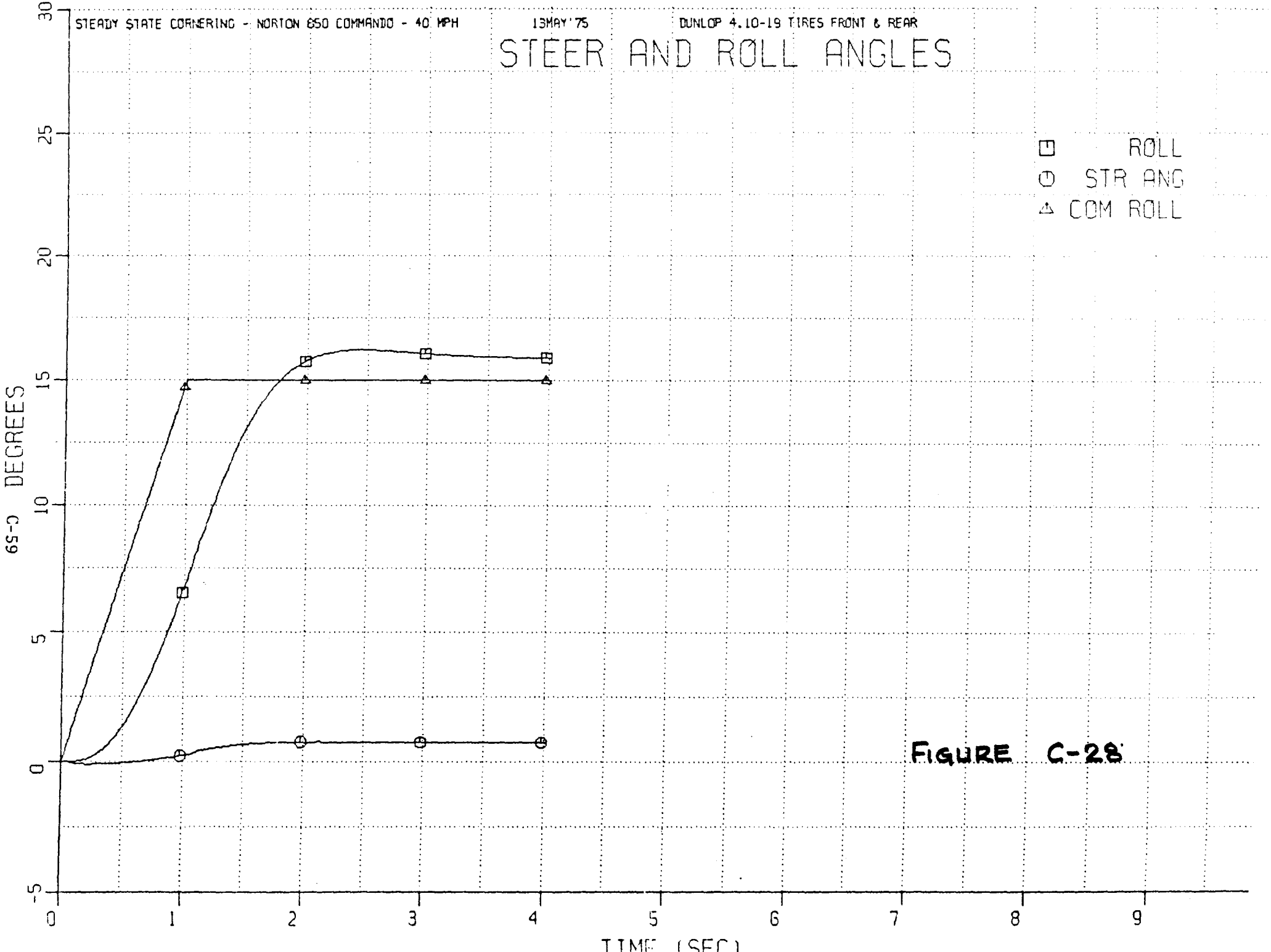

STEADY STATE CORNERING - NORTON 850 COMMANDO - 40 MPH
13MAY'75
DUNLOP 4.10-19 TIRES FRONT & REAR
STEER AND ROLL ANGLES
ROLL
STR ANG
COM ROLL
DEGREES
TIME (SEC)
30
25
20
15
10
5
0
-5
0
1
2
3
4
5
6
7
8
9

FIGURE C-28

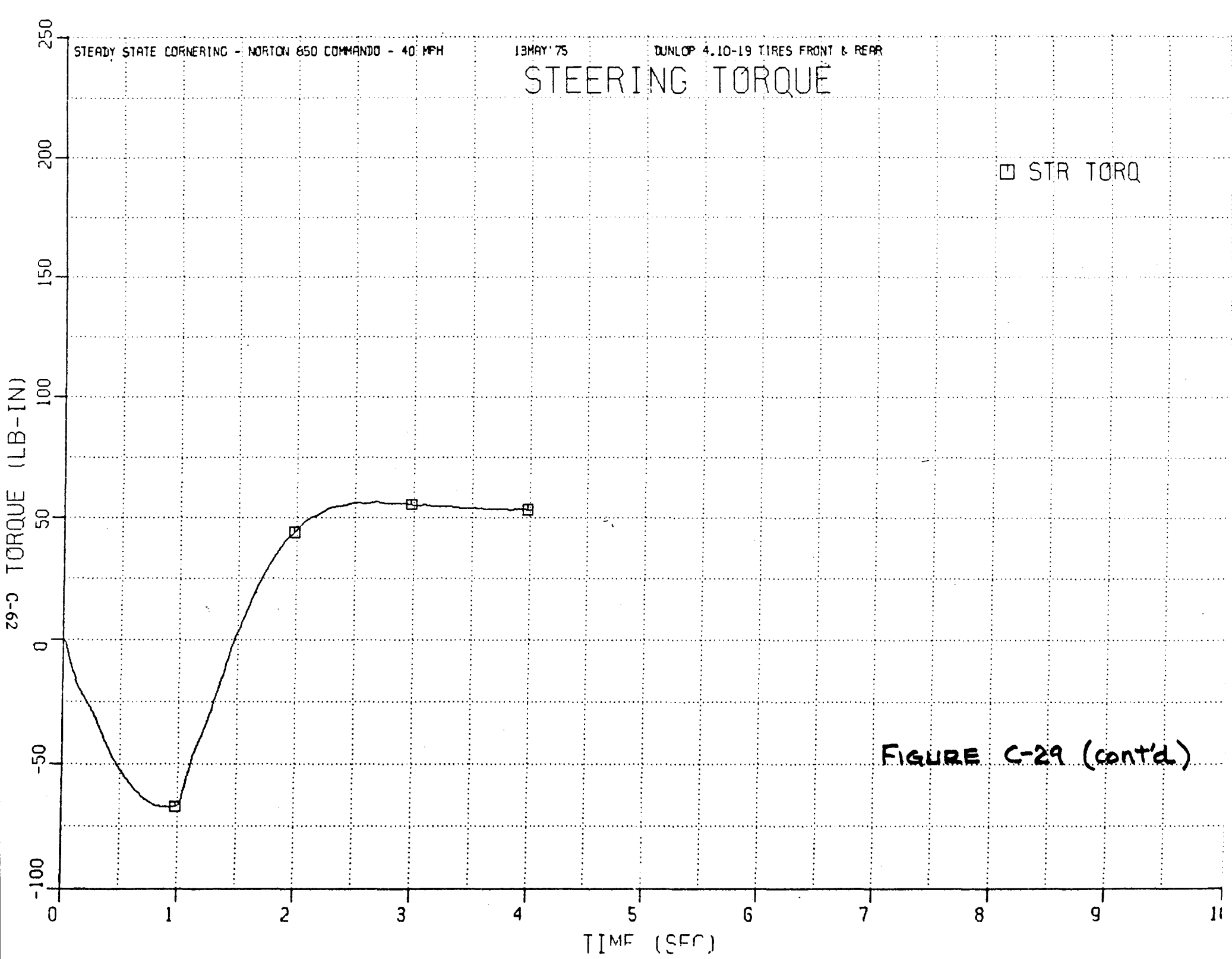


FIGURE C-29 (cont'd)

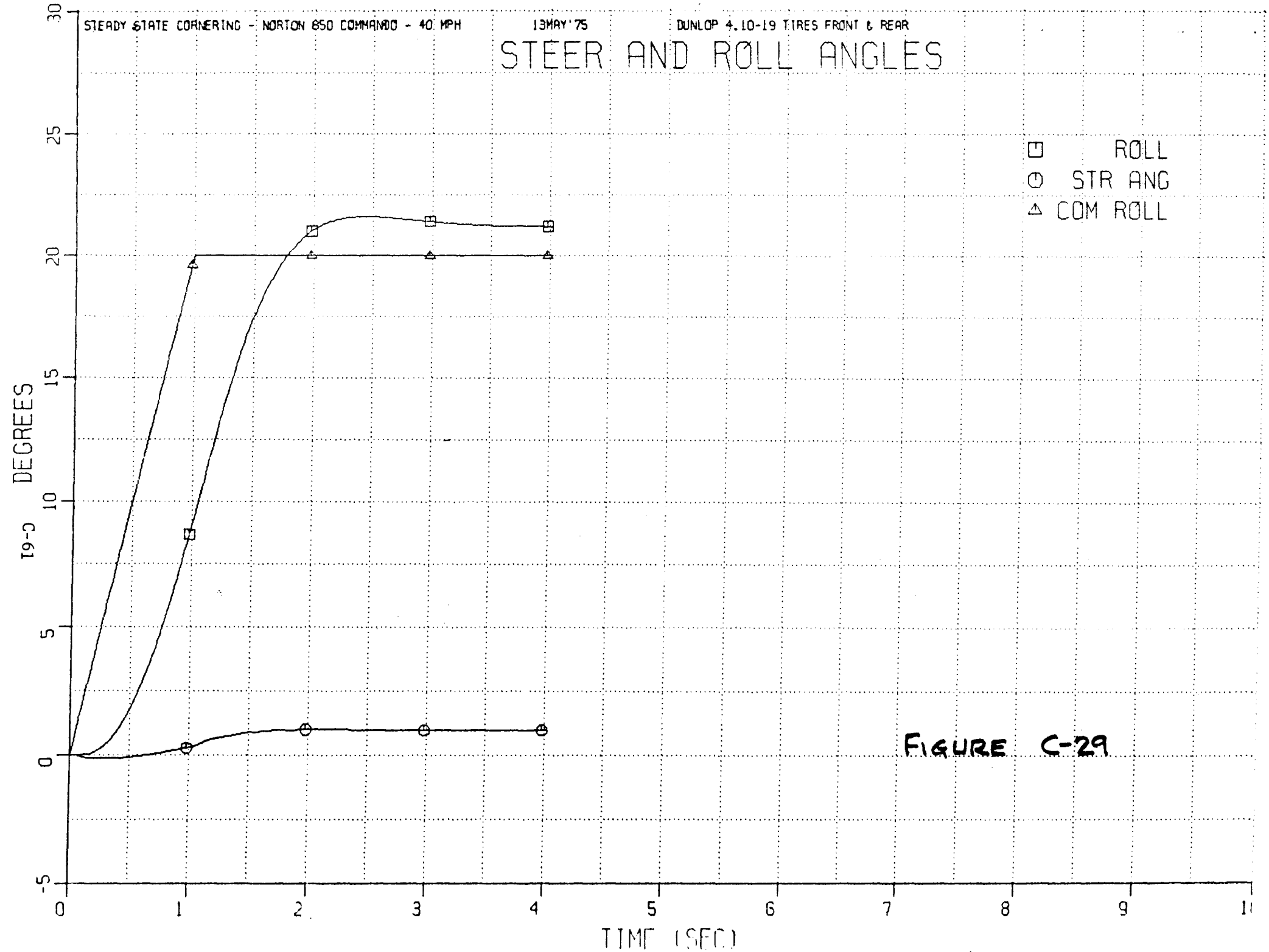

STEADY STATE CORNERING - NORTON 850 COMMANDO - 40 MPH
13MAY'75
DUNLOP 4.10-19 TIRES FRONT & REAR
STEER AND ROLL ANGLES
ROLL
STR ANG
COM ROLL
DEGREES
TIME (SEC)
30
25
20
15
10
5
0
-5
0
1
2
3
4
5
6
7
8
9
10

FIGURE C-29

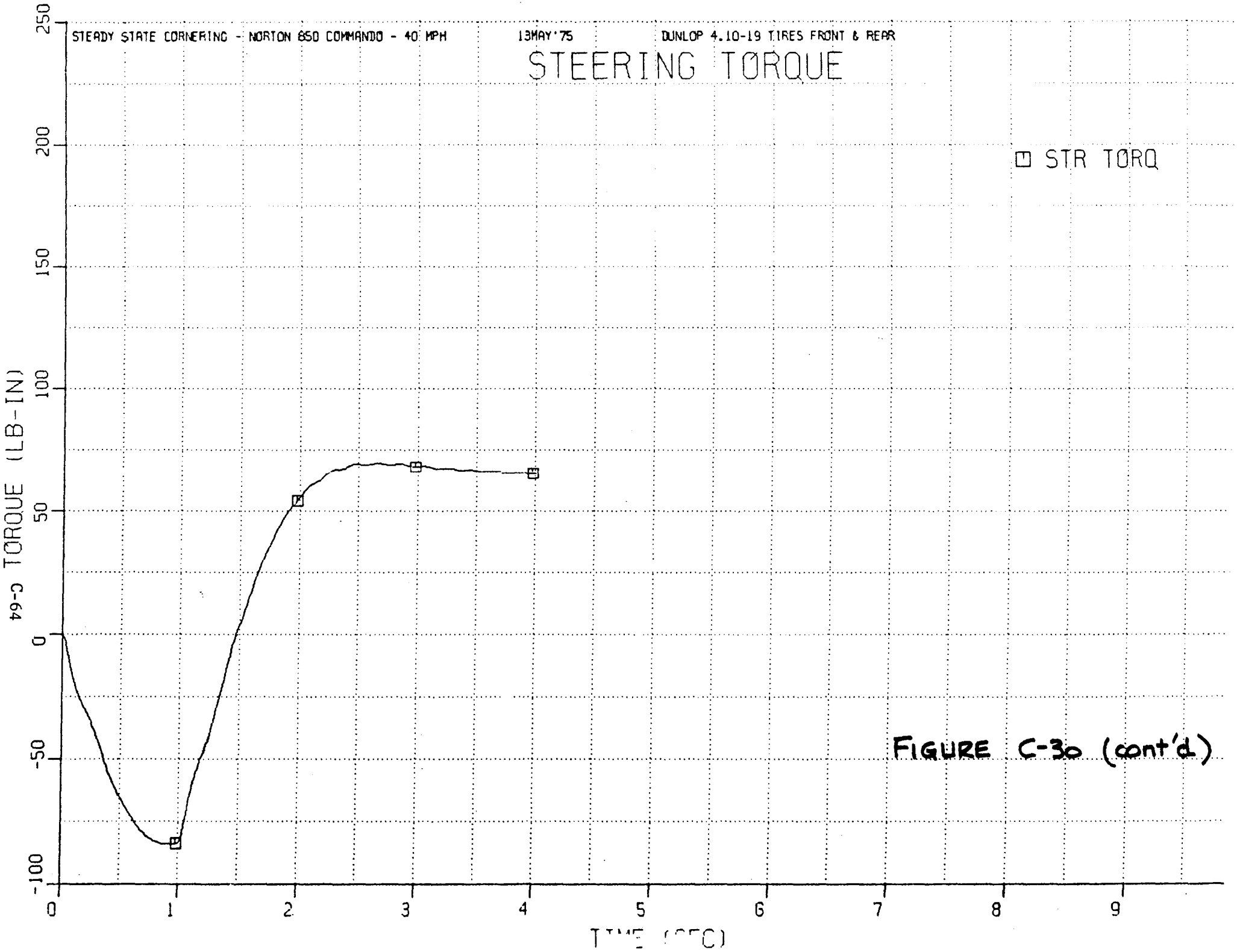


FIGURE C-30 (cont'd)

