February 22, 2002

HSA-10/CC-69B

Mr. Kaddo Kothmann
President, Road Systems, Inc.
3616 Howard County Airport Road
Big Spring, TX 79720

Dear Mr. Kothmann:

In your January 24 letter to Mr. Frederick G. Wright, Jr., the Federal Highway Administration's former Program Manager for the Safety Core Business Unit, you formally requested acceptance of your Box-Beam Burster Energy Absorbing Terminal Single-Sided Crash Cushion (BEAT-SSCC) as an NCHRP Report 350 crash cushion at test level 3 (TL-3). To support your request, you submitted a copy of the Midwest Roadside Safety Facility's January 7, 2002 test report entitled "Safety Performance Evaluation of a Single-Sided Crash Cushion," a videotape of the crash tests that were conducted and drawings and photographs of the BEAT-SSCC.

The BEAT-SSCC is similar in design concept to the BEAT and the BEAT-MT and is comprised of the following main components:

- **an impact head assembly**
- **a Stage 1 energy absorber (152-mm x 152-mm x 3.2 mm box beam rail)**
- **a Stage 2 energy absorber (152-mm x 152-mm x 4.8-mm box-beam rail)**
- **eight breakaway steel posts, and**
- **a fabricated end section for transitioning the BEAT-SSCC to a New Jersey shaped barrier**

The BEAT-SSCC is approximately 8.4-m long. The general design features and layout are shown in the enclosure to this letter. I assume you will be able to provide detailed drawings and installation guidelines to interested parties.

The test report states that seven NCHRP Report 350 tests (test numbers 3-30 through 3-35, and 3-39) are normally required to certify the crashworthiness of a gating terminal or crash cushion. Based on earlier tests conducted on the Wyoming DOT's box-beam terminal (WYBET) and/or the BEAT and BEAT-MT box beam terminals and the similarities of these designs to the BEAT-SSCC, you concluded that tests 3-30, 3-32, 3-33, 3-34, and 3-35 were not needed. My staff reviewed the information you provided and concurred with your analysis. Test 3-31 was successfully conducted. Test 3-38, which is identified in Report 350 as being needed for a nongating device, was run twice, with one impact point at the beginning of the length of need (approximately 400 mm upstream from post 3) and the second 2.0 m upstream from the rigid New Jersey barrier. In addition, test 3-39, was also run twice: to test the BEAT-SSCC on its backside at mid-length in a reverse direction

impact and to test the concrete barrier connection on the front side from the reverse direction. Summary reports on each of the five tests are included in the enclosure.

