U.S. Department
of Transportation
Federal Highway Administration

400 Seventh St., S.W.
Washington, D.C. 20590

JUN 29 1990

Refer to: HNG-14

Dennis H. O'Brien, P.E.
Manager, Product Planning
Industrial & Construction Products Division
Valmont Industries, Inc.
Valley, Nebraska 68064

Dear Mr. O'Brien:

By your September 16 and 22, 1988, letters to Mr. Thomas 0. Willett, Director, of Office of Engineering, you requested Federal Highway Administration (FHWA) acceptance of steel breakaway slip-base luminaire supports for use on Federal-aid highway projects. As you know, considerable effort has gone into evaluating steel slip-base luminaire supports since you made your request. Your cooperation and assistance in that effort is much appreciated. Enclosure I summarizes the tests FHWA has evaluated in reaching a decision on the breakaway acceptability of steel slip-base luminaire supports.

In each of the tests shown in the summary the geometry of the slip-base was nominally the same as California Department of Transportation's (Caltrans) Type 31 base, which is shown on Enclosure II, except that in one series of tests the keeper plate thickness was reduced to 0.0149 inches (28 gage). The pole base plate in the type 31 base Is 1 inch thick, the lower slip plate is 1 1/4 inches thick, and the anchor plate is 1 inch thick. We would also point out that in all tests two of the slip-base clamp bolts lay in a line parallel to the direction of traffic and were on the street side of the pole.

from the summarization of tests it can be seen that there is considerable scatter in the results and that in some tests FHWA's maximum 16-foot-per-second breakaway change in velocity requirement was exceeded and in some instances the test device was actually stopped. Because of the apparently unpredictable nature of the slip-base the testing effort was extended and a theoretical analysis of the slip-base release mechanism was undertaken. As a result of this work we are now confident that safe slip-base luminaire supports can be configured that will be within substantial compliance with FHWA's breakaway requirements. Thus, steel slip-base luminaire supports will be acceptable for use on Federal-aid highways if proposed by a State highway agency provided they fall within the limitations setforth below:

Basic Type: Triangular, three-bolt base similar to Caltrans' Type 30 and 31 bases (see Enclosure II).

Minimum Shaft Wall Thickness: 0.1196 inches for diameters up to 10 inches.

Bolt Circle Diameter: 14 inches (minimum).

Base Plate Thickness: 1 inch (minimum), 1 1/4 inches (maximum).

Lower Slip Plate Thickness: 1 1/4 inches (minimum), 1 1/2 inches (maximum).

Anchor Plate Thickness: 1 1/4 inches (maximum).

Steel Keeper Plate Thickness: 0.0149 inches before coating (28 gage) (maximum).

Height Top of Lower Slip Plate from Ground Line: 4 inches (maximum).

Clamp Bolt Type: Galvanized ASTM A325 with dry lubricant (Heads and nuts shall have heavy hex dimensions).

Clamp Bolt Size: 7/8-inch to 1 1/4-inch diameter.

Rectangular Clamp Bolt Washer Size: Length, width, and thickness shall be sufficient to prevent significant deflection (bending) when clamp bolt is loaded to its tensile capacity.

Hole in Clamp Bolt Rectangular Washer: Camp bolt diameter plus 1/16 inch, with edges chamfered to prevent binding with radius under bolt head.

Clamp Bolt Tension: 8,000 pounds per bolt (maximum). In the absence of a more exact method of determining bolt tension the following maximum tightening torques shall be used:

Bolt diameter (inches)	7/8	1	1 1/8	1 1/4
Torque (foot-pounds)	87	95	104	111

Finish: All faying surfaces to be galvanized, free of paint, and smooth and free of ridges, scallops, nicks, and burrs.

Mounting Height: 56 feet, 6 inches measured from bottom of pole base plate to centerline of luminaire mounting tenon (maximum).

Weight: 1,000 pounds (include luminaire, mast arm(s), pole, and base plate) (maximum).

Mast Arm Orientation: Mast arm may be parallel to a flat side of the base provided that side faces approach traffic or may pass over a clamp bolt (see Enclosure III.)