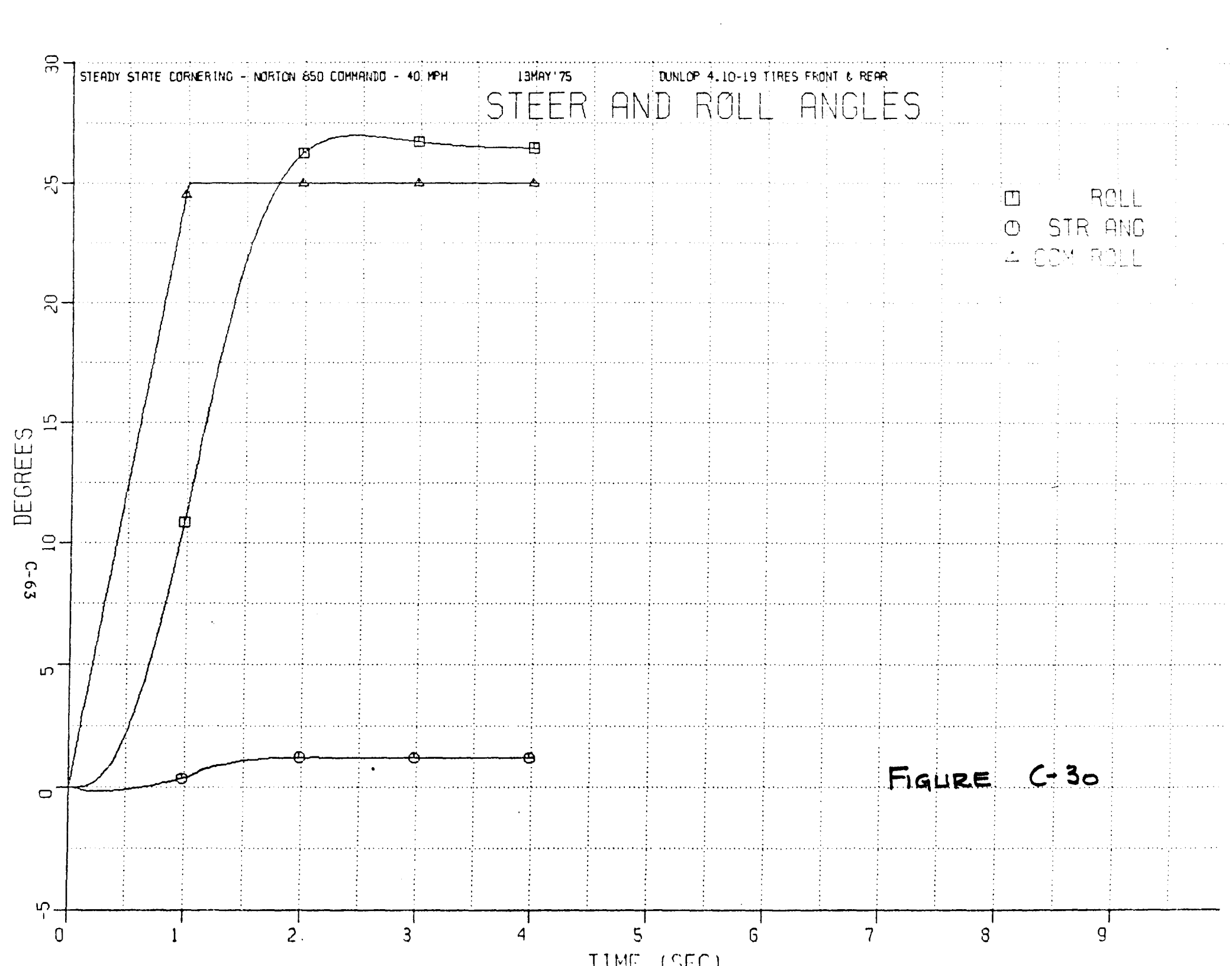

STEADY STATE CORNERING - NORTON 650 COMMANDO - 40. MPH
13MAY'75
DUNLOP 4.10-19 TIRES FRONT & REAR
STEER AND ROLL ANGLES
ROLL
STR ANG
COM ROLL
DEGREES
TIME (SEC)
30
25
20
15
10
5
0
-5
0
1
2
3
4
5
6
7
8
9

FIGURE C-30

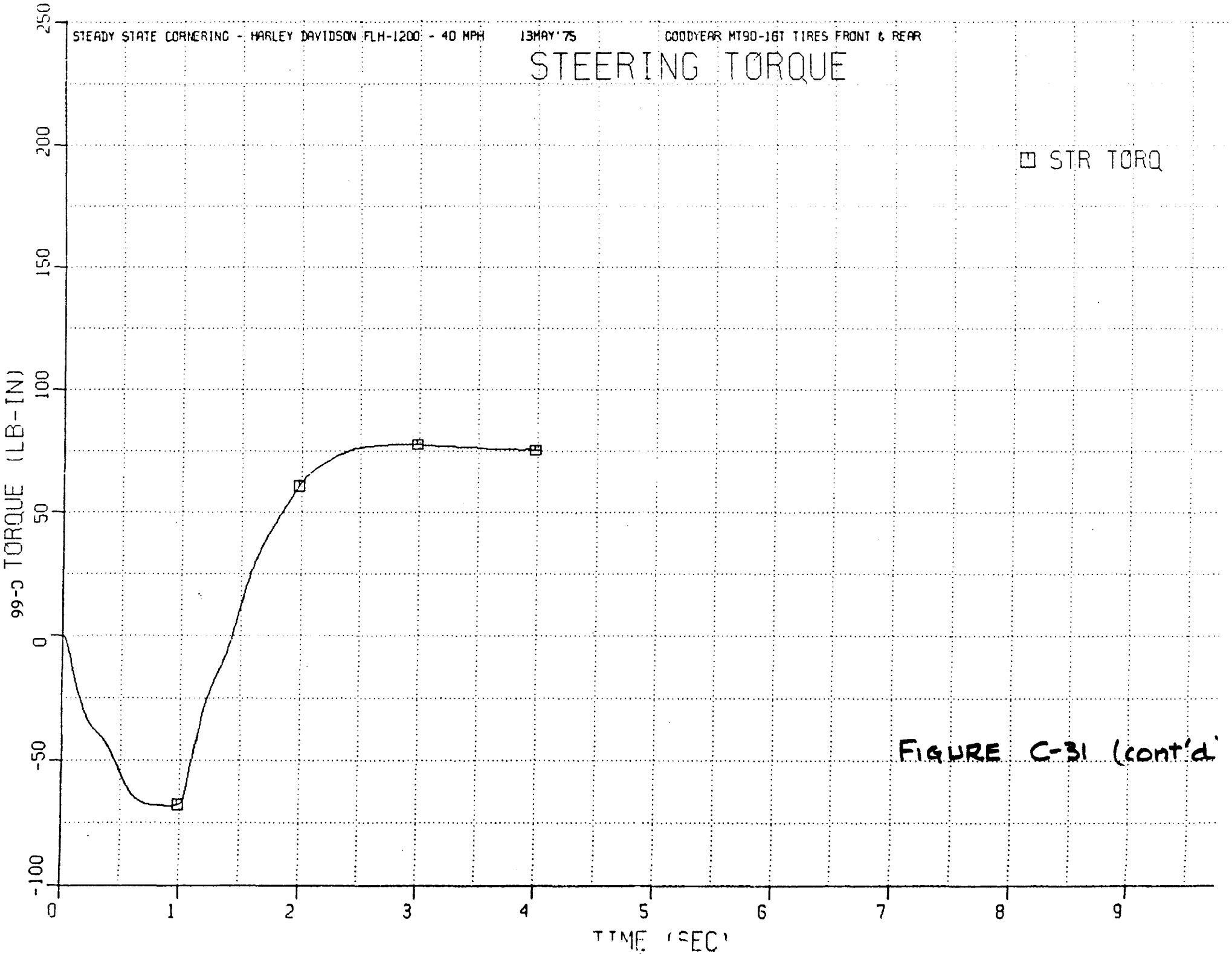


FIGURE C-31 (cont'd)

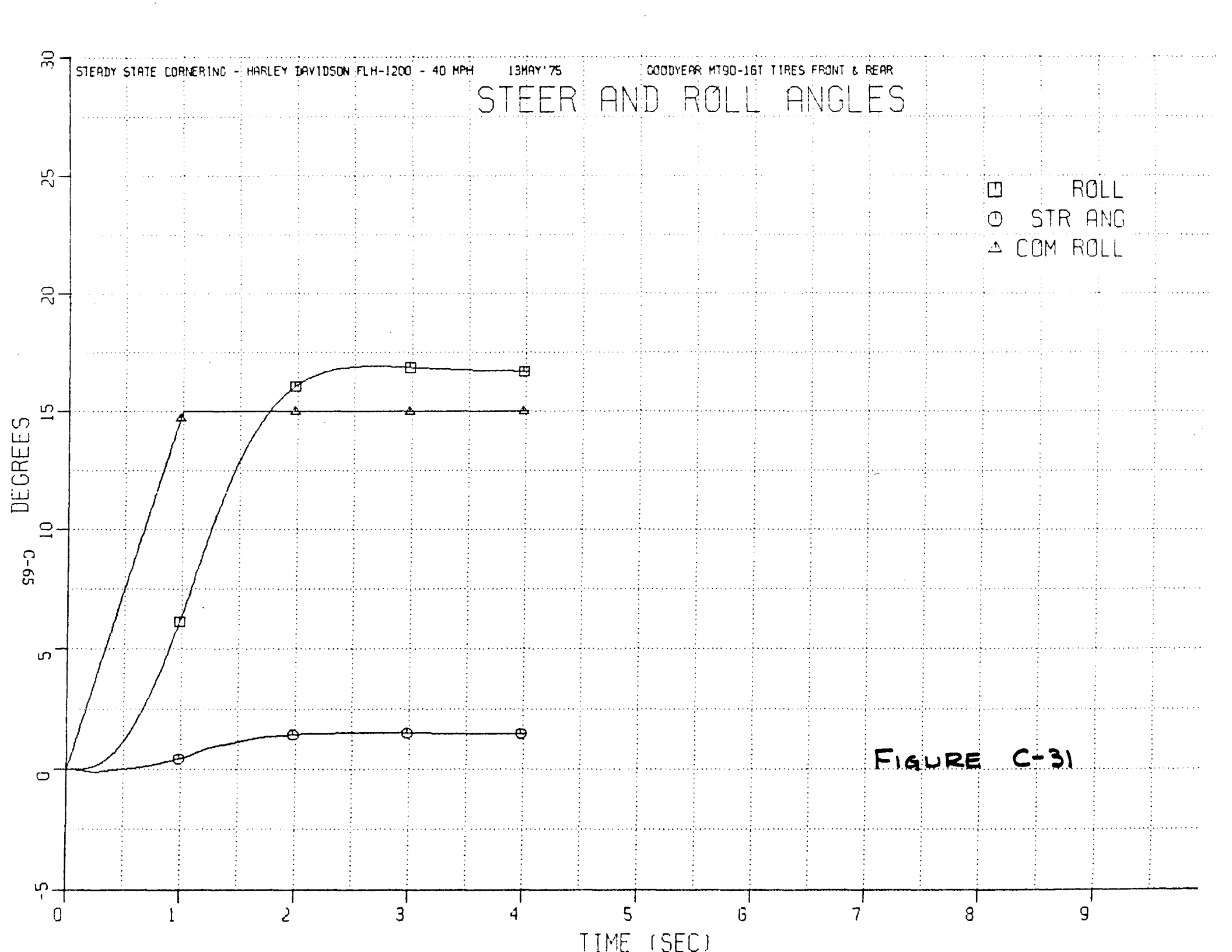

STEADY STATE CORNERING - HARLEY DAVIDSON FLH-1200 - 40 MPH 13MAY'75
GOODYEAR MT90-16T TIRES FRONT & REAR
STEER AND ROLL ANGLES
ROLL
STR ANG
COM ROLL
DEGREES
TIME (SEC)
30
25
20
15
10
5
0
-5
0
1
2
3
4
5
6
7
8
9

FIGURE C-31

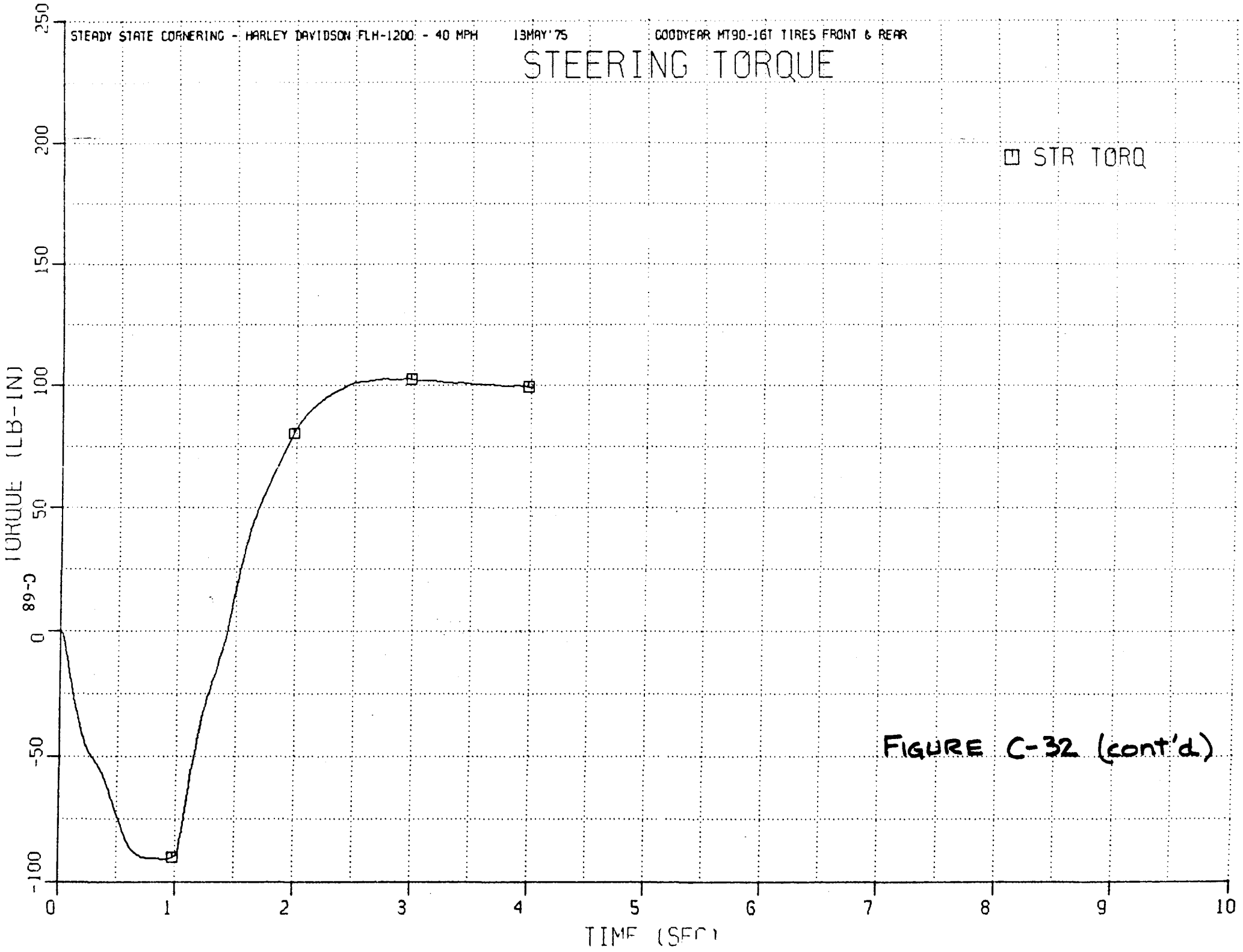


FIGURE C-32 (cont'd.)