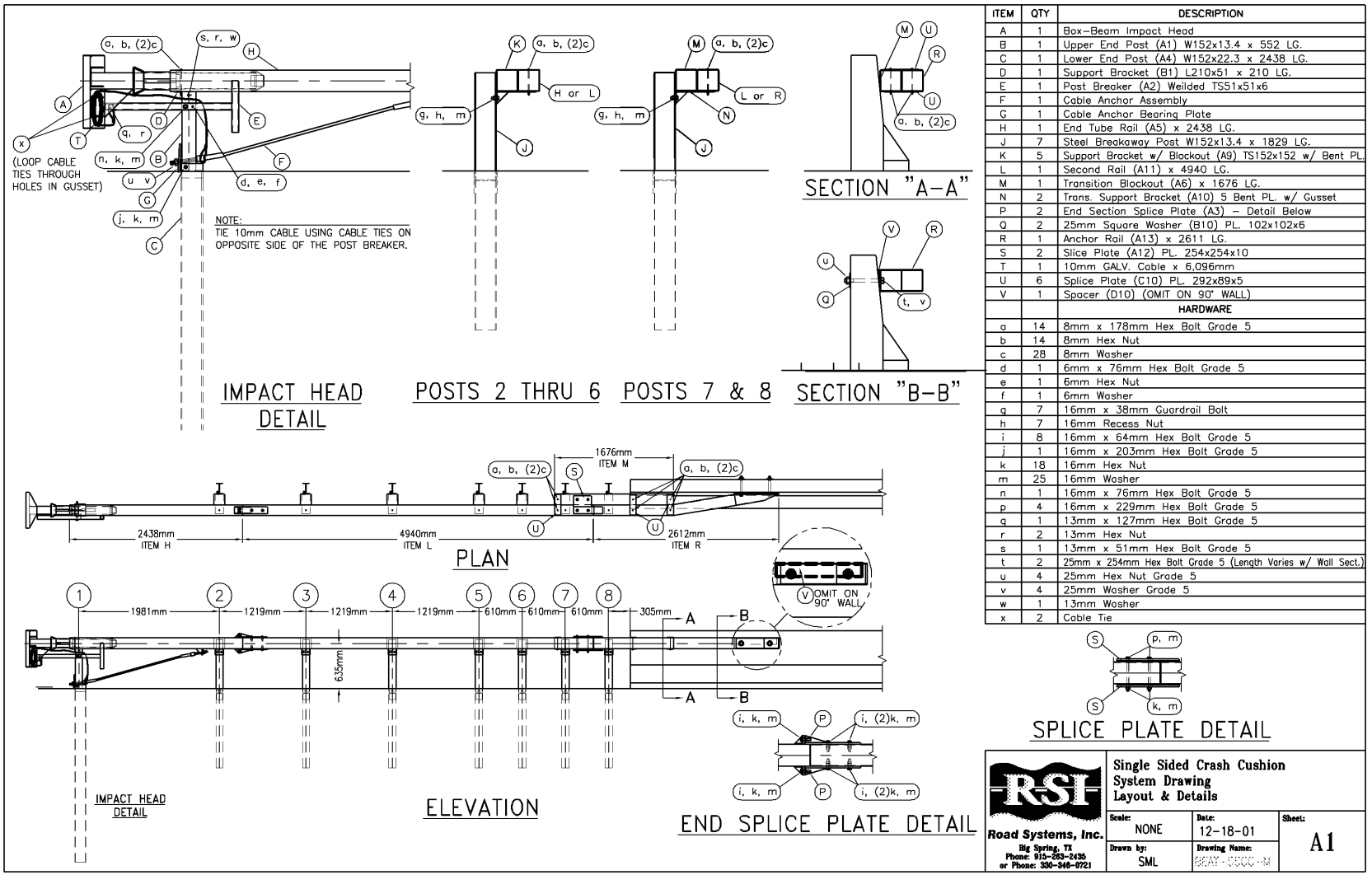
Based on the results of these tests and earlier testing done on the WYBET, the roadside BEAT, and the BEAT-MT, the BEAT-SSCC, as described above, may be considered an NCHRP Report 350 crash cushion at test level 3. Consequently, it may be used on the National Highway System (NHS) when such use is acceptable to the contracting authority. Due to its single-sided design, the BEAT-SSCC is not appropriate for use at locations where backside hits towards the rigid concrete barrier are possible, e.g., in gore areas, nor is it appropriate for use in a narrow median where backside, opposite direction hits are likely. Test 3-38 demonstrated that the BEAT-SSCC has no significant containment or re-directional capabilities when struck in this manner. Since it is a proprietary product, its use on Federal-aid projects, except exempt non-NHS projects, is subject to the provisions in Title 23, Code of Federal Regulations, Section 635.411.

Sincerely yours,

(original signed by Michael L. Halladay)

