March 30, 2004

Refer to: HSA-10/B-126

Ronald K. Faller, Ph.D., P.E.
Research Assistant Professor
Midwest Roadside Safety Facility-UNL
527 Nebraska Hall
Lincoln, Nebraska 68588-0529

Dear Dr. Faller:

In your February 24, 2004 letter to Mr. A. George Ostensen, you provided information on the design and crash testing recently done on Nebraska Department of Roads' Open Concrete Bridge Rail and requested formal acceptance of this design for use on National Highway System (NHS). This bridge rail is a concrete post and beam design. Support posts are 11-inches wide and 24-inches long, spaced on 8-foot centers. The reinforced concrete beam is 16-inches high, 14-inches deep and has a top height of 29 inches. The clear distance beneath the beam is 13 inches. The offset from the traffic face of the beam to the face of each post is 2 inches.

Staff review of your request and its supporting documentation revealed that this bridge railing has been previously accepted as a National Cooperative Highway Research Program (NCHRP) Report 350 test level 4 (TL-4) bridge railing and is listed on the Federal Highway Administration's safety hardware website under the Bridge Railing category (Appendix B7, page 14 of 15 under the sub-heading Vertical Concrete Parapet – Open or Closed/General). This earlier acceptance was based on test and evaluation criteria contained in NCHRP Report 230 and in the 1989 AASHTO Guide Specifications for Bridge Railings, and the railing was assigned an NCHRP Report 350 "equivalency" test level 4 (TL-4). The test documented in your January 21, 2004 report entitled "Safety Performance Evaluation of the Nebraska Open Bridge Rail on an Inverted Tee Bridge Deck" verified acceptable impact performance with the NCHRP Report 350 2000P truck impacting at a nominal speed of 100 km/h and a 25-degree impact angle. Enclosure 1 is the test summary page from that report. Although the bridge rail itself was identical to the previously tested rail, the bridge deck design and rail attachment details differed from the original tests in which the concrete post and beam bridge rail was constructed on a 200-mm thick deck with the vertical steel tied to two layers of deck reinforcing. For the latest test, the rail was constructed on a 150-mm thick inverted Tee section with only one layer of reinforcing steel. A cross section of this design is shown in Enclosure 2.

Based on the results of your recent test, the NDOR Open Concrete Bridge Rail is reconfirmed as a TL-4 design and may be used on the NHS (with either deck design) when such use is acceptable to the contracting authority. Although your test was successful, damage done to the

wheel and front suspension of the pickup truck and scrub marks on the support post in the impact area indicate a potential snagging problem. The Texas T202 bridge rail, a similar concrete post and beam design with a 2-inch lower height, a 2-inch shallower beam, and a 1.5-inch offset from the beam face to the post face was tested unsuccessfully at the Texas Transportation Institute. When the offset dimension was increased to 4.5 inches, acceptable crash performance resulted. To reduce the potential for wheel snagging, you may wish to consider increasing the rail-to-post offset dimension in the NDOR design and/or using trapezoidal-shaped rather than rectangular posts to offset the leading edges of these posts further away from traffic.