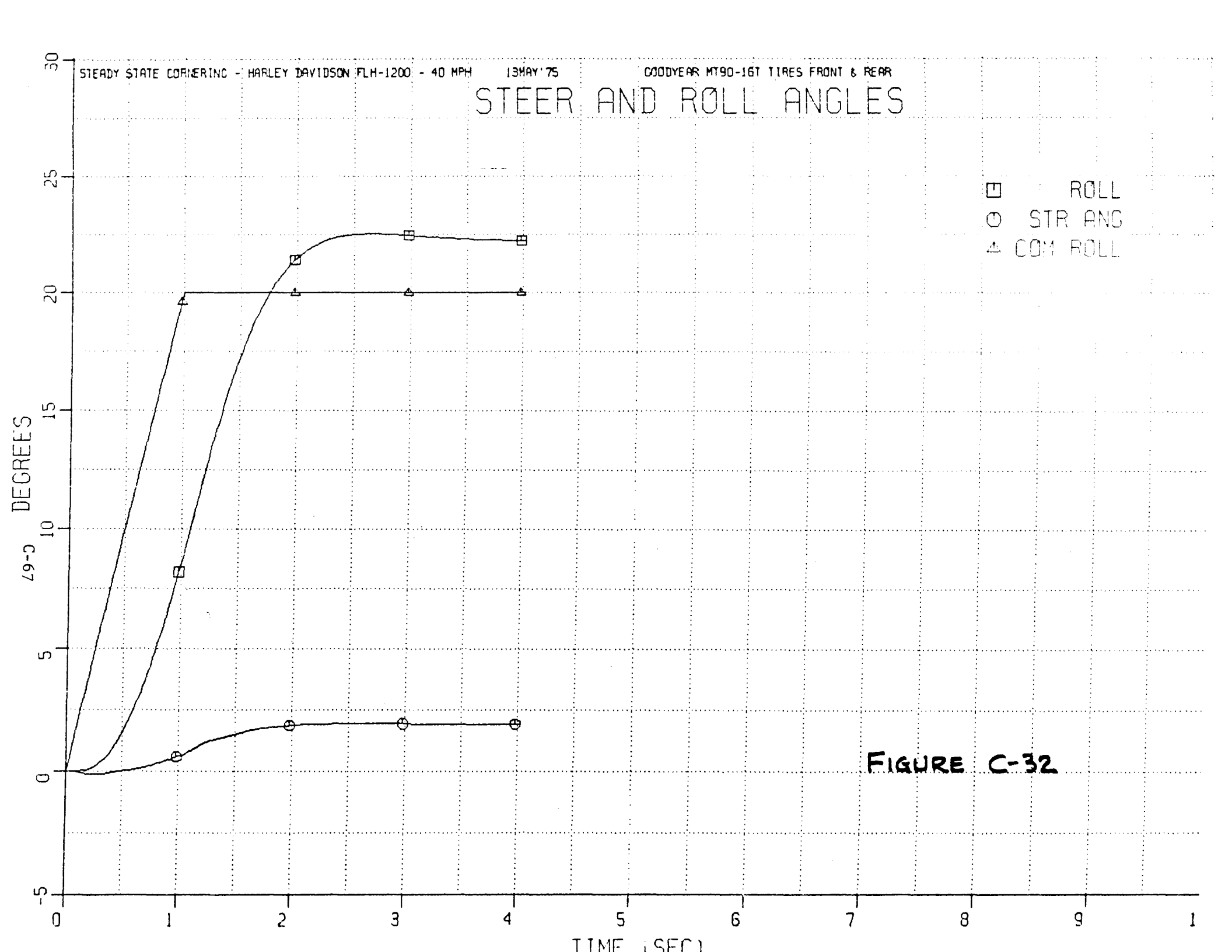

STEADY STATE CORNERING - HARLEY DAVIDSON FLH-1200 - 40 MPH 13MAY'75 GOODYEAR MT90-16T TIRES FRONT & REAR
STEER AND ROLL ANGLES
ROLL
STR ANG
COM ROLL
DEGREES
TIME (SEC)
30
25
20
15
10
5
0
-5
0
1
2
3
4
5
6
7
8
9
1

FIGURE C-32

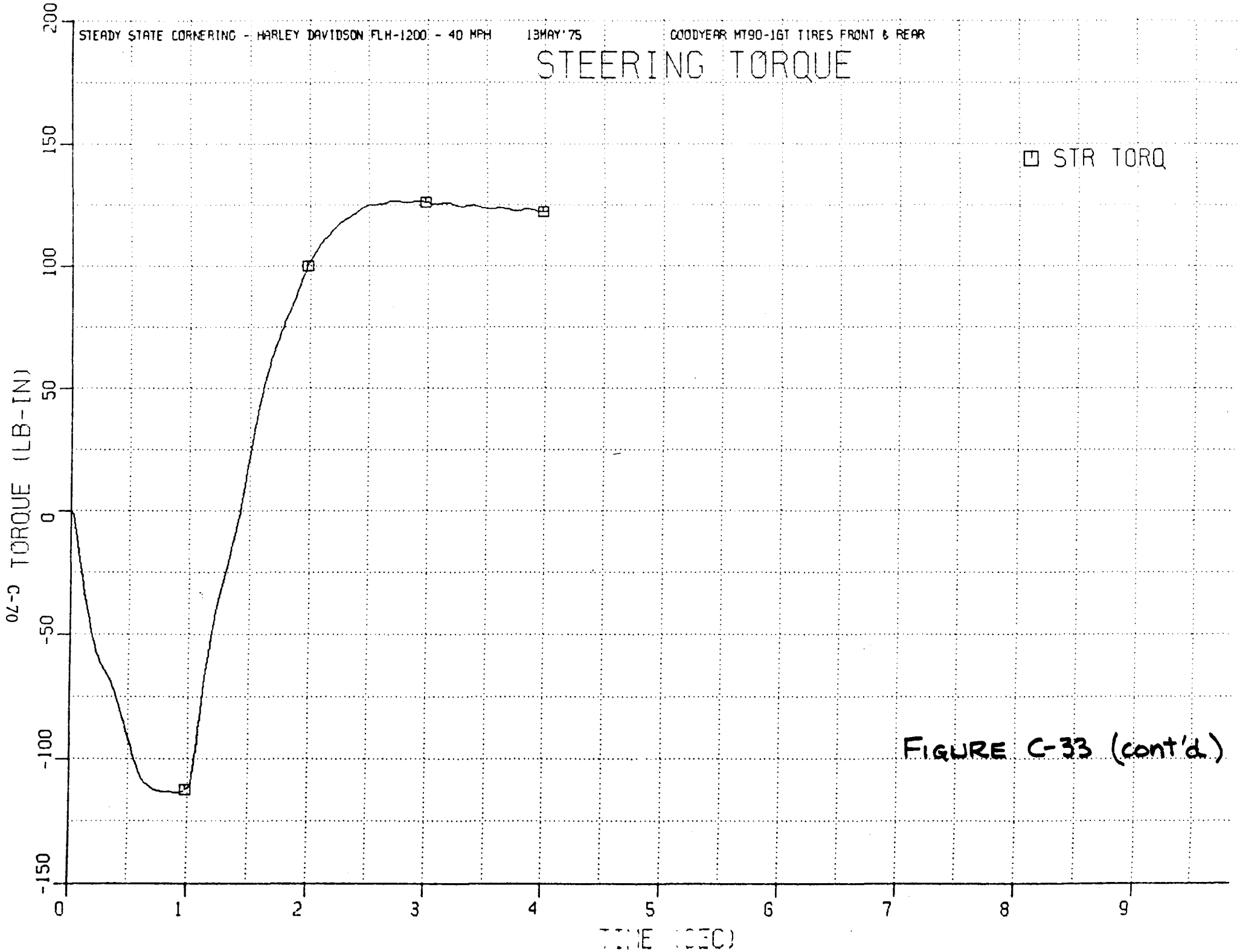


FIGURE C-33 (cont'd.)

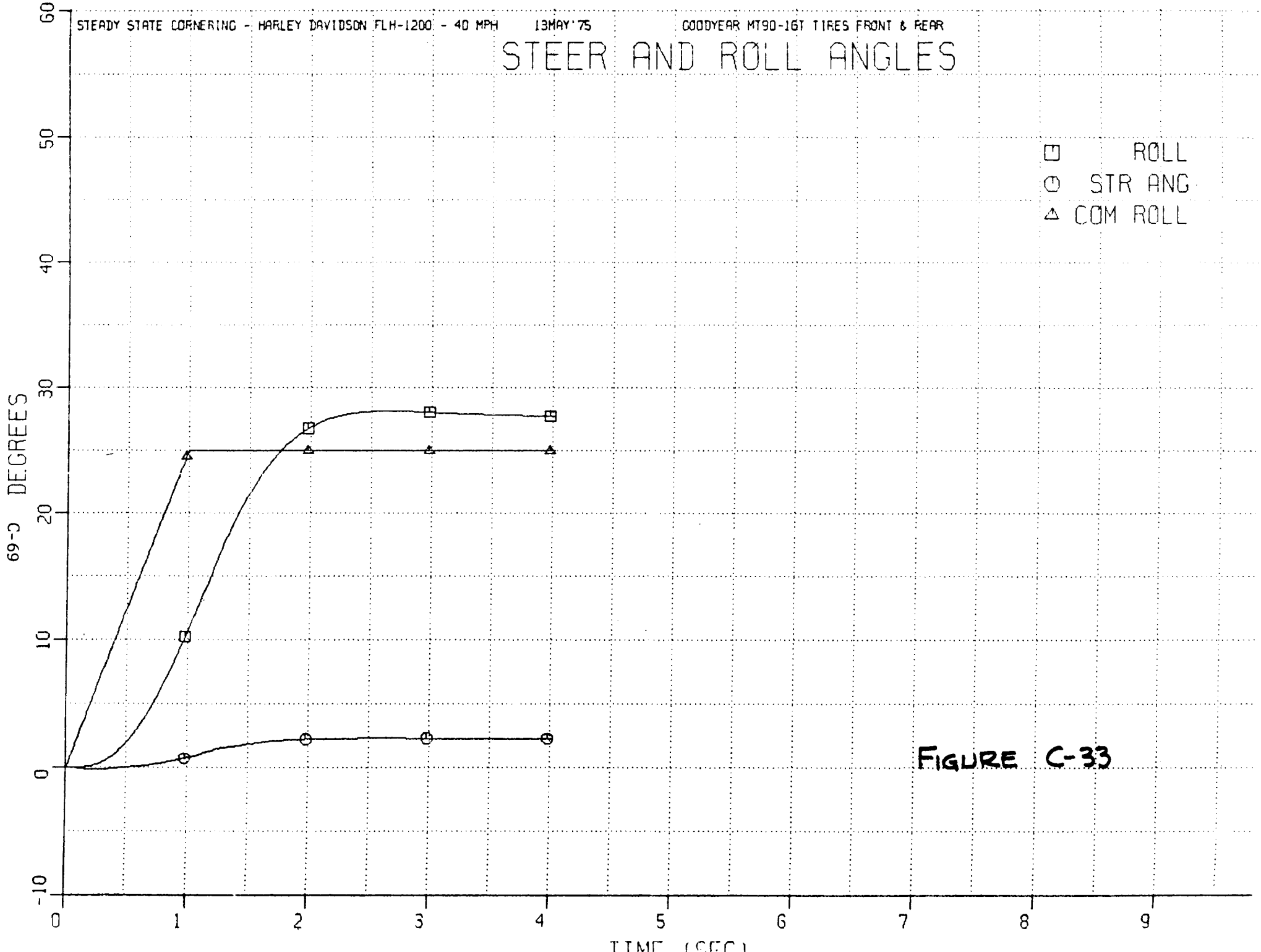

STEADY STATE CORNERING - HARLEY DAVIDSON FLH-1200 - 40 MPH 13MAY'75 GOODYEAR MT90-16T TIRES FRONT & REAR
STEER AND ROLL ANGLES
ROLL
STR ANG
COM ROLL
69-0 DEGREES
60
50
40
30
20
10
0
-10
0
1
2
3
4
5
6
7
8
9
TIME (SEC)

FIGURE C-33

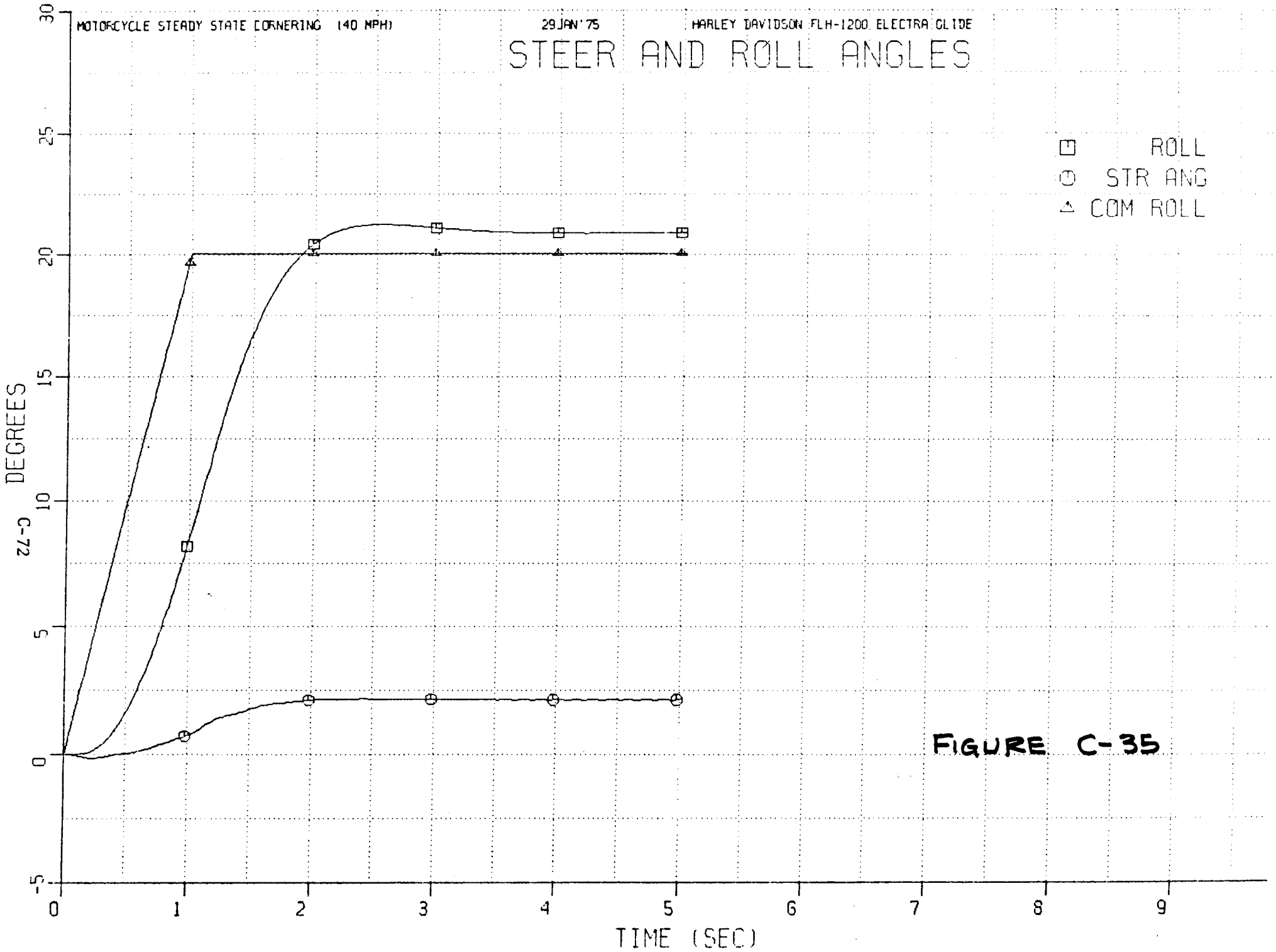

MOTORCYCLE STEADY STATE CORNERING (40 MPH)
29 JAN '75
HARLEY DAVIDSON FLH-1200 ELECTRA GLIDE
STEER AND ROLL ANGLES
ROLL
STR ANG
COM ROLL
DEGREES
TIME (SEC)
C-72
30
25
20
15
10
5
0
-5
0
1
2
3
4
5
6
7
8
9