Michael L. Halladay
Acting Program Manager, Safety

Enclosure



ITEM	QTY	DESCRIPTION
A	1	Box-Beam Impact Head
B	1	Upper End Post (A1) W152x13.4 x 552 LG.
C	1	Lower End Post (A4) W152x22.3 x 2438 LG.
D	1	Support Bracket (B1) L210x51 x 210 LG.
E	1	Post Breaker (A2) Weilded TS51x51x6
F	1	Cable Anchor Assembly
G	1	Cable Anchor Bearing Plate
H	1	End Tube Rail (A5) x 2438 LG.
J	7	Steel Breakaway Post W152x13.4 x 1829 LG.
K	5	Support Bracket w/ Blockout (A9) TS152x152 w/ Bent PL.
L	1	Second Rail (A11) x 4940 LG.
M	1	Transition Blockout (A6) x 1676 LG.
N	2	Trans. Support Bracket (A10) 5 Bent PL. w/ Gusset
P	2	End Section Splice Plate (A3) – Detail Below
Q	2	25mm Square Washer (B10) PL. 102x102x6
R	1	Anchor Rail (A13) x 2611 LG.
S	2	Slice Plate (A12) PL. 254x254x10
T	1	10mm GALV. Cable x 6,096mm
U	6	Splice Plate (C10) PL. 292x89x5
V	1	Spacer (D10) (OMIT ON 90° WALL)
		HARDWARE
a	14	8mm x 178mm Hex Bolt Grade 5
b	14	8mm Hex Nut
c	28	8mm Washer
d	1	6mm x 76mm Hex Bolt Grade 5
e	1	6mm Hex Nut
f	1	6mm Washer
g	7	16mm x 38mm Guardrail Bolt
h	7	16mm Recess Nut
i	8	16mm x 64mm Hex Bolt Grade 5
j	1	16mm x 203mm Hex Bolt Grade 5
k	18	16mm Hex Nut
m	25	16mm Washer
n	1	16mm x 76mm Hex Bolt Grade 5
p	4	16mm x 229mm Hex Bolt Grade 5
q	1	13mm x 127mm Hex Bolt Grade 5
r	2	13mm Hex Nut
s	1	13mm x 51mm Hex Bolt Grade 5
t	2	25mm x 254mm Hex Bolt Grade 5 (Length Varies w/ Wall Sect.)
u	4	25mm Hex Nut Grade 5
v	4	25mm Washer Grade 5
w	1	13mm Washer
x	2	Cable Tie

Figure 2. BEAT-SSCC System Details

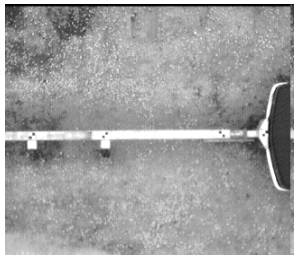


Figure 20.000 sec

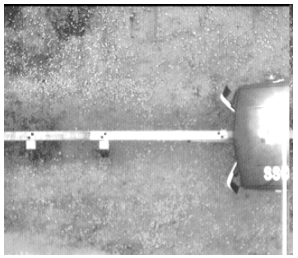


Figure 60.024 sec

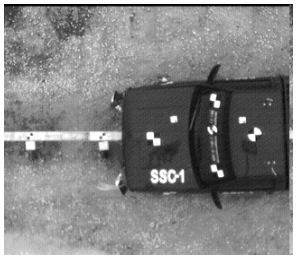


Figure 30.100 sec

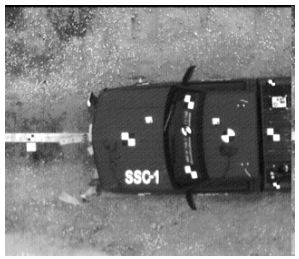


Figure 40.120 sec

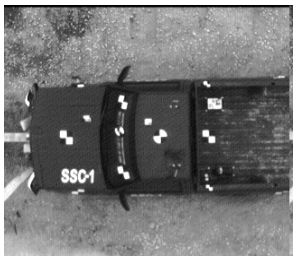
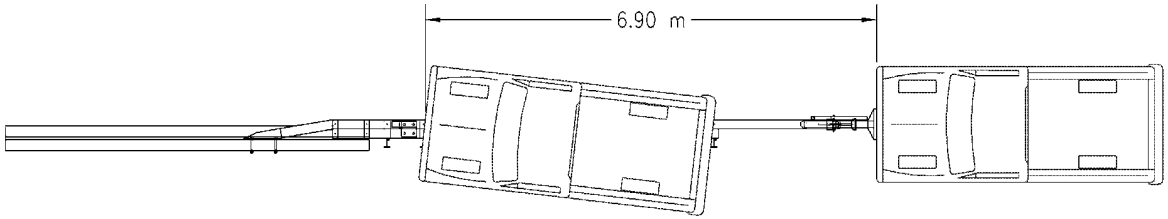