Placement: The terrain about the pole base shall not inhibit translation of the pole and approach topography shall be such that a vehicle leaving the roadway at design speed and an angle of up to 25 degrees will not strike the pole at a height greater than were the pole located at the edge of the pavement. (The approach terrain will not cause an errant vehicle to become airborne.)

While the restrictions listed here are rather extensive and in some instances differ from some current practices, for example the clamp bolt tension, keeper plate thickness, and mast arm orientation prescribed differ from those in the Caltrans standard, one should not infer FHWA is apprehensive about the use of slip-base luminaire supports. It is just that our extensive study of these structures has given us an insight that leads us to believe they will work best and the public will be best served by adhering to the guidance we have outlined.

Sincerely yours,

L. A. Staron

L. A. Staron
Chief, Federal-Aid and Design Division

Enclosures

Geometric and Roadside Design acceptance letter number LS-16.

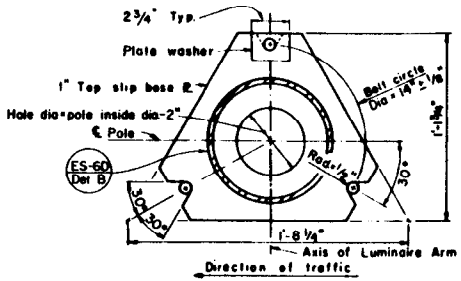
Agency Test No. Date	Mastarm(s) Length (ft) Weight (#)	Shaft Length (ft) Weight (#)	Mounting Height (ft) Total Weight (#)	Pole Diam. at base (in) Wall Thick. at base (in)	Slip Base Bolt Circle Diameter (in)	Clamp Bolt Diameter (in)	Est. Clamp Bolt Force 3 @ (lbs) ea	Keeper Plate Thickness (in)	Impact Angle from Roadway (degrees)	Test Veh. Type and Weight (lbs)	Impact speed (m.p.h.)	Occupant Change in Velocity (f.p.s.)
CALTRANS	CALIFORNIA TYPE 31 SLIP BASE											
404 JUL 26, 84	20 189	35 627	37 883	10.875 0.1793	14	1	11,400	0.0359	30	'79 HONDA 1865	19.9	8.5
405 MAY 23, 85	20 189	35 627	37 883	10.875 0.1793	14	1	11,200	0.0359	30	'79 HONDA 1885	53.9	12.4
406 MAY 8,'87	20 132	35 *	39.25 627.4	10 0.25 *	14	1	18,600	0.0359	30	'79 HONDA 1850	58.8	13.0
407 JUNE 23,'87	20 132	35 *	39.25 639.4	10 0.25 *	14	1	12,200	0.0359	30	'79 HONDA 1840	23.7	8.6
CAPABILITY TESTS - FOIL	VALMONT SLIP BASE											
87F033 MAR 12,'87	1.33 AND 16 115 AND 112	48.5 630	55.5 964	10 0.1793	14	1	12,500	0.0359	0	FOIL BOGIE 1850	19.8	14.5
87F034 MAR 13,'87	1.33 AND 16 115 AND 112	48.5 630	55.5 964	10 0.1793	14	1	12,500	0.0359	0	FOIL BOGIE 1850	58.7	15.5
THIN WALL TESTS - FOIL												
89F023 SEP 21,'89	1.33 AND 15 120 AND 107	46.5833 415	53.42 744	10 0.1196	14	1	12,500	0.0359	0	FOIL BOGIE 1850	20.7	24.4
89F024 SEP 27,'89	1.33 AND 15 120 AND 107	46.5833 415	53.42 744	10 0.1196	14	1	12,500	0.0359	0	'79 RABBIT 1850	19.8	15.8
89F025 OCT 5,'89	1.33 AND 15 120 AND 107	46.5833 415	53.42 744	10 0.1196	14	1	12,500	0.0359	0	'79 RABBIT 1850	59.2	13.2
89F026 OCT 24,'89	1.33 AND 15 120 AND 107	46.5833 415	53.42 744	10 0.1196	14	1	12,500	0.0359	0	FOIL BOGIE 1850	60.6	13.7