FIGURE C-35

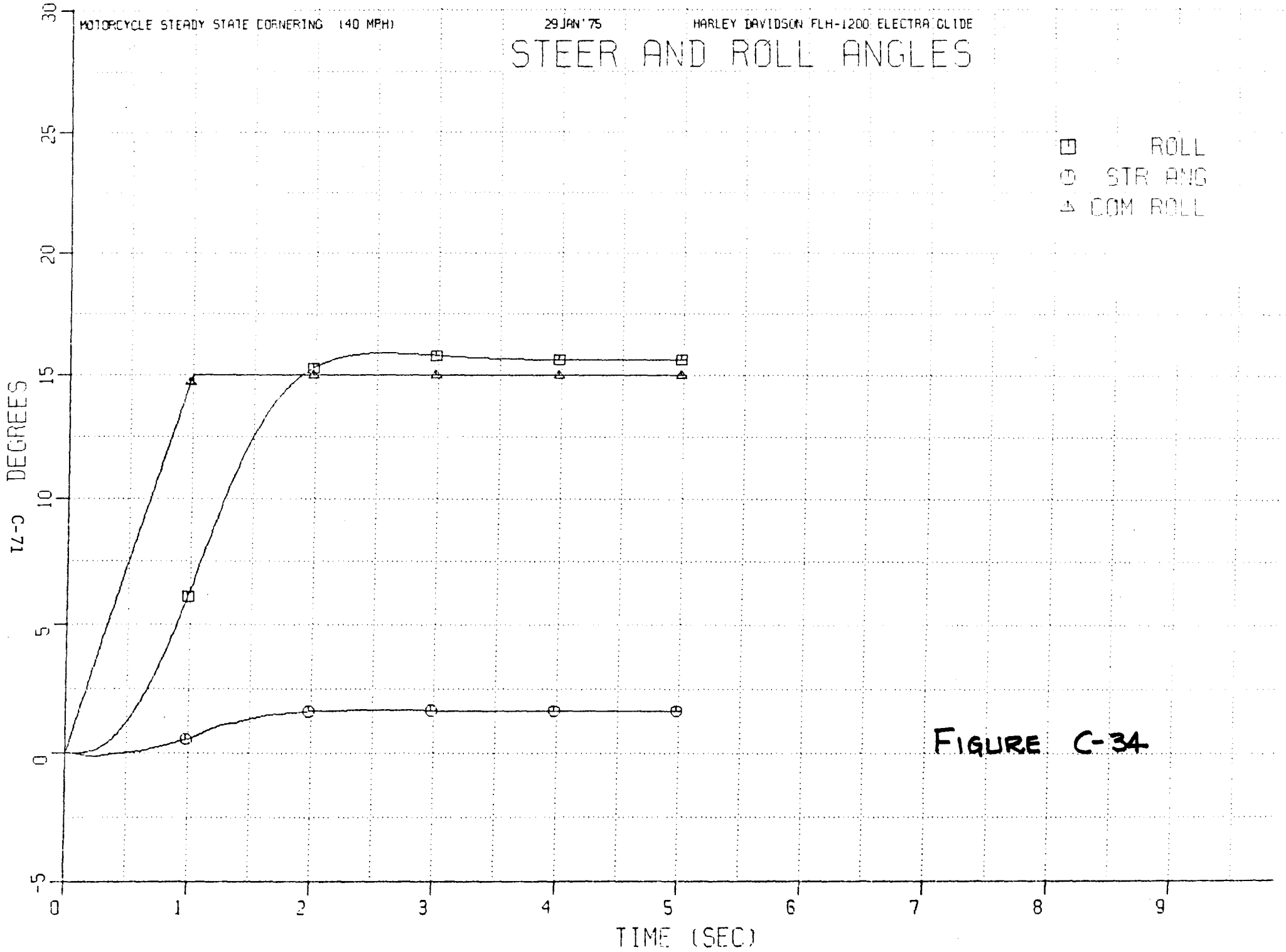

MOTORCYCLE STEADY STATE CORNERING (40 MPH)
29 JAN '75
HARLEY DAVIDSON FLH-1200 ELECTRA GLIDE
STEER AND ROLL ANGLES
ROLL
STR ANG
COM ROLL
DEGREES
TIME (SEC)
30
25
20
15
10
5
0
-5
0
1
2
3
4
5
6
7
8
9

FIGURE C-34

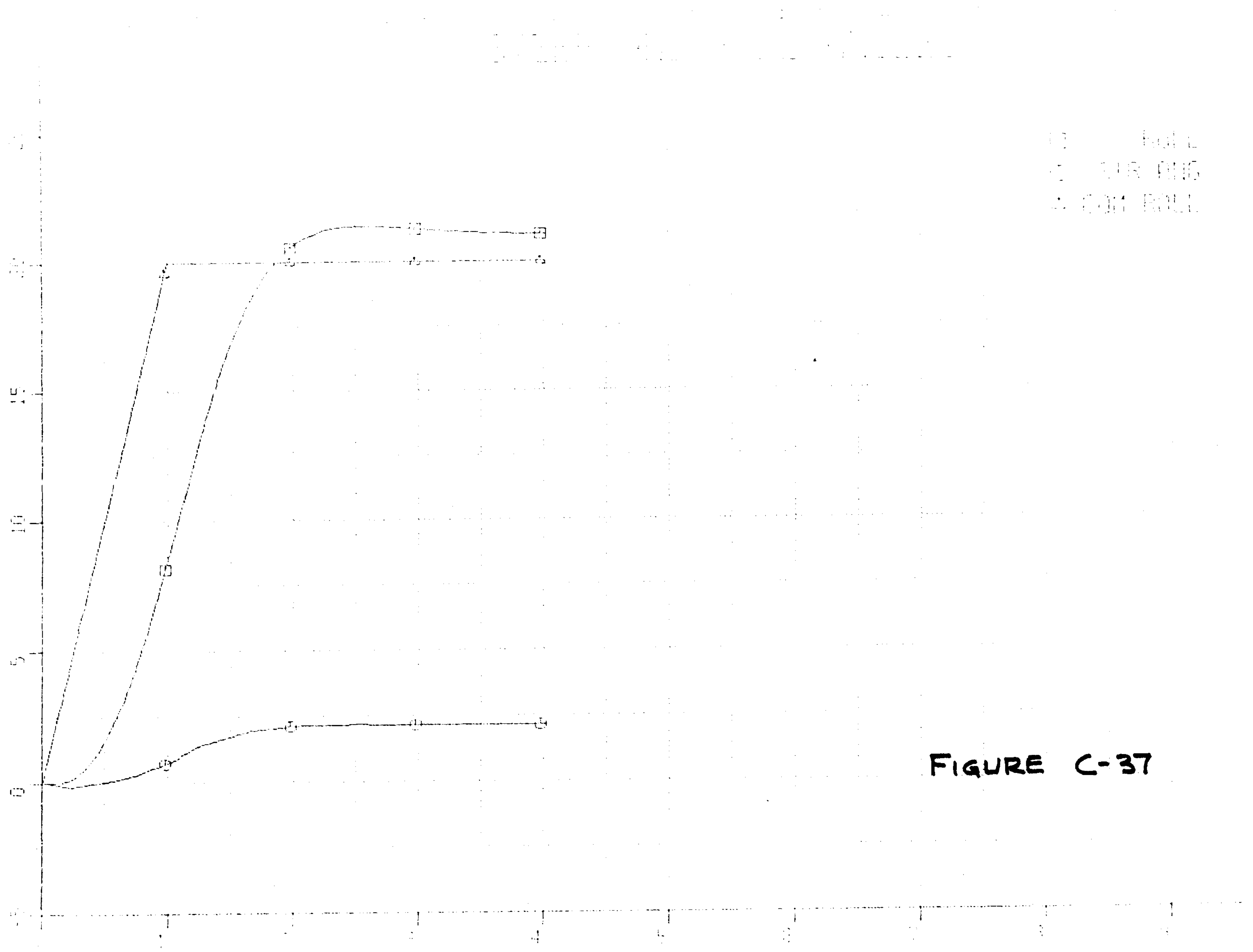


FIGURE C-37

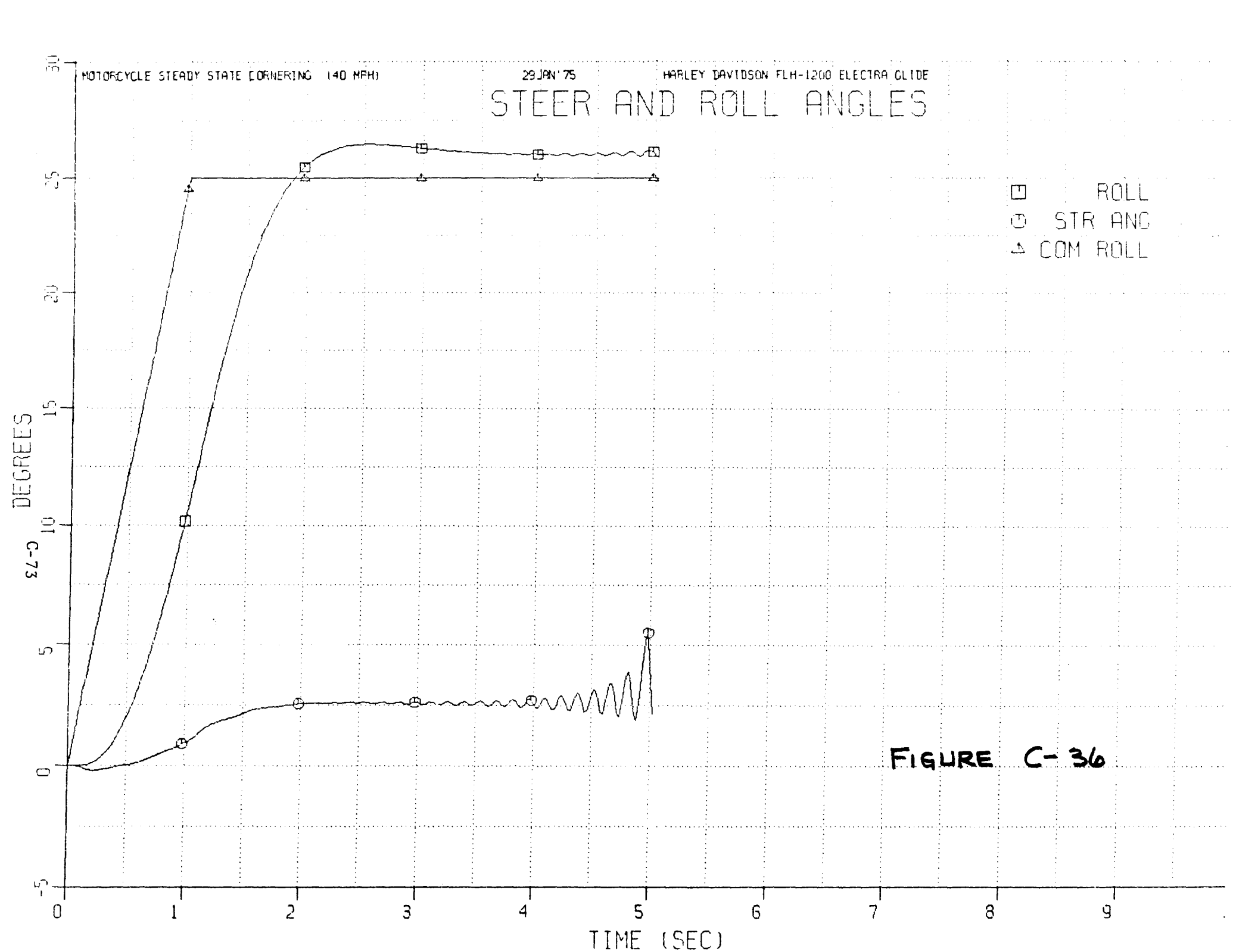

MOTORCYCLE STEADY STATE CORNERING (40 MPH)
29JAN'75
HARLEY DAVIDSON FLH-1200 ELECTRA GLIDE
STEER AND ROLL ANGLES
ROLL
STR ANG
COM ROLL
DEGREES
TIME (SEC)
-5
0
5
10
15
20
25
30
0
1
2
3
4
5
6
7
8
9

FIGURE C-36

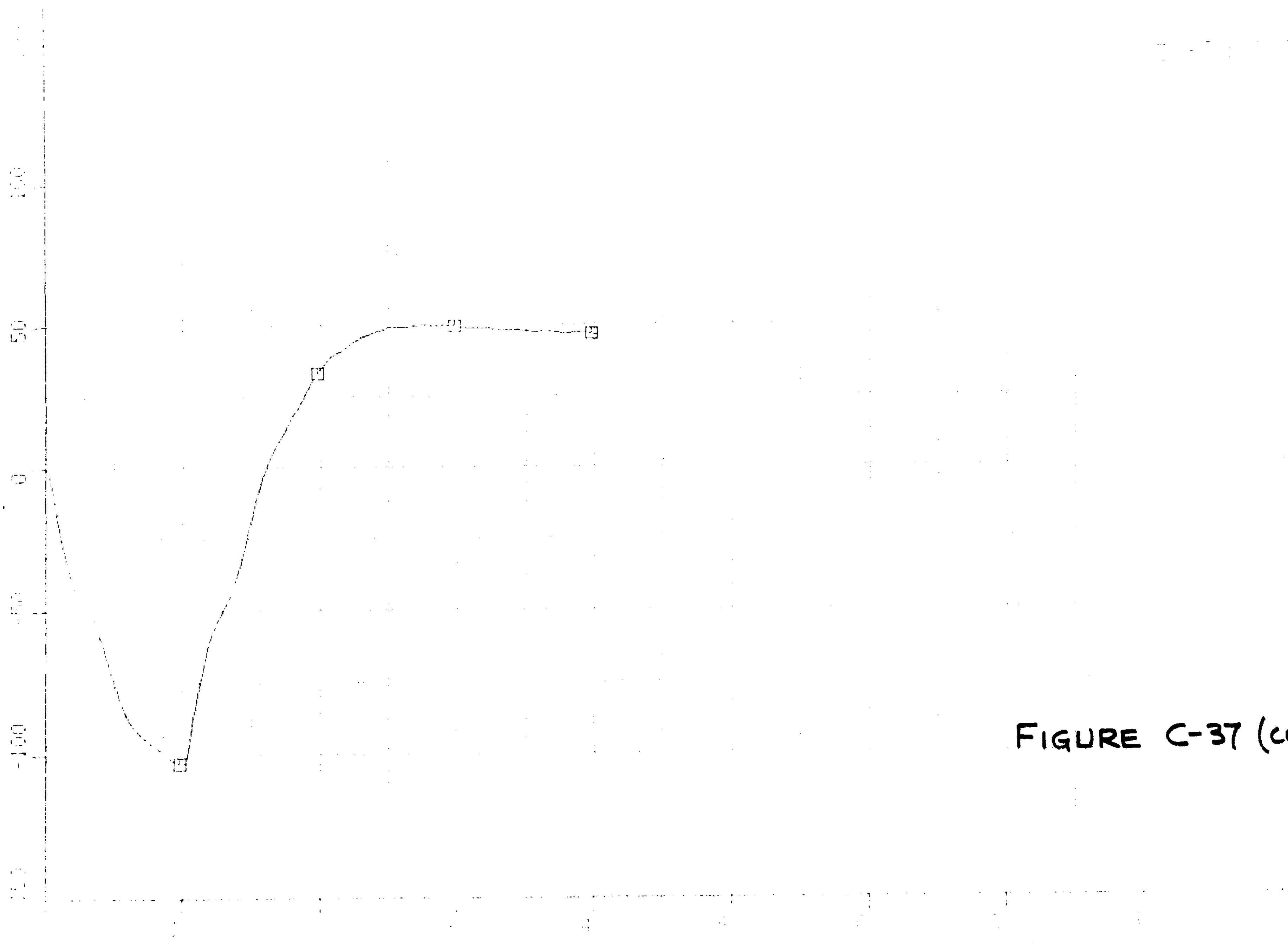


FIGURE C-37 (cont'd)