Figure 50.174 sec



- Test Number SSC-1 (3-31)
- Date 6/14/01
- Test Article
  - Type . . . . . BEAT-SSCC
  - Key Elements . . . . . Box-beam impact head
    8 steel breakaway posts
    3 sections of box-beam steel tube
    Post breaker attached to post no. 1
    Cable anchor system
    End section attachment to concrete barrier
  - Orientation . . . . . Head-on with center line
- Soil Type . . . . . Grading B - AASHTO M 147-65 (1990)
- Vehicle Model . . . . . 1995 GMC C2500 pickup truck
  - Curb . . . . . 2,081 kg
  - Test Inertial . . . . . 2,022 kg
  - Gross Static . . . . . 2,022 kg
- Vehicle Speed
  - Impact . . . . . 99.0 km/hr
  - Exit . . . . . NA
- Vehicle Angle
  - Impact . . . . . 1.46 deg
  - Exit . . . . . NA
- Vehicle Stability . . . . . Satisfactory
- Occupant Ridedown Deceleration (10 msec avg.)
  - Longitudinal . . . . . 16.24 g's
  - Lateral (not required) . . . . . 4.12 g's
- Occupant Impact Velocity
  - Longitudinal . . . . . 7.89 m/s
  - Lateral (not required) . . . . . 0.38 m/s
- Vehicle Damage . . . . . Moderate
  - TAD[10] 12-FD-4
  - SAE[11] 12FDEW2
- Vehicle Stopping Distance . . . . . 6.90 m downstream
  0.00 m right
- Test Article Damage . . . . . Extensive
- Maximum Deflections
  - Permanent Set . . . . . NA
  - Dynamic . . . . . NA

Figure 22. Summary of Test Results and Sequential Photographs, Test SSC-1

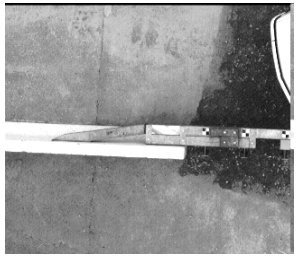


Figure 220.000 sec

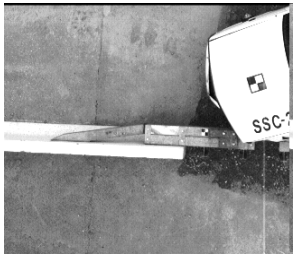


Figure 240.038 sec

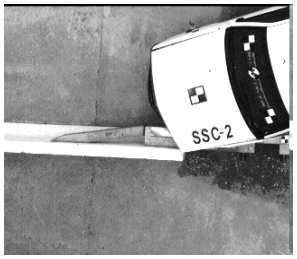


Figure 230.072 sec

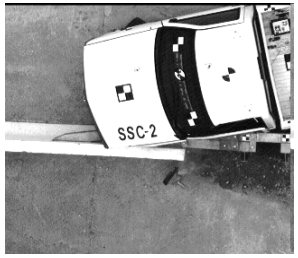


Figure 260.116 sec

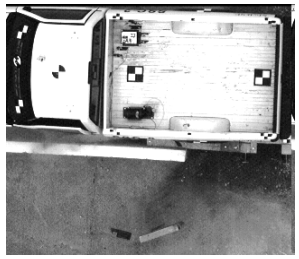
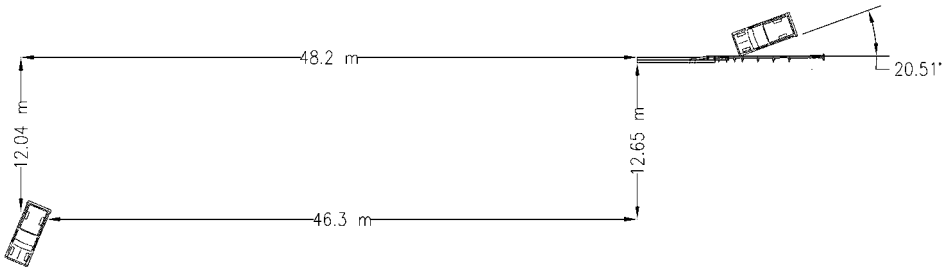