Agency Test No. Date	Mastarm(s) Length (ft) Weight (#)	Shaft Length (ft) Weight (#)	Mounting Height (ft) Total Weight (#)	Pole Diam. at base (in) Wall Thick. at base (in)	Slip Base Bolt Circle Diameter (in)	Clamp Bolt Diameter (in)	Est. Clamp Bolt Force 3 @ (lbs) ea	Keeper Plate Thickness (in)	Impact Angle from Roadway (degrees)	Test Veh. Type and Weight (lbs)	Impact speed (m.p.h.)	Occupant Change in Velocity (f.p.s.)
CLAMP FORCE STUDY - FOIL												
89F005 APR 12,'89	None	30.25 275	None 275	7.5 0.1345	14	1	1,965	0.0359	0	FOIL BOGIE 1850	20.6	6.5
89F006 APR 19,'89	"	" "	" "	" "	"	"	3,928	"	0	" "	20.7	5.9
89F007 APR 20,'89	"	" "	" "	" "	"	"	5,891	"	0	" "	20.7	8.3
89F008 APR 24,'89	"	" "	" "	" "	"	"	7,614	"	0	" "	20.5	6.4
89F009 APR 25,'89	"	" "	" "	" "	"	"	9,817	"	0	" "	20.8	23.2
89F010 APR 26,'89	"	" "	" "	" "	"	"	11,780	"	0	" "	20.7	20.6
89F011 APR 26,'89	"	" "	" "	" "	"	"	9,817	"	0	" "	20.5	7.7
89F012 APR 27,'89	"	" "	" "	" "	"	"	11,780	"	0	" "	20.6	36.9 **
89F014 MAY 19,'89	"	" "	" "	" "	"	"	13,743	"	0	" "	20.4	22.7
89F015 MAY 24,'89	"	" "	" "	" "	"	"	7,614	"	0	" "	20.5	14.8
89F016 MAY 25,'89	"	" "	" "	" "	"	"	15,808	"	0	" "	20.4	18.2
89F017 MAY 31,'89	"	" "	" "	" "	"	"	5,891	"	0	" "	20.6	21.4

* A 2-foot high steel tube with 0.25 in. wall thickness was welded to the bottom of a 33 foot tall pole which had a wall thickness of 0.1196 in.

Agency Test No. Date	Mastarm(s) Length (ft) Weight (#)	Shaft Length (ft) Weight (#)	Mounting Height (ft) Total Weight (#)	Pole Diam. at base (in) Wall Thick. at base (in)	Slip Base Bolt Circle Diameter (in)	Clamp Bolt Diameter (in)	Est. Clamp Bolt Force 3 @ (lbs) ea	Keeper Plate Thickness (in)	Impact Angle from Roadway (degrees)	Test Veh. Type and Weight (lbs)	Impact speed (m.p.h.)	Occupant Change in Velocity (f.p.s.)
KEEPER PLATE STUDY - FOIL												
90P023 4/24/90	None None	30.83 486	None 486	10.0 0.1793	14	1	12,500	0.0359	0	FOIL PNDLM 1850	19.9	25.9
90P024 4/25/90	" "	" "	" "	" "	"	"	"	NONE	"	" "	19.8	8.8
90P025 4/25/90	" "	" "	" "	" "	"	"	"	NONE	"	" "	19.8	13.2
90P026 4/26/90	" "	" "	" "	" "	"	"	"	NONE	"	" "	19.9	11.1
90P027 4/26/90	" "	" "	" "	" "	"	"	"	0.0149	"	" "	20	16.9
90P028 5/1/90	" "	" "	" "	" "	"	"	"	0.0149	"	" "	19.8	35 **
90P029 5/2/90	" "	" "	" "	" "	"	"	3,600	0.0149	"	" "	20	5.6
90P032 5/30/90	" "	" "	" "	" "	"	"	3,600	0.0149	"	" "	20	7
90P033 5/31/90	" "	" "	" "	" "	"	"	3,600	0.1049	"	" "	20	6.4
90P034 5/31/90	" "	" "	" "	" "	"	"	9,000	0.0149	"	" "	20	11.8
90P035 6/05/90	" "	" "	" "	" "	"	"	9,000	0.0149	"	" "	20	35.4 **
90P036 6/06/90	" "	" "	" "	" "	"	"	8,000	0.0149	"	" "	20	17.7