Table D-1

FULL SCALE TESTING - RUN SUMMARY

Run No.		Run Description
Start	End	
1	12	Directional Control, 300-700 ft. radius, CCW, 40 mph, normal lean control, velocity noise
13	17	DC, 300-700'
18	22	DC, 300', 40-50 mph
23	25	Lane Change, 60', 30-40 mph
26		Steady State, 150' radius, CW, Max Speed
27	32	Yaw rate gyro checkout - straight, serpentine, 20 and 30 mph SS @ 150'
33	35	DC, 300', lean = normal, out, in
36		DC, 300', rider plus passenger
37	42	LC, 20, 30, 40 mph
43	45	Yaw checkout, straight with mild turns
46	47	Straight - Roll angle established with rider lean and steer
48	51	LC, 40 mph, course layout off slightly
52		SS, 150', 30 mph New yaw gyro installed to eliminate 1-2 Hz oscillation. Course layout adjusted.
53	54	DC, 300', CCW, 40 mph
55	61	DC, 300/200/150/100, CCW, 20 mph
62	63	DC, 300', CW, 40 mph
64	68	DC, 200/150/100', CCW, 30 mph
69	71	DC, 200/150/100', CCW, 20 mph
72	117	Lane Change Maneuvers - all done from entrance lane to left exit lane
72	81	LC, Δx=60', 40 mph
82	83	LC, Δx=60', 30 mph
84		LC, Δx=60', 20 mph
85	87	LC, Δx=60', 40 mph
88	91	LC, Δx=60', max speed attempt at about 45 mph
92	94	LC, Δx=80', 50 mph, transmission of signal improved
95	98	LC, Δx=80', max speed attempt at about 52-54 mph
99	100	LC, Δx=45', 30 mph
101	104	LC, Δx=45', max speed attempt at about 32-33 mph
105	108	LC, Δx=30', 20 mph
109	114	Repeat LC, Δx=60', 40 mph with improved signal
115	117	LC, Δx=60', 40 mph with cone pair at midpoint of LC for simulation analysis

Appendix D
Full Scale Testing

This appendix contains representative raw data plots (time histories) for runs selected from the full-scale test program. All runs were performed with the Honda CB 360 G in its OE configuration under dry road conditions on Calspan's VERF testing grounds. One rider performed all tests--some 117 runs--over a range of speed and test course geometry (which are discussed at length in the technical volume of this report) for the two procedures described earlier in Appendix A. A summary of the run schedule is included here as Table D-1.

All data are presented with the same time base of 25 mm = 1 sec. Scale factors for each of the variables were adjusted over test period and are indicated in each figure. For the sake of convenience, the sense of each variable is described here as "right" and "left" in the rider's perspective. A more detailed explanation of the applicable coordinate systems is given in Section 3.8 of this report.

As explained previously, tape switches placed at the starting points of the two course layouts were used to activate the event marker of the chart recorder and thus indicate the motorcycle's position as its wheels passed over the switch. This signal appears below the yaw rate trace in each of the data records.

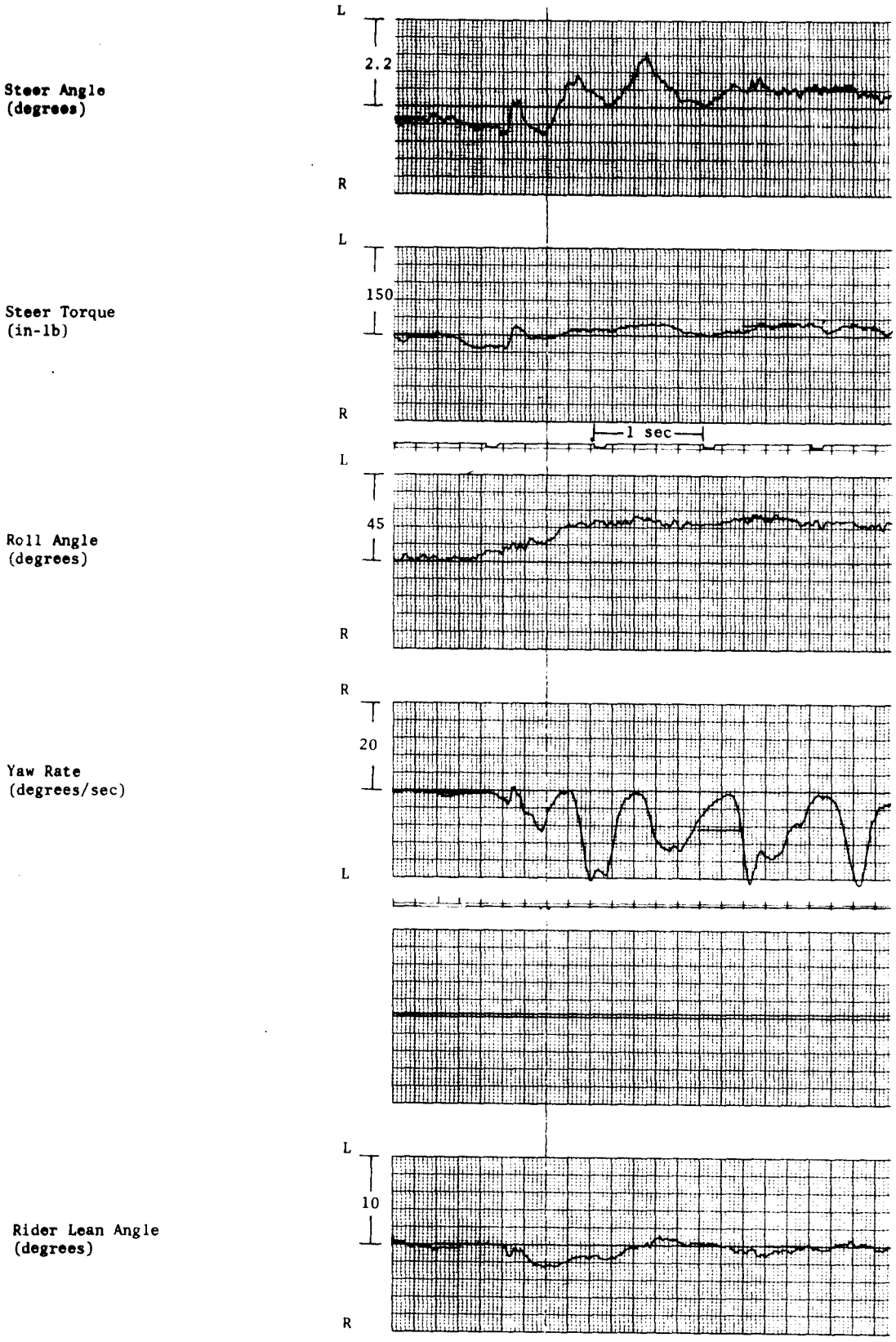


Fig. D-2. Run No. 14. Directional Control, 40 mph, 400 ft. radius.

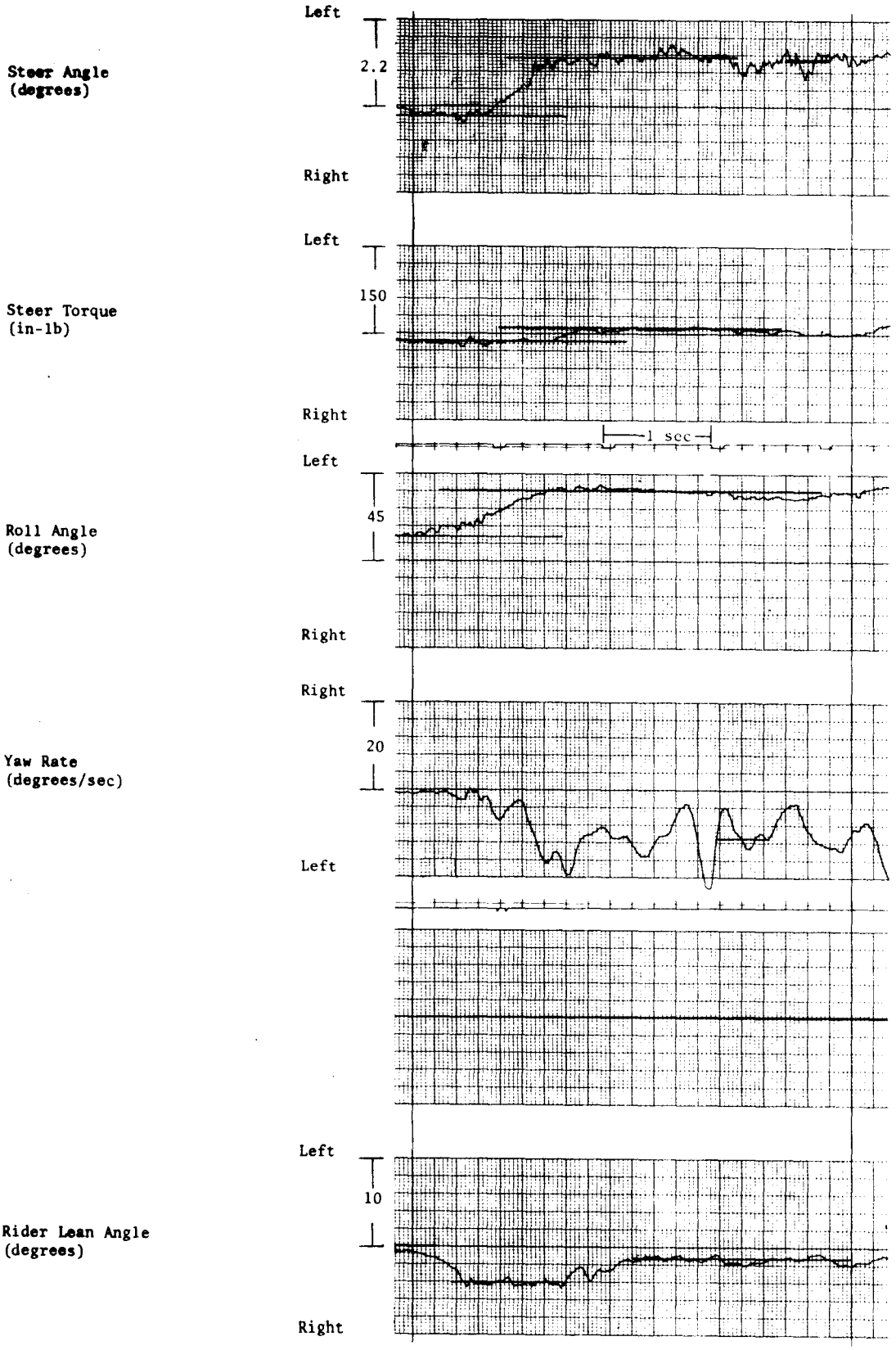


Fig. D-1. Run No. 13. Directional Control, 40 mph, 300 ft. radius.

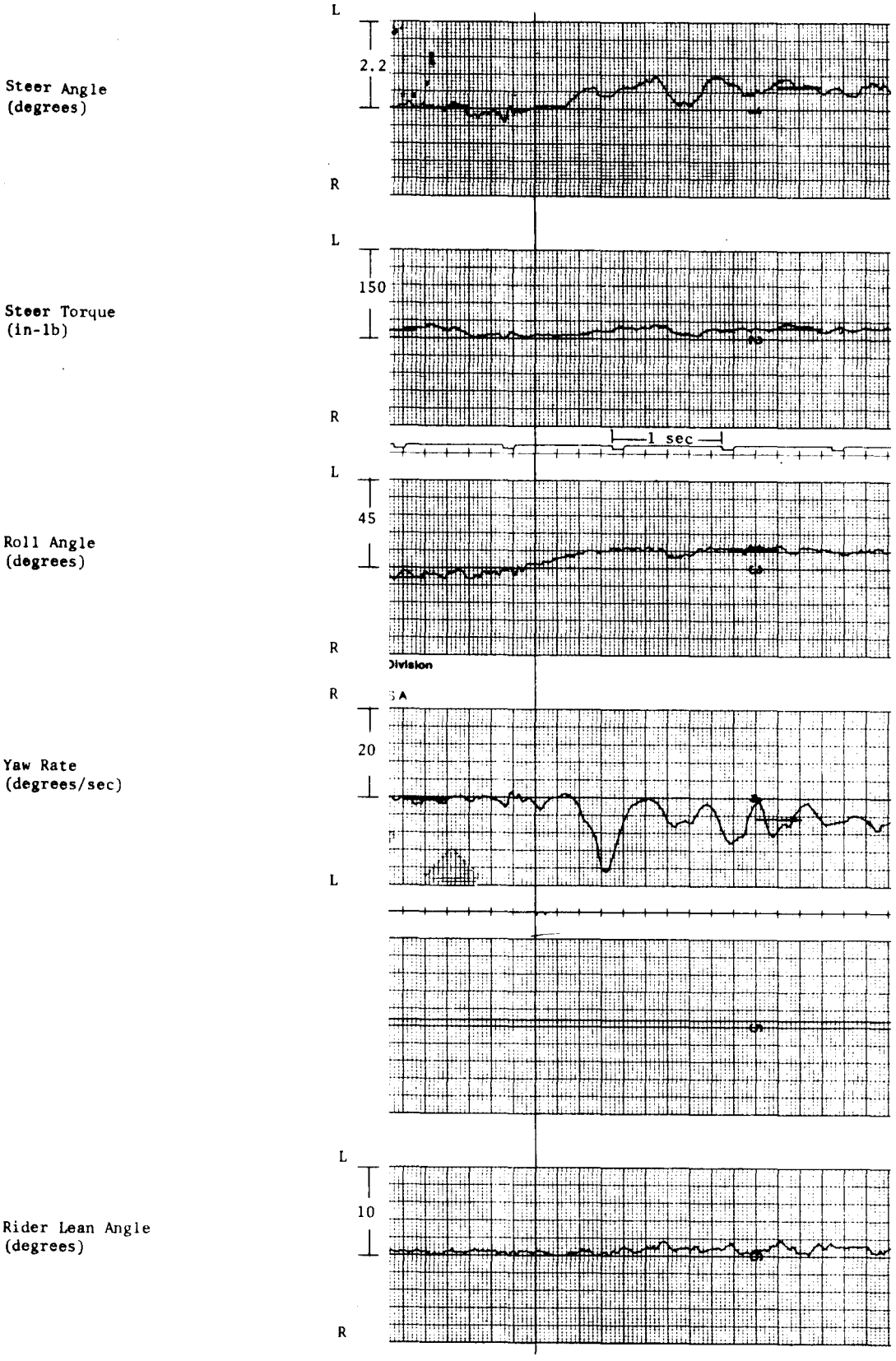


Fig. D-4. Run No. 16. Directional Control, 40 mph, 600 ft. radius.