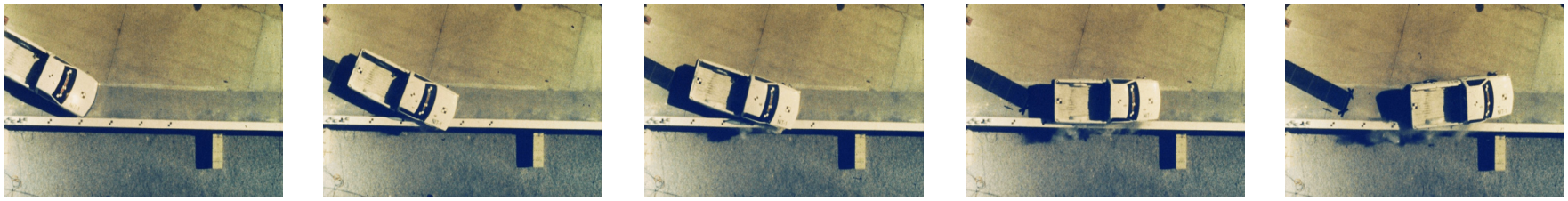
Sincerely yours,

/***Original Signed By R. Powers***/

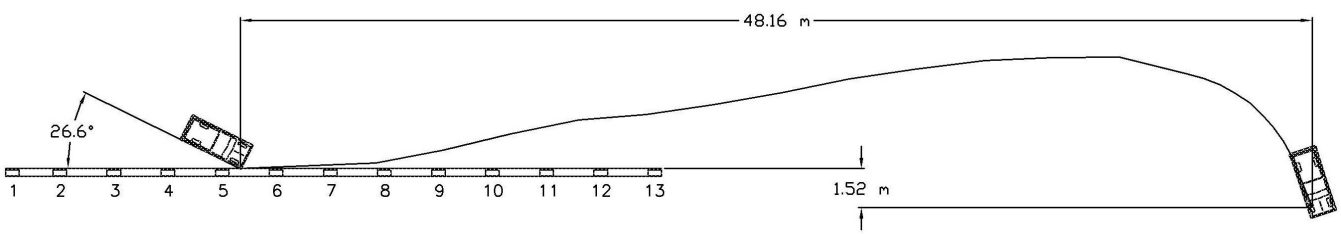
for:

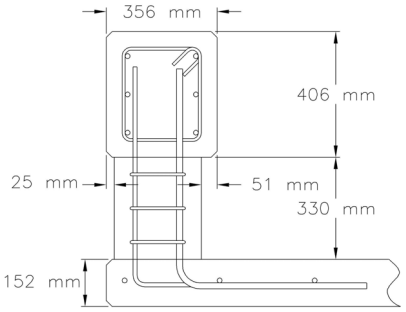