Figure 250.224 sec



- Test Number
  SSC-2 (3-38)
- Date 6/26/01
- Test Article
  - Type . . . . . BEAT-SSCC
  - Key Elements . . . . . Box-beam impact head
    8 steel breakaway posts
    3 sections of box-beam steel tube
    Post breaker attached to post no. 1
    Cable anchor system
    End section attachment to concrete barrier
  - Orientation . . . . . 2.0 meters upstream of concrete end at angle
- Soil Type . . . . . Grading B - AASHTO M 147-65 (1990)
- Vehicle Model . . . . . 1995 Chevy 2500 pickup truck
  - Curb . . . . . 1,961 kg
  - Test Inertial . . . . . 2,028 kg
  - Gross Static . . . . . 2,028 kg
- Vehicle Speed
  - Impact . . . . . 97.31 km/hr
  - Exit . . . . . NA
- Vehicle Angle
  - Impact . . . . . 20.51 deg
  - Exit . . . . . NA
- Vehicle Stability . . . . . Satisfactory
- Occupant Ridedown Deceleration (10 msec avg.)
  - Longitudinal . . . . . 5.94 g's
  - Lateral . . . . . 11.33 g's
- Occupant Impact Velocity
  - Longitudinal . . . . . 4.91 m/s
  - Lateral . . . . . 6.35 m/s
- Vehicle Damage . . . . . Moderate
  - TAD[10] 11-FL-5
  - SAE[11] 11LYEW2
- Vehicle Stopping Distance . . . . . 54.1 m downstream
  12.04 m left
- Test Article Damage . . . . . Minor
- Maximum Deflections
  - Permanent Set . . . . . 0.069 m
  - Dynamic . . . . . 0.069 m

Figure 29. Summary of Test Results and Sequential Photographs, Test SSC-2

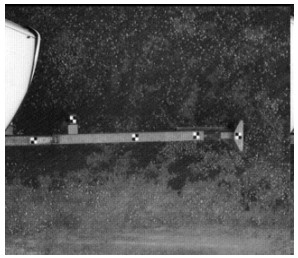


Figure 290.054 sec

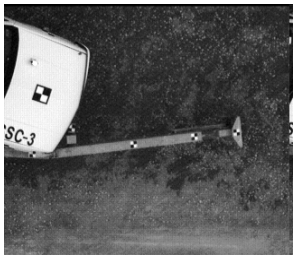


Figure 300.086 sec

Figure 310.160 sec

Figure 330.198 sec

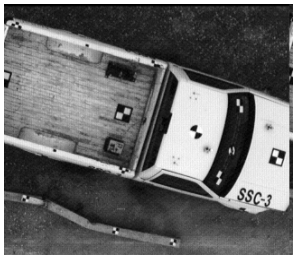
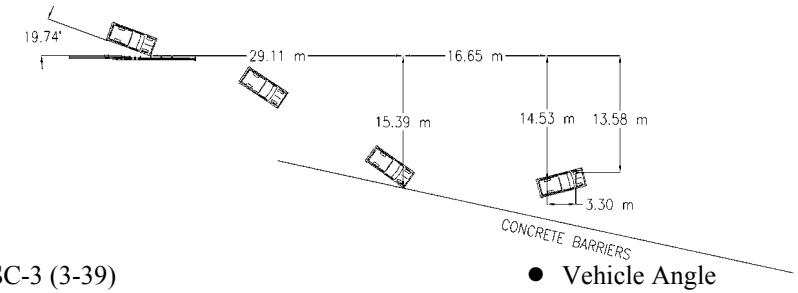