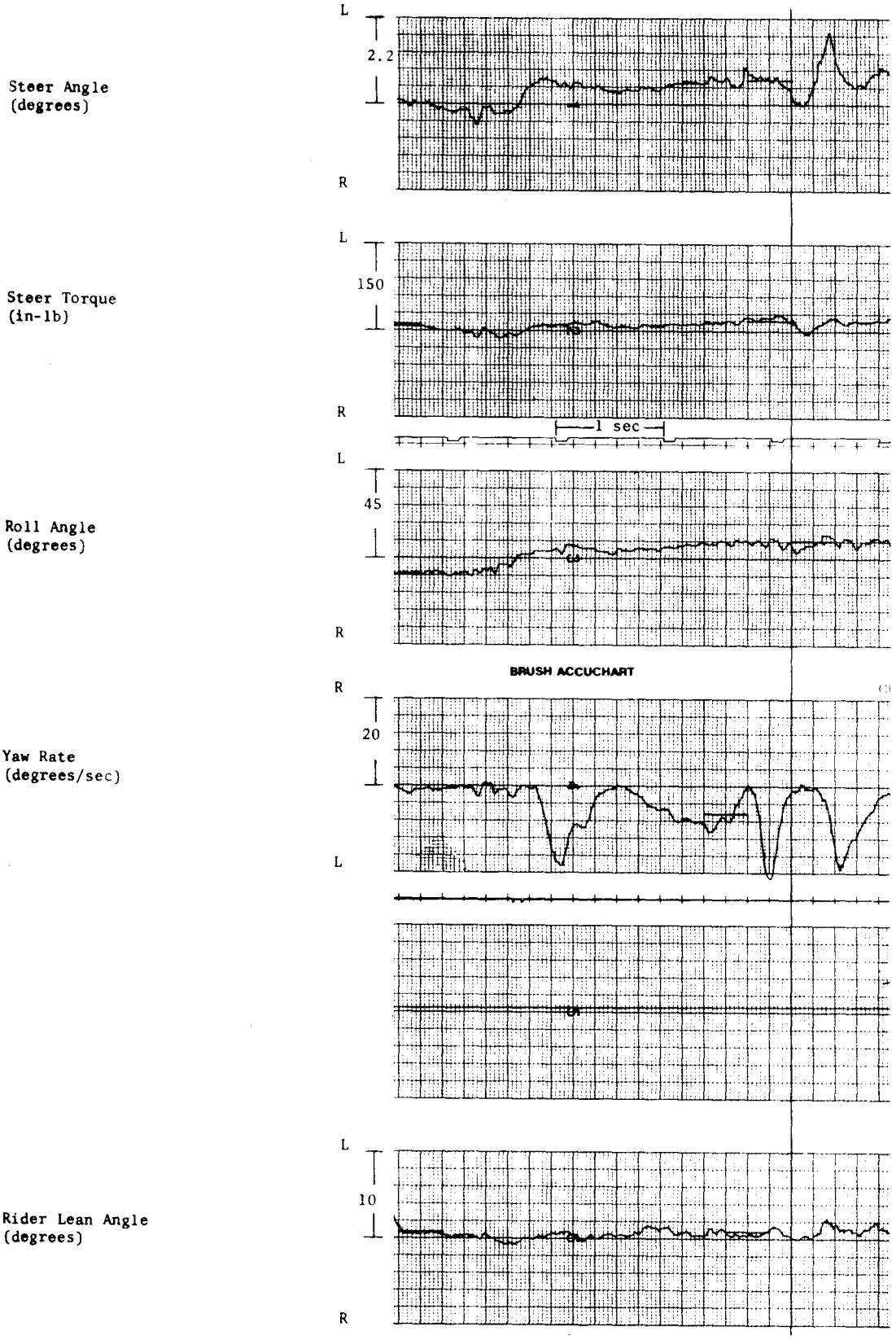


Fig. D-3. Run No. 15. Directional Control, 40 mph, 500 ft. radius.

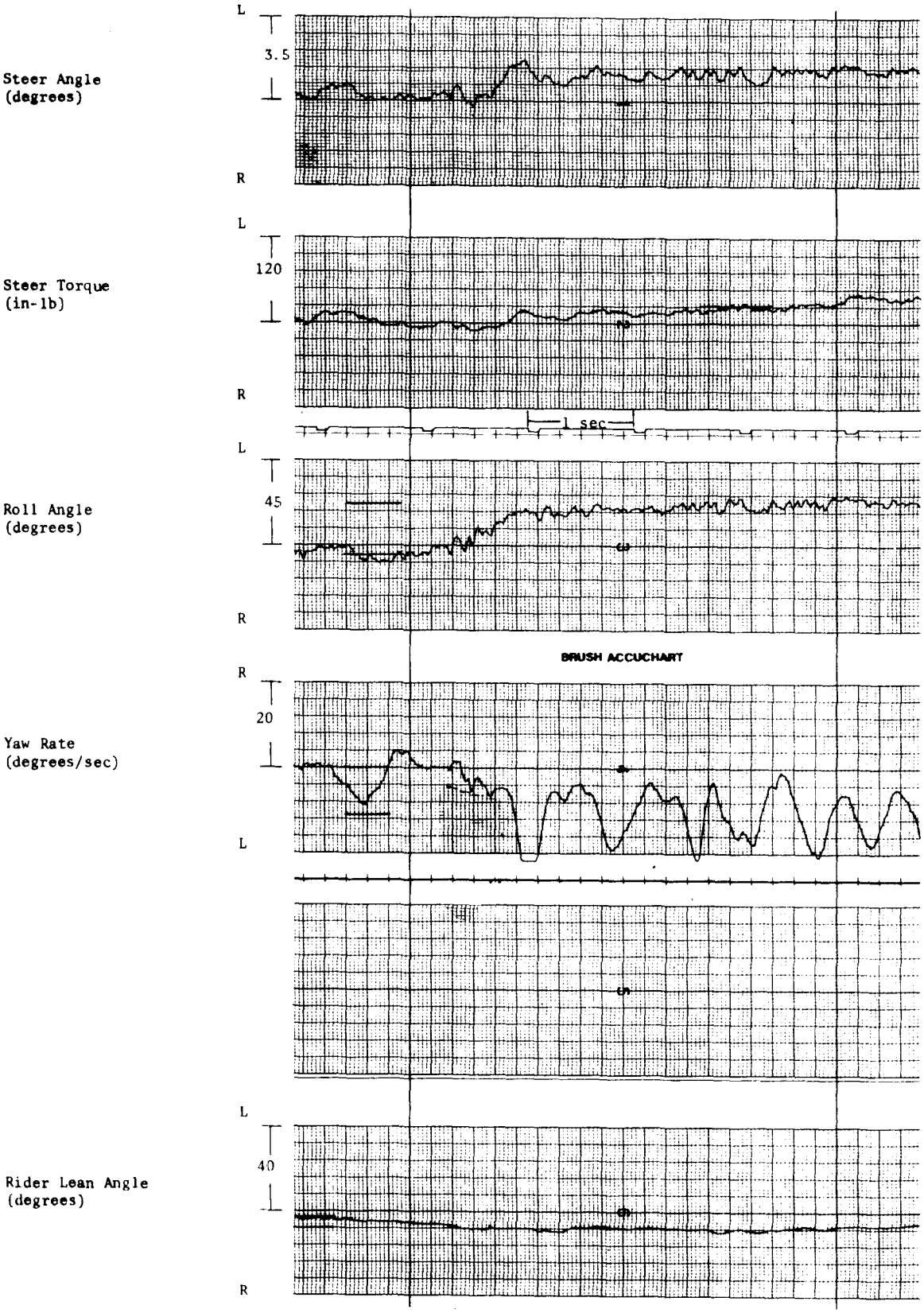


Fig. D-6. Run No. 33. Directional Control, 40 mph, 300 ft. radius. Rider Lean Normal.

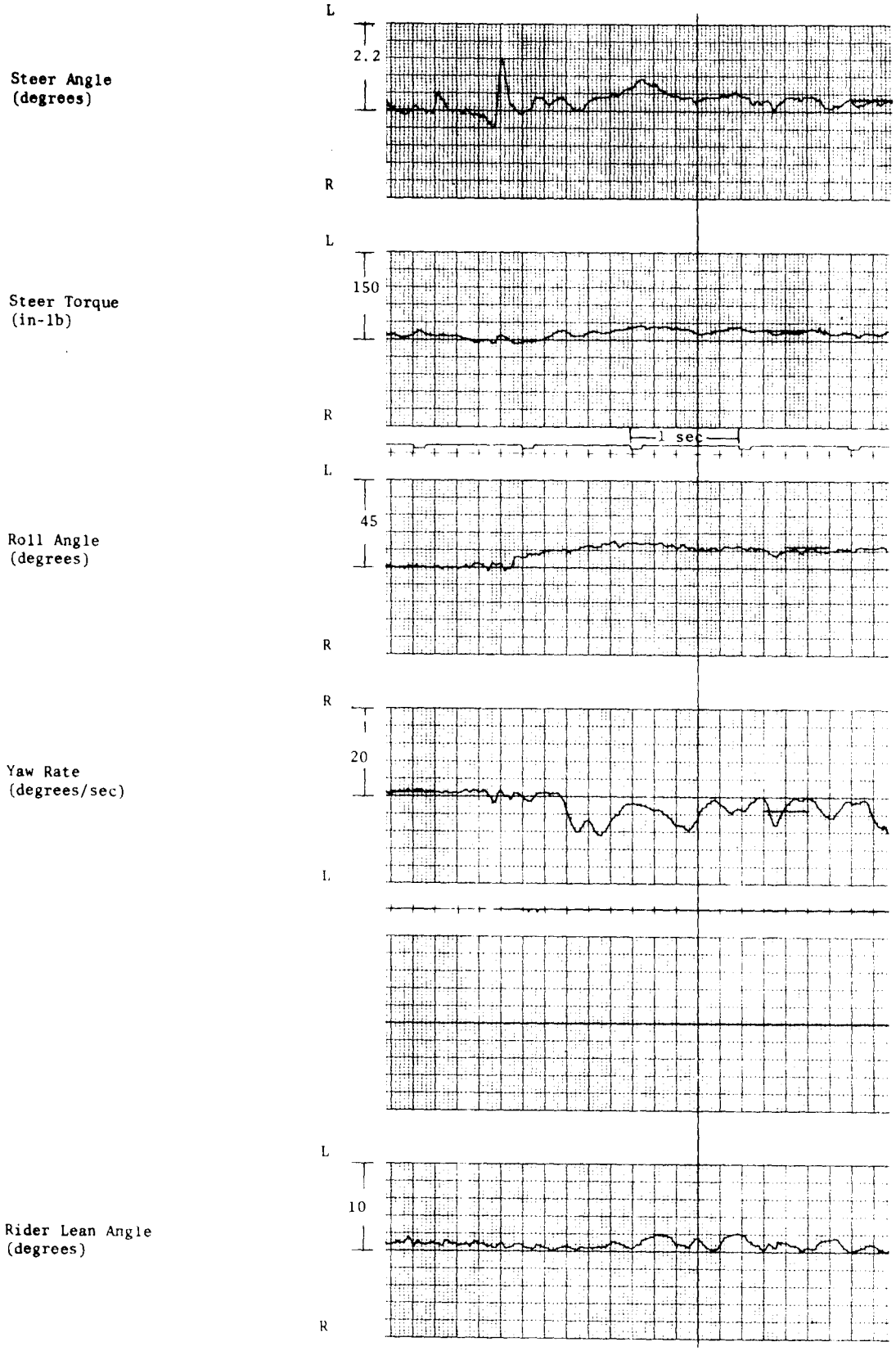


Fig. D-5. Run No. 17. Directional Control, 40 mph, 700' radius.

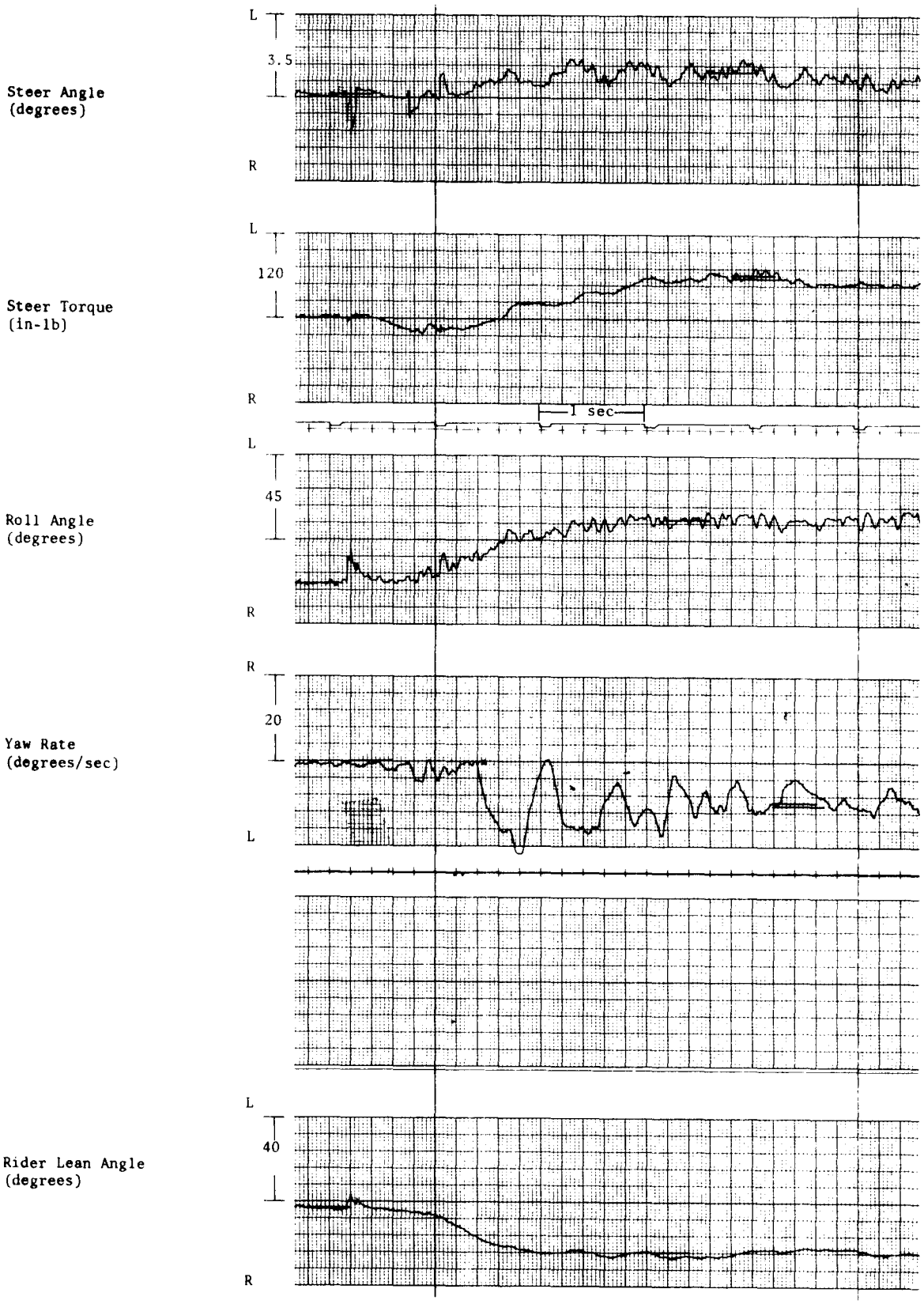


Fig. D-8. Run No. 35. Directional Control, 40 mph, 300 ft. radius. Rider Lean Forced Outward.