John R. Baxter, P.E.
Director, Office of Safety Design
Office of Safety

2 Enclosures



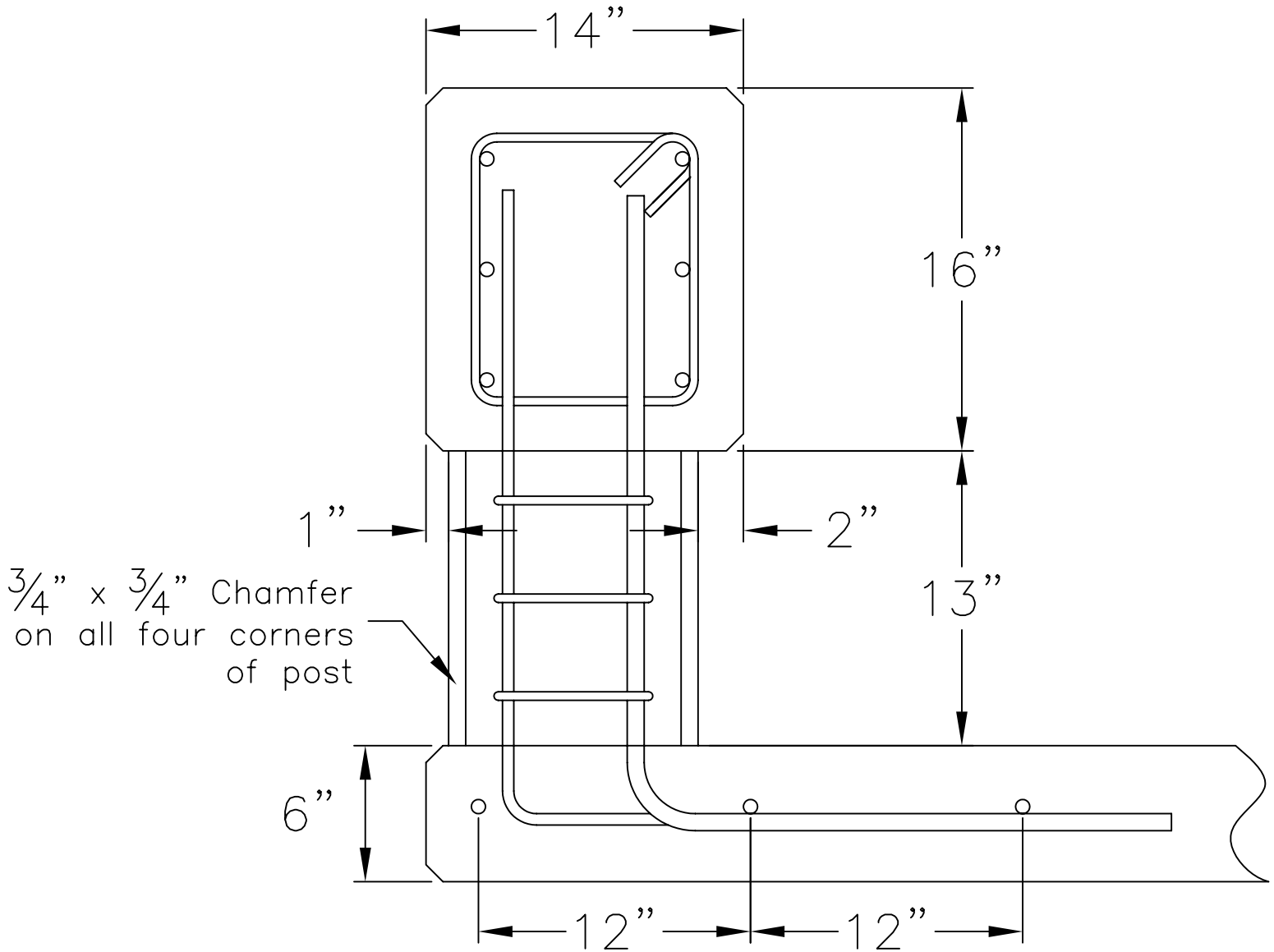
0.000 sec | 0.079 sec | 0.126 sec | 0.221 sec | 0.308 sec