Figure 320.246 sec



- Test Number SSC-3 (3-39)
- Date 7/12/01
- Test Article
  - Type . . . . . BEAT-SSCC
  - Key Elements . . . . . Box-beam impact head
    8 steel breakaway posts
    3 sections of box-beam steel tube
    Post breaker attached to post no. 1
    Cable anchor system
    End section attachment to concrete barrier
  - Orientation . . . . . Reverse impact on midpoint of system at angle
- Soil Type . . . . . Grading B - AASHTO M 147-65 (1990)
- Vehicle Model . . . . . 1995 GMC C2500 pickup truck
  - Curb . . . . . 1,989 kg
  - Test Inertial . . . . . 2,018 kg
  - Gross Static . . . . . 2,018 kg
- Vehicle Speed
  - Impact . . . . . 97.95 km/hr
  - Exit . . . . . NA
- Vehicle Angle
  - Impact . . . . . 19.74 deg
  - Exit . . . . . NA
- Vehicle Stability . . . . . Satisfactory
- Occupant Ridedown Deceleration (10 msec avg.)
  - Longitudinal . . . . . 1.96 g's
  - Lateral . . . . . 0.99 g's
- Occupant Impact Velocity
  - Longitudinal . . . . . 5.29 m/s
  - Lateral . . . . . 1.48 m/s
- Vehicle Damage . . . . . Moderate
  - TAD[10] 1-FR-4
  - SAE[11] 01FZEW4
- Vehicle Stopping Distance . . . . . 50.9 m downstream
  13.6 m right
- Test Article Damage . . . . . Extensive
- Maximum Deflections
  - Permanent Set . . . . . NA
  - Dynamic . . . . . NA

Figure 37. Summary of Test Results and Sequential Photographs, Test SSC-3

Figure 370.000 sec

Figure 400.068 sec

Figure 390.104 sec

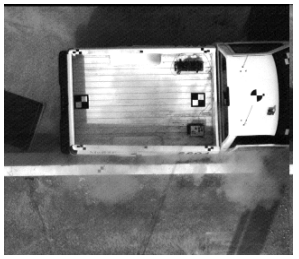


Figure 410.172 sec

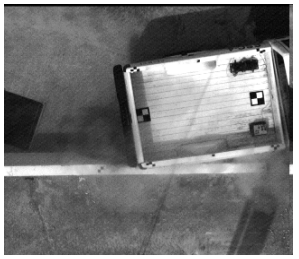
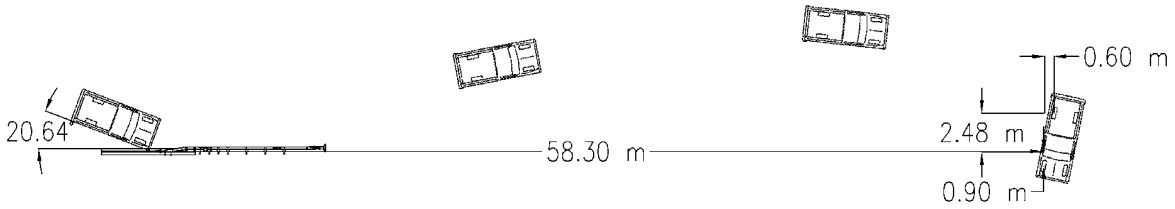


Figure 380.220 sec



- Test Number SSC-4 (3-39M)
- Date 7/18/01
- Test Article
  - Type . . . . . BEAT-SSCC
  - Key Elements . . . . . Box-beam impact head
    8 steel breakaway posts
    3 sections of box-beam steel tube
    Post breaker attached to post no. 1
    Cable anchor system
    End section attachment to concrete barrier
  - Orientation . . . . . Reverse impact on end connection
- Soil Type . . . . . Grading B - AASHTO M 147-65 (1990)
- Vehicle Model . . . . . 1997 GMC C2500 pickup truck
  - Curb . . . . . 2,082 kg
  - Test Inertial . . . . . 2,035 kg
  - Gross Static . . . . . 2,035 kg
- Vehicle Speed
  - Impact . . . . . 99.49 km/hr
  - Exit . . . . . 69.96 km/hr
- Vehicle Angle
  - Impact . . . . . 20.64 deg
  - Exit . . . . . 12.50 deg
- Vehicle Stability . . . . . Satisfactory
- Occupant Ridedown Deceleration (10 msec avg.)
  - Longitudinal . . . . . 6.87 g's
  - Lateral (not required) . . . . . 14.55 g's
- Occupant Impact Velocity
  - Longitudinal . . . . . 5.97 m/s
  - Lateral (not required) . . . . . 8.25 m/s
- Vehicle Damage . . . . . Moderate
  - TAD[10] 1-FR-5
  - SAE[11] 01FZEW5
- Vehicle Stopping Distance . . . . . 58.30 m downstream
  0.90 m right
- Test Article Damage . . . . . Minimal
- Maximum Deflections
  - Permanent Set . . . . . NA
  - Dynamic . . . . . NA