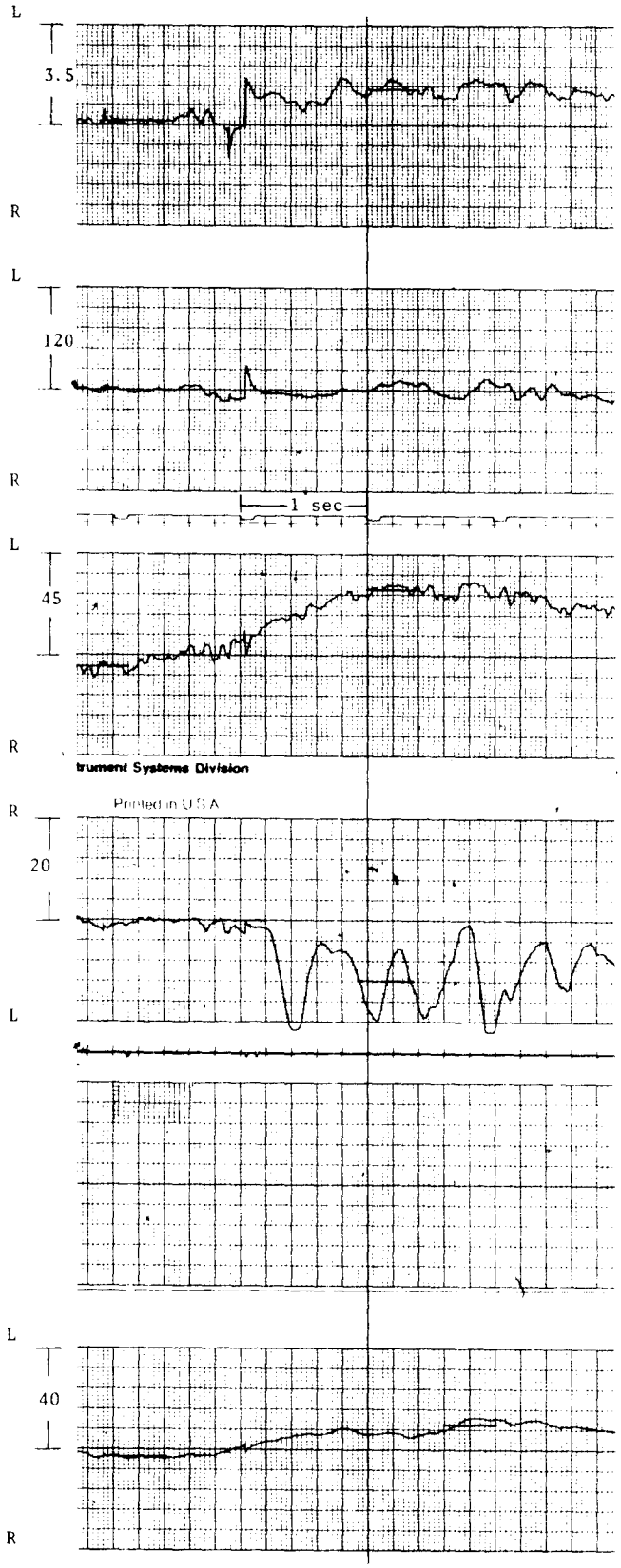


Fig. D-7. Run No. 34. Directional Control, 40 mph, 300 ft. radius. Rider Lean Forced Inward.

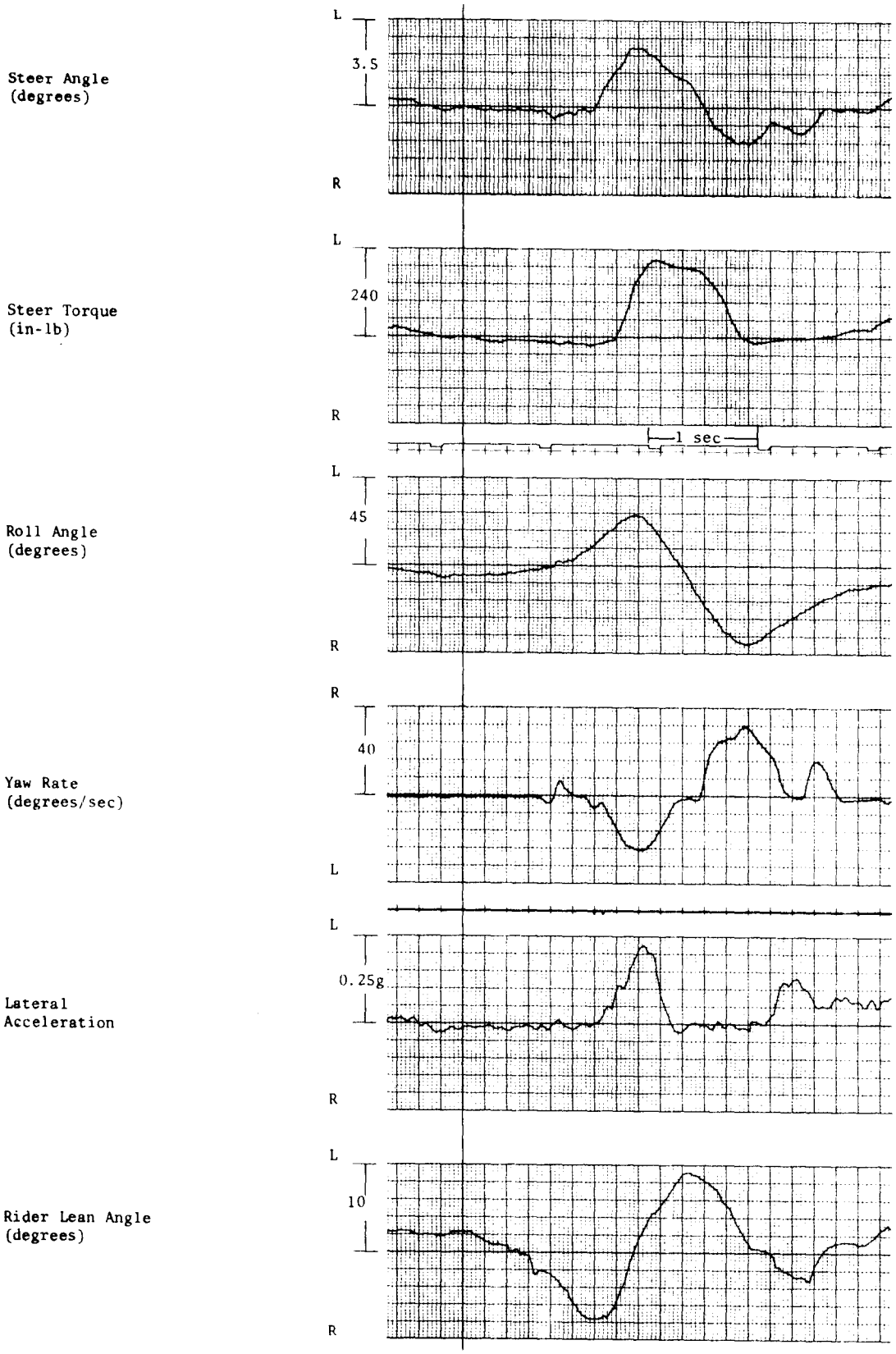


Fig. D-10. Run No. 114. Lane Change, Δx=60 ft. 40 mph.

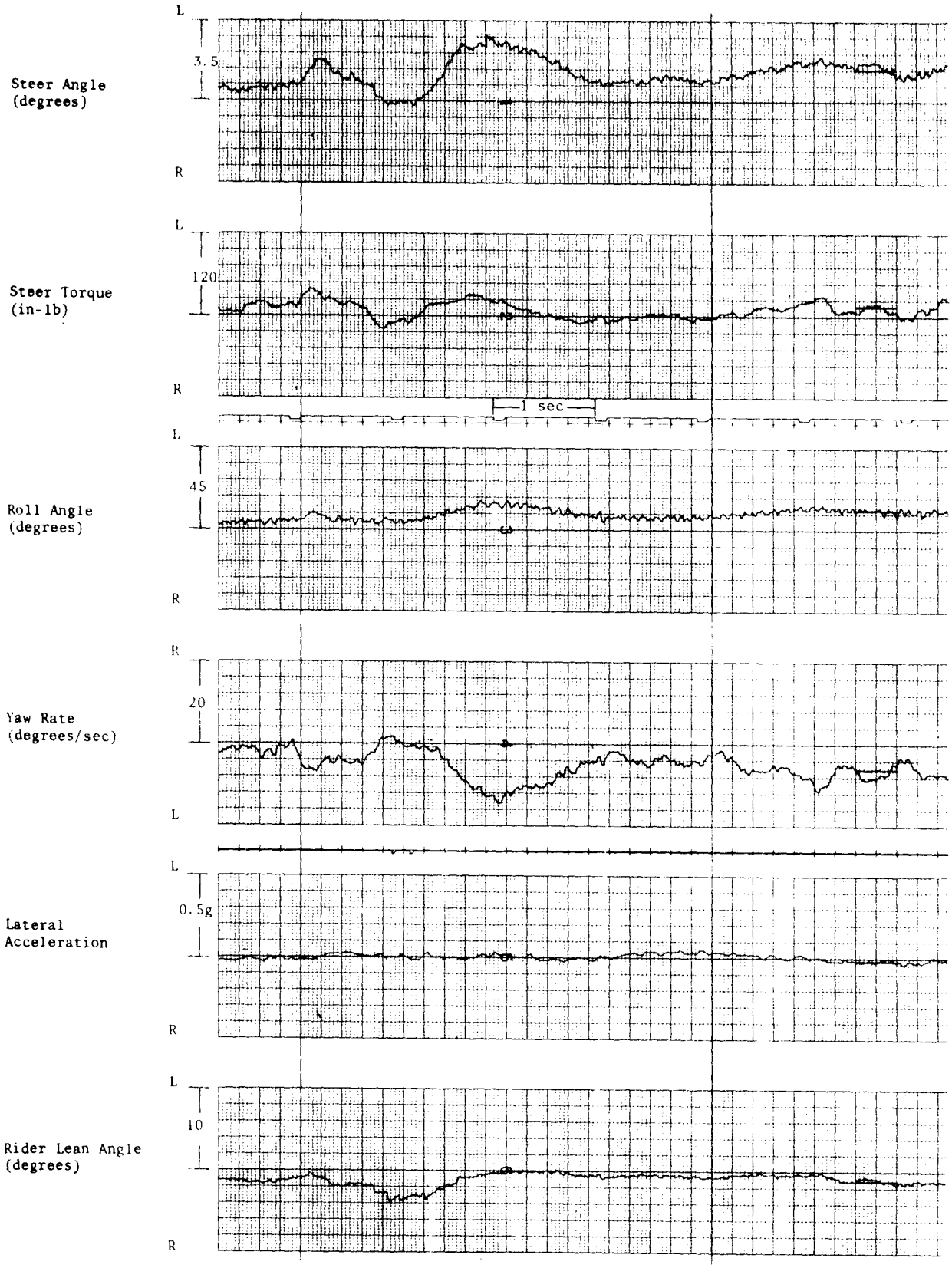


Fig. D-9. Run No. 55. Directional Control, 20 mph, 300 ft. radius.

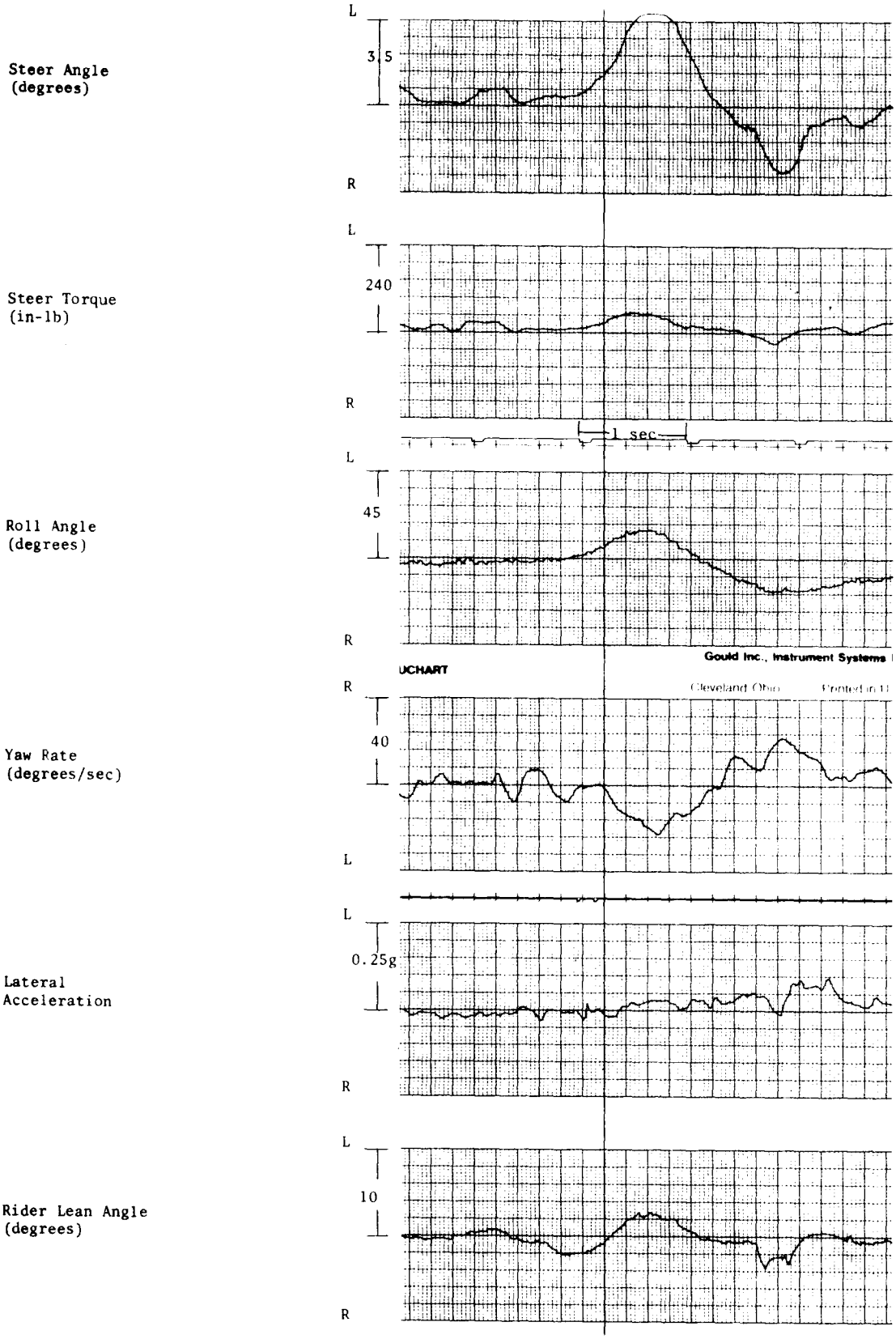


Fig. D-12. Run No. 84. Lane Change, Δx=60 ft., 20 mph.