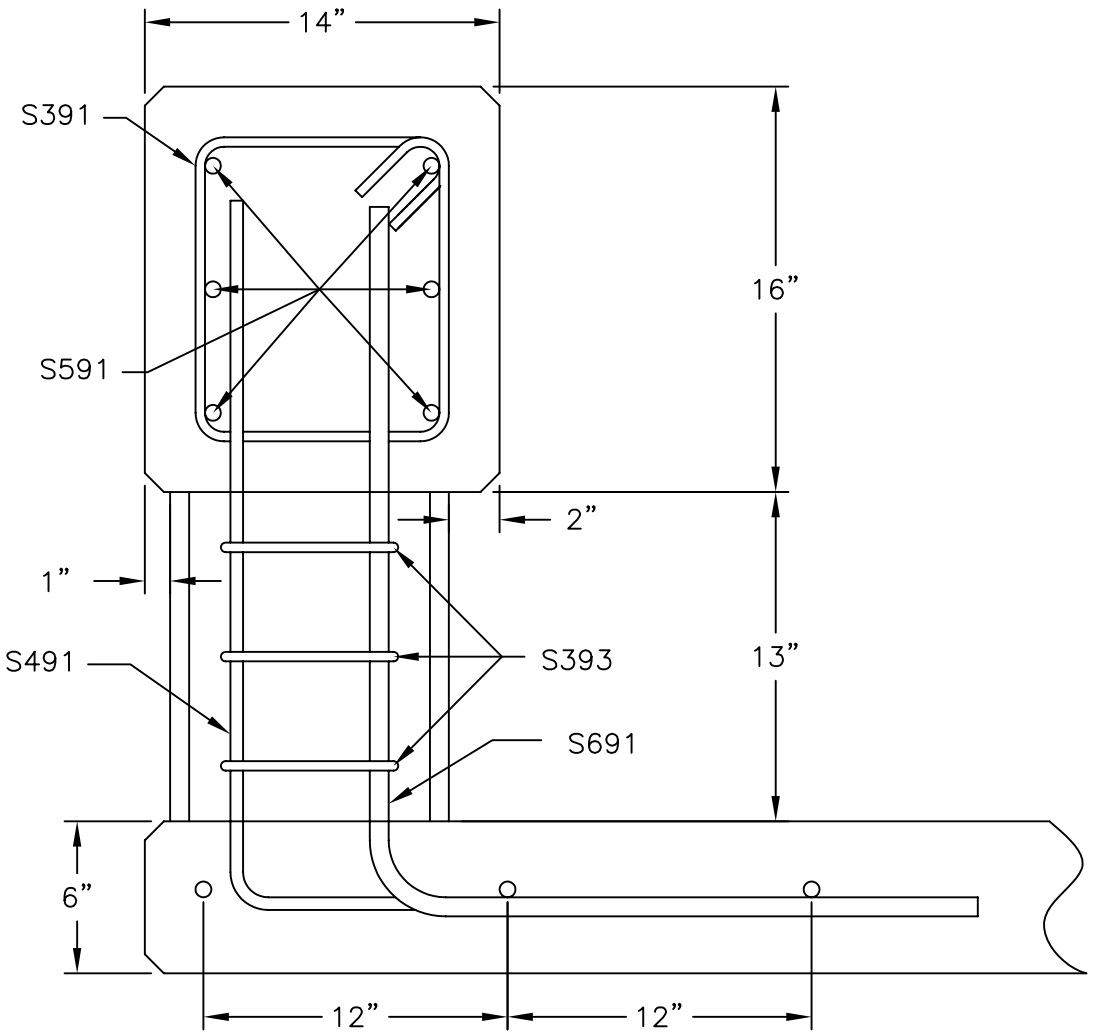




- Test Number NIT-1
- Date 3/20/02
- Appurtenance . . . . . Nebraska's Open Concrete Bridge Rail Attached to an Inverted Tee Bridge Deck System
- Total Length . . . . . 31.95 m
- Concrete Material . . . . . Nebraska 47-BD Mix
- Reinforcing Steel Material . . . . Grade 60 Rebar - Epoxy Coated
- Concrete Bridge Rail
  - Length . . . . . 29.57 m
  - Width . . . . . 356 mm
  - Depth . . . . . 406 mm
  - Top Mounting Height . . . . 737 mm
- Concrete Bridge Posts
  - Length . . . . . 610 mm
  - Width . . . . . 279 mm
  - Height . . . . . 330 mm
  - Spacing . . . . . 2,438 mm
- Concrete Bridge Deck
  - Length . . . . . 31.95 m
  - Width . . . . . 1,829 mm
  - Thickness . . . . . 152 mm
- Vehicle Model . . . . . 1995 GMC 2500 ¾-ton pickup
  - Curb . . . . . 1,963 kg
  - Test Inertial . . . . . 2,016 kg
  - Gross Static . . . . . 2,016 kg
- Vehicle Speed
  - Impact . . . . . 99.8 km/hr
  - Exit . . . . . 80.0 km/hr
- Vehicle Angle
  - Impact . . . . . 26.6 deg
  - Exit . . . . . est. 13-15 deg
- Vehicle Snagging . . . . . None
- Vehicle Pocketing . . . . . None
- Vehicle Stability . . . . . Satisfactory
- Occupant Ridedown Deceleration (10 msec avg.)
  - Longitudinal . . . . . 6.29 G's < 20 G's
  - Lateral (not required) . . . . . 7.75 G's
- Occupant Impact Velocity
  - Longitudinal . . . . . 6.60 m/s < 12 m/s
  - Lateral (not required) . . . . . 7.75 m/s
- Vehicle Damage . . . . . Moderate
  - TAD[9] 1-RFQ-4
  - SAE[10] 1-RFEW4
- Vehicle Stopping Distance . . . . . 48.16 m downstream 1.52 m laterally behind
- Barrier Damage . . . . . Moderate
- Maximum Rail Deflections
  - Permanent Set . . . . . NA
  - Dynamic . . . . . 22 mm
- Working Width . . . . . 587 mm