Figure 45. Summary of Test Results and Sequential Photographs, Test SSC-4

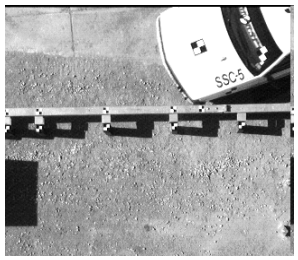


Figure 450.000 sec

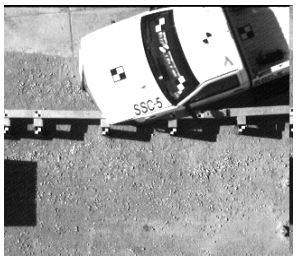


Figure 490.054 sec

Figure 460.112 sec

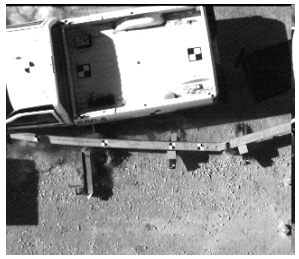
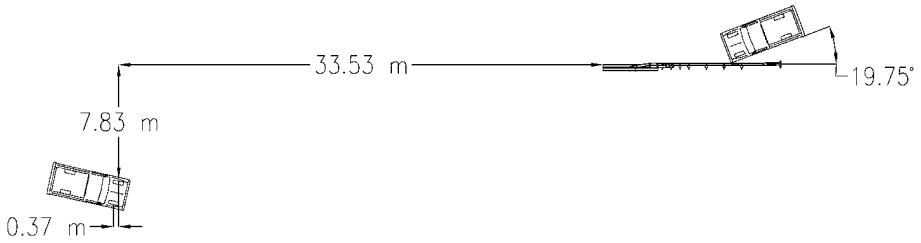


Figure 480.180 sec

Figure 470.240 sec



- Test Number
  SSC-5 (3-38 (2))
- Date 10/8/01
- Test Article
  - Type . . . . . BEAT-SSCC
  - Key Elements . . . . . Box-beam impact head
    8 steel breakaway posts
    3 sections of box-beam steel tube
    Post breaker attached to post no. 1
    Cable anchor system
    End section attachment to concrete barrier
  - Orientation . . . . . Reverse impact on end connection
- Soil Type . . . . . Grading B - AASHTO M 147-65 (1990)
- Vehicle Model . . . . . 1995 Chevy C2500 pickup truck
  - Curb . . . . . 1,997 kg
  - Test Inertial . . . . . 2,021 kg
  - Gross Static . . . . . 2,021 kg
- Vehicle Speed
  - Impact . . . . . 100.35 km/hr
  - Exit . . . . . 66.26 km/hr
- . . Vehicle Angle
  - Impact . . . . . 19.75 deg
  - Exit . . . . . NA
- Vehicle Stability . . . . . Satisfactory
- Occupant Ridedown Deceleration (10 msec avg.)
  - Longitudinal . . . . . -7.94/9.50 g's
  - Lateral (not required) . . . . . 12.21 g's
- Occupant Impact Velocity
  - Longitudinal . . . . . 3.87 m/s
  - Lateral (not required) . . . . . 5.35 m/s
- Vehicle Damage . . . . . Moderate
  - TAD[10] 11-FR-4
  - SAE[11] 11FZEW7
- Vehicle Stopping Distance . . . . . 42.41 m downstream
  7.83 m left
- Test Article Damage . . . . . Extensive
- Maximum Deflections
  - Permanent Set . . . . . NA
  - Dynamic . . . . . 0.75 m

Figure 52. Summary of Test Results and Sequential Photographs, Test SSC-5