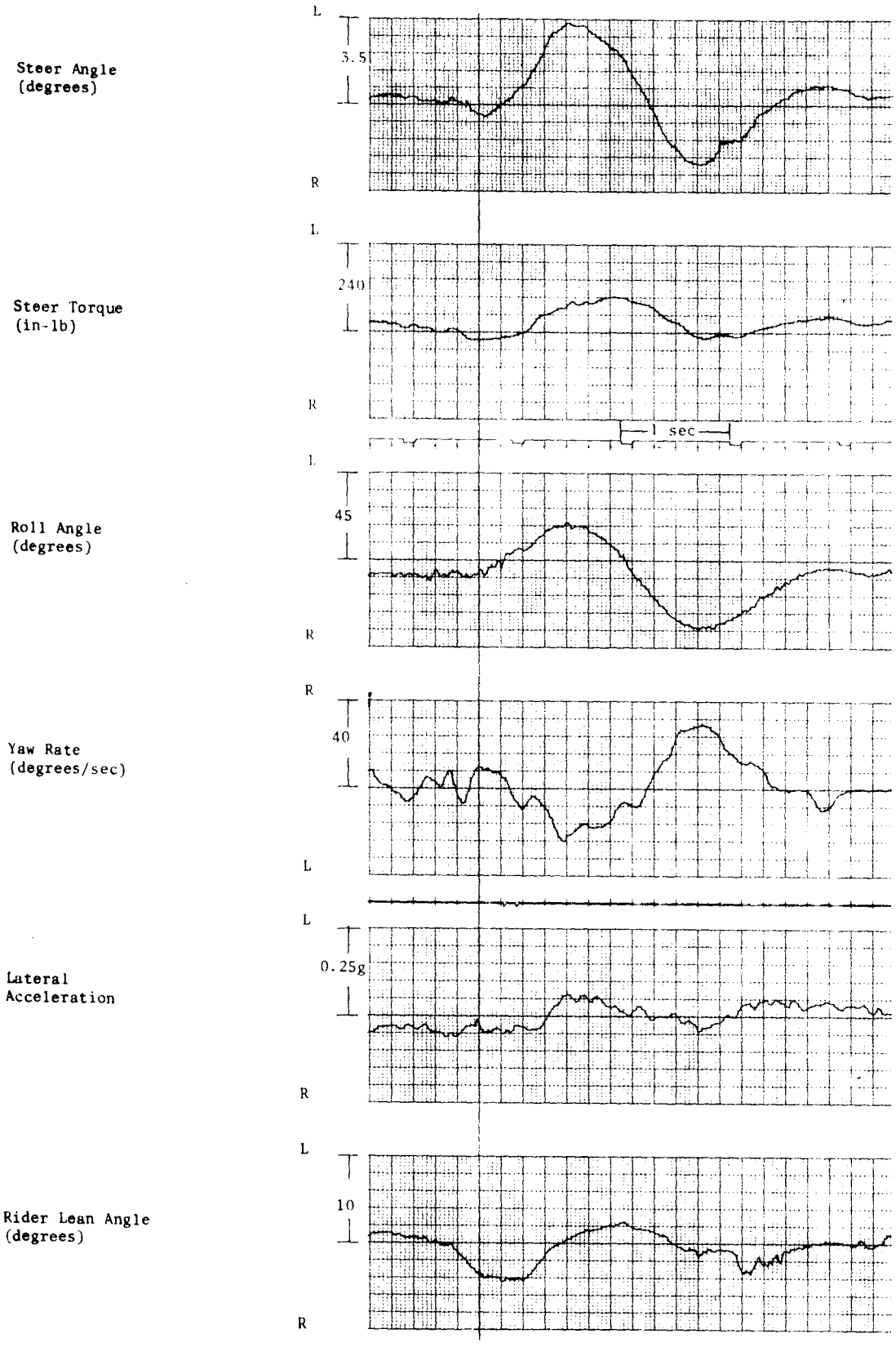


Fig. D-11. Run No. 83. Lane Change, Δx=60 ft., 30 mph.

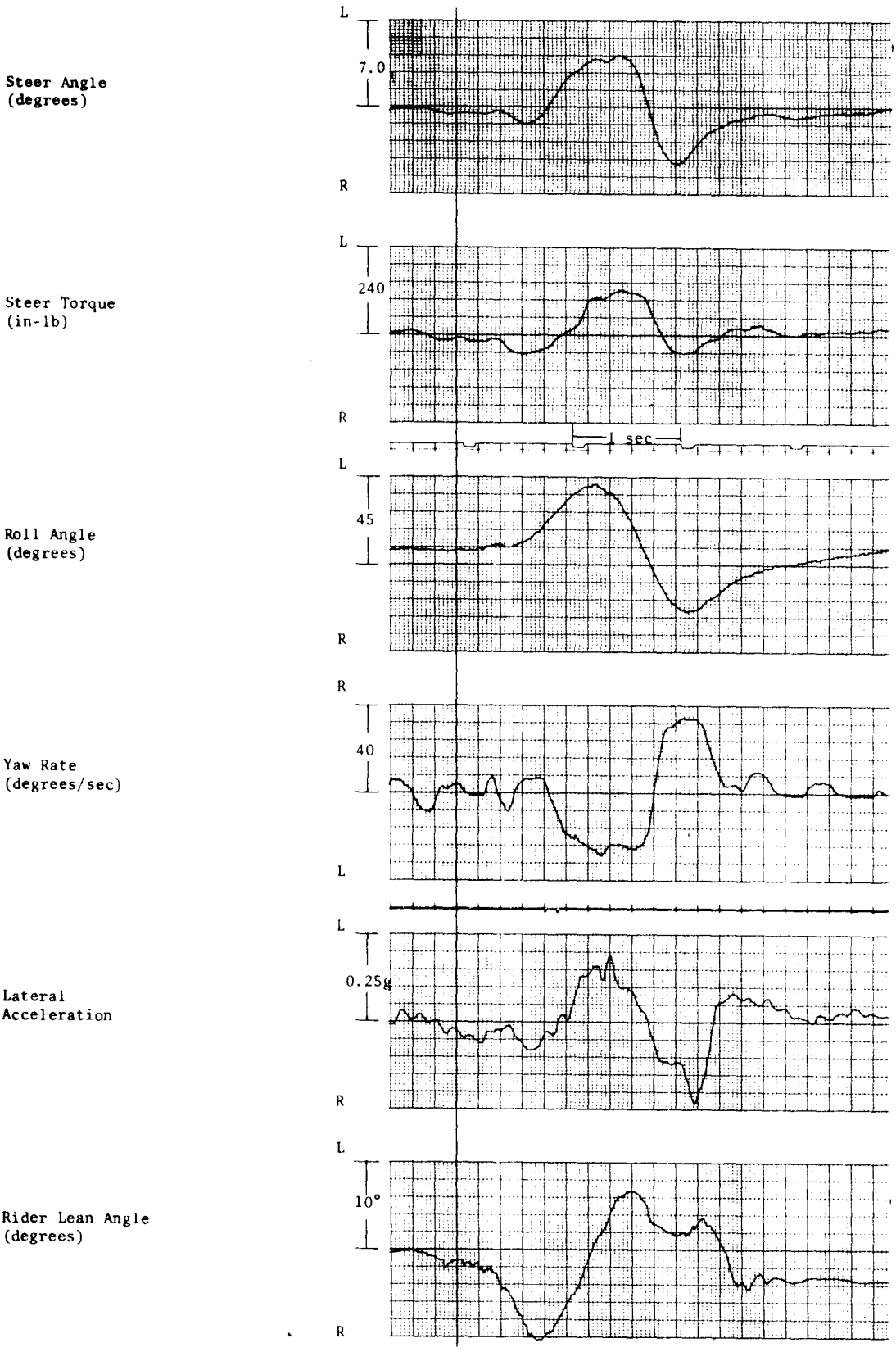


Fig. D-14. Run No. 100. Lane Change, Δx=45', 30 mph.

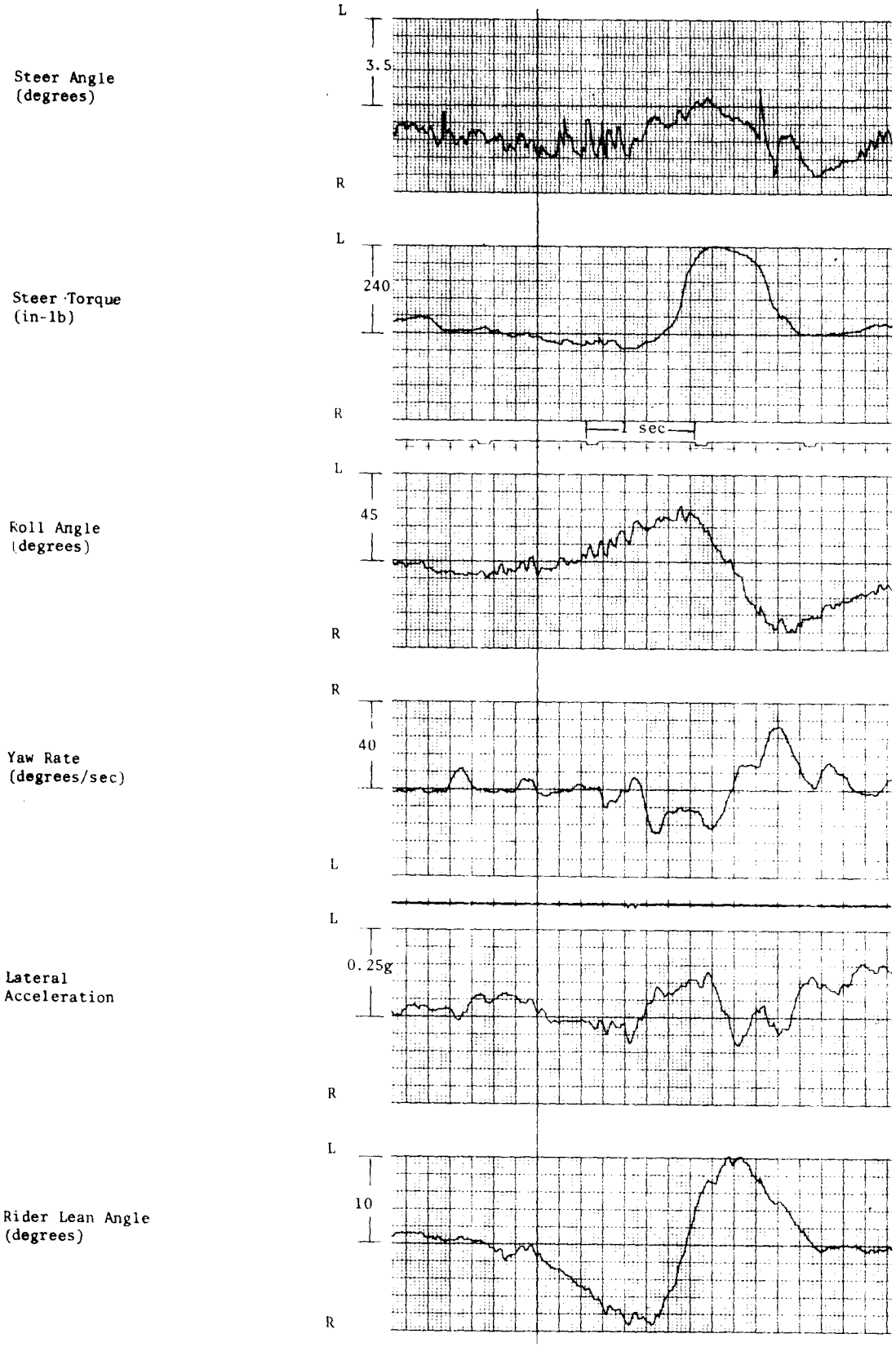


Fig. D-13. Run No. 84. Lane Change, Δx=80 ft., 50 mph.

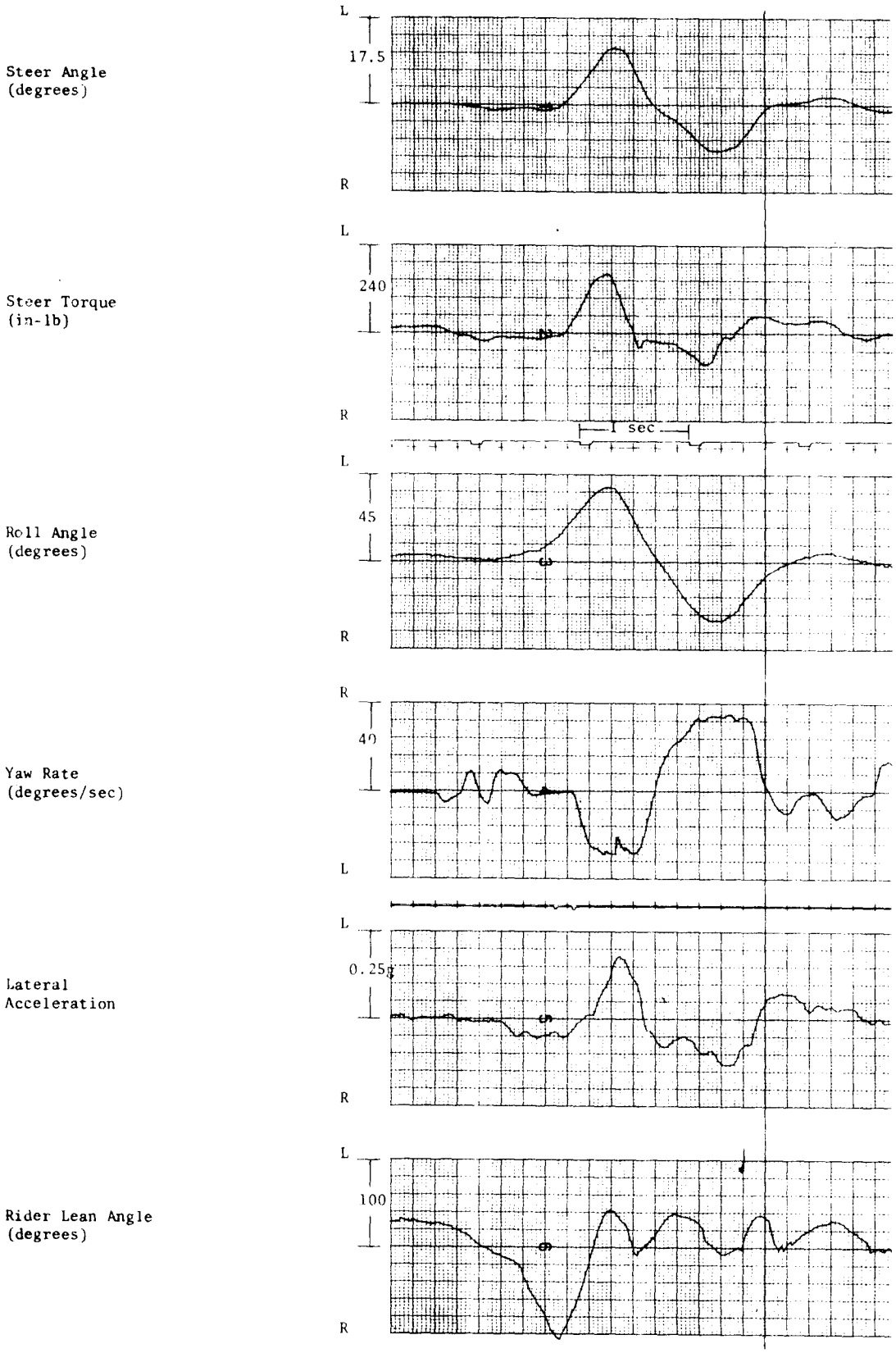


Fig. D-15. Run No. 108. Lane Change, $\Delta x=30'$, 20 mph.