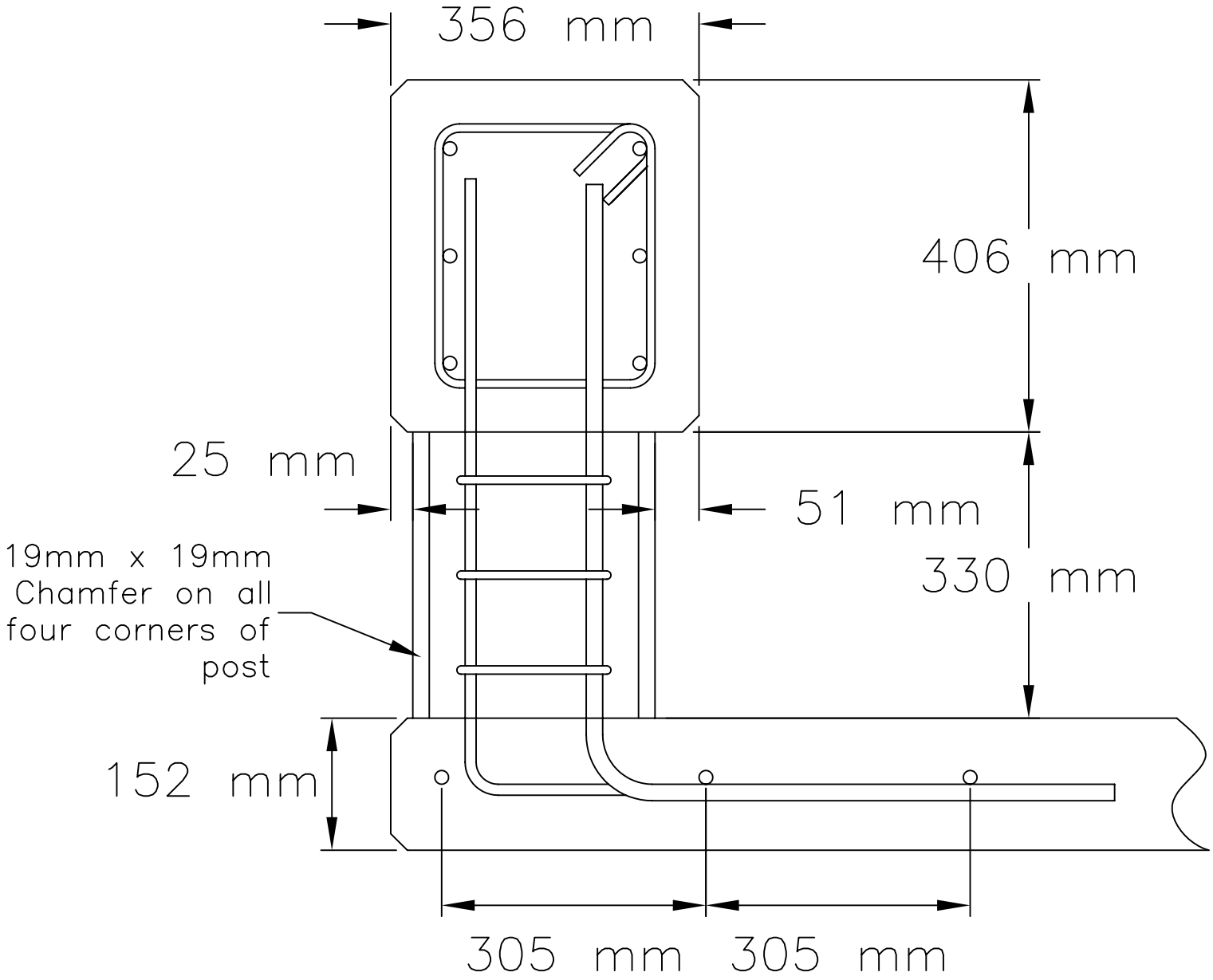
Figure 20. Summary of Test Results and Sequential Photographs, Test NIT-1

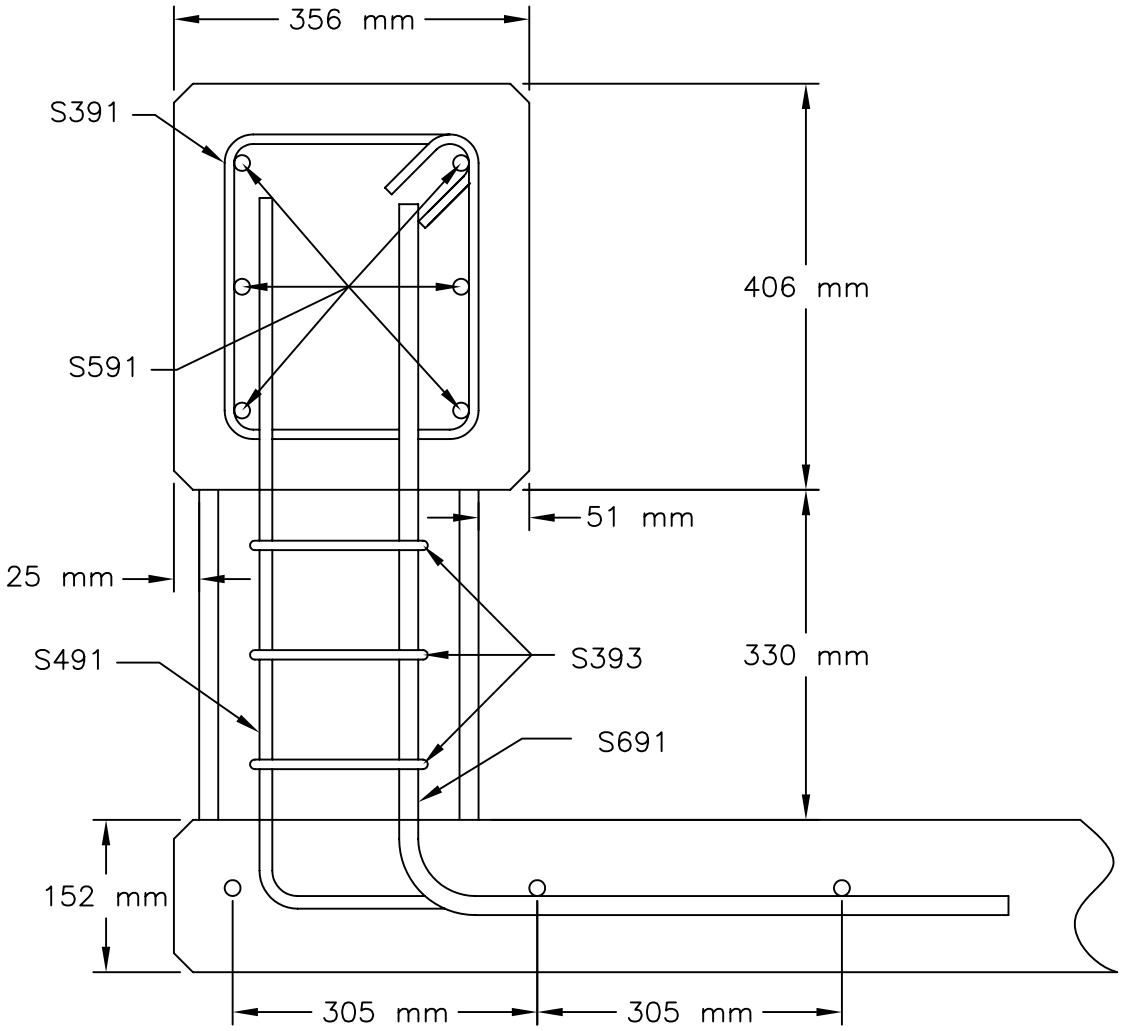

14”
16”
1”
2”
13”
¾” x ¾” Chamfer
on all four corners
of post
6”
12”
12”



NOTES:

(1) USE GRADE 60 REINFORCING STEEL
(2) USE NEBRASKA 47–BD TYPE 3 CONCRETE MIX DESIGN WITH 4,500 PSI MINIMUM 28–DAY CONCRETE COMPRESSIVE STRENGTH
(3) USE 24 IN. MINIMUM BAR LAP FOR ALL LONGITUDINAL AND TRANSVERSE BARS
(4) USE 2 IN. CONCRETE COVER FOR ALL CONSTRUCTION
(5) ALL CHAMFERS ARE ¾” X ¾”


356 mm
406 mm
25 mm
51 mm
330 mm
19mm x 19mm
Chamfer on all
four corners of
post
152 mm
305 mm
305 mm



NOTES:

(1) USE GRADE 60 REINFORCING STEEL
(2) USE NEBRASKA 47–BD TYPE 3 CONCRETE MIX DESIGN WITH 31.03 MPA MINIMUM 28–DAY CONCRETE COMPRESSIVE STRENGTH
(3) USE 610 MM MINIMUM BAR LAP FOR ALL LONGITUDINAL AND TRANSVERSE BARS
(4) USE 51 MM CONCRETE COVER FOR ALL CONSTRUCTION
(5) ALL CHAMFERS ARE 19MM X 19MM