** Value includes rebound, thus exceeds impact speed.



PLAN - TYPICAL BASE PLATE

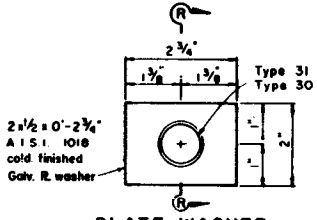
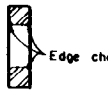
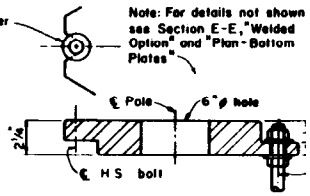


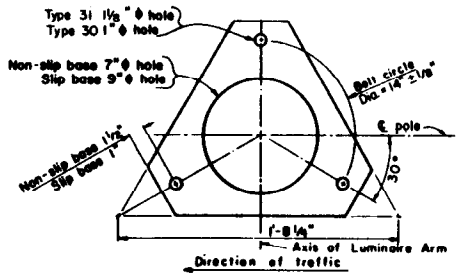
PLATE WASHER



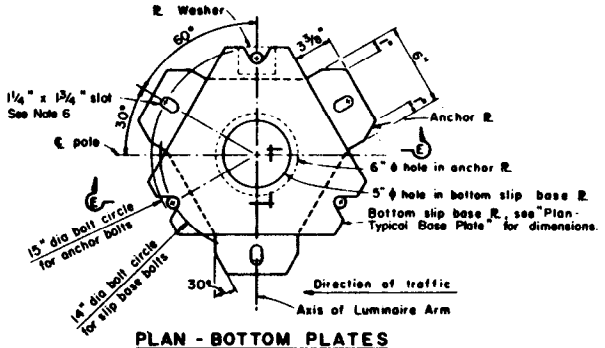
SECTION R-R



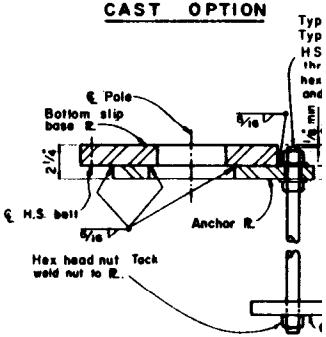
CAST OPTION



KEEPER PLATE



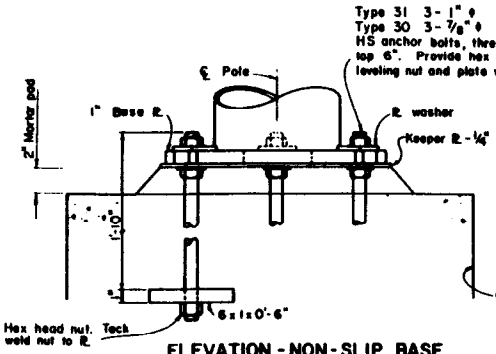
PLAN - BOTTOM PLATES



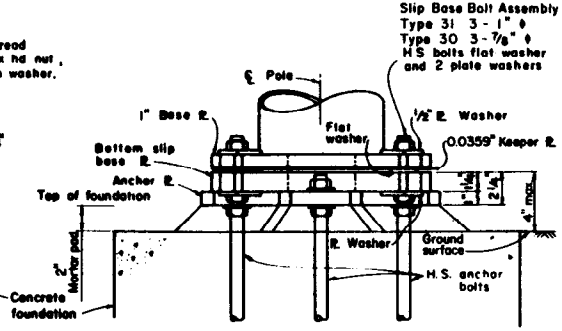
WELDED OPTION

SECTION E-E

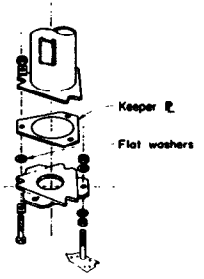
SLIP BASE PLATE DETAILS



ELEVATION - NON-SLIP BASE



ELEVATION - SLIP BASE

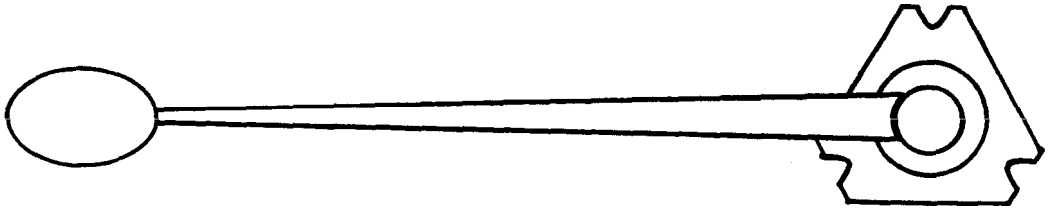


SLIP BASE INSERT DETAIL

Notes:

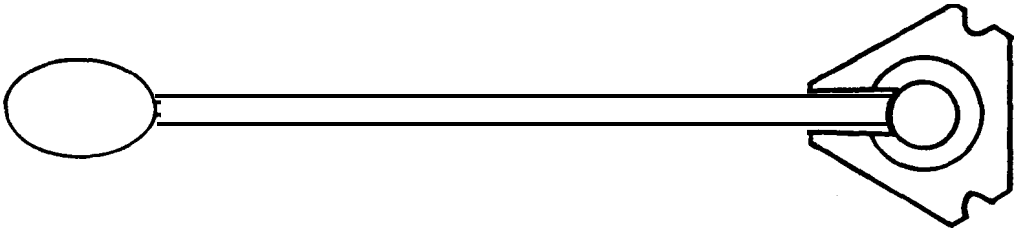
1. 1" & 7/8" HS requirement
2. A slip base provisions s
3. 7/8" ϕ ancho oversize wa Two washer one washer

Luminaire Slip Base Orientation



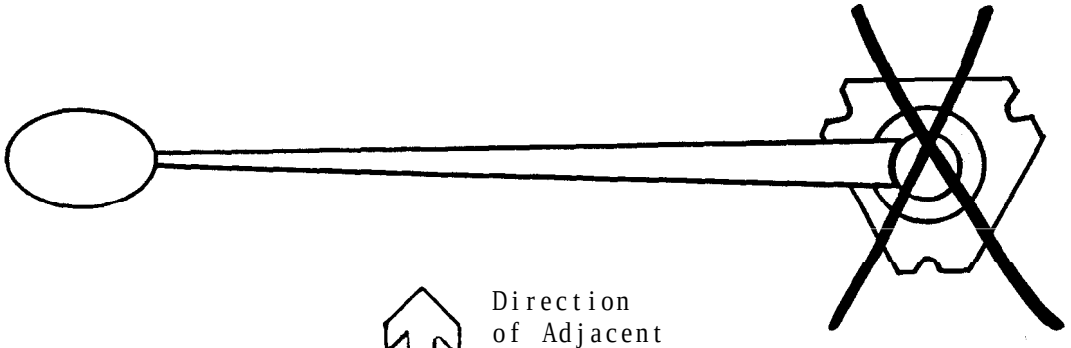
Best Breakaway Performance
Acceptable

Direction of Adjacent Traffic



Best Compromise to avoid undesirable orientation
Acceptable

Direction of Adjacent Traffic



Worst Breakaway Performance
Not Recommended

Direction of Adjacent Traffic

L5-16, Addendum

Memorandum

U.S. Department
of Transportation
Federal Highway
Administration

Washington, D.C. 20590

Subject: Slip-Base Luminaire Supports

Date: JAN 28 1991

From: Chief, Federal-Aid and Design Division

Reply to Attn. of: HNG-14

To: Regional Federal Highway Administrators
Federal Lands Highway Program Administrator

Our July 6, 1990, memorandum "Breakaway Sign and Luminaire Supports," transmitted a sketch titled "Luminaire Slip-Base Orientation." This sketch illustrated three ways that the triangular slip-base could be welded to the pole with respect to orientation of the mast arm. These were shown in decreasing order of preference with respect to crashworthiness. We have had questions regarding the middle sketch, which showed an acceptable compromise situation where the far side of the triangular slip-base was parallel to traffic. Although our memorandum did not address the situation where the orientation of the triangular slip-base is such that the near side is parallel to traffic, it is an acceptable, though less desirable, compromise. A revised copy of that sketch is attached-to show that traffic may pass to either side of a slip-base where one face is parallel to the edge of the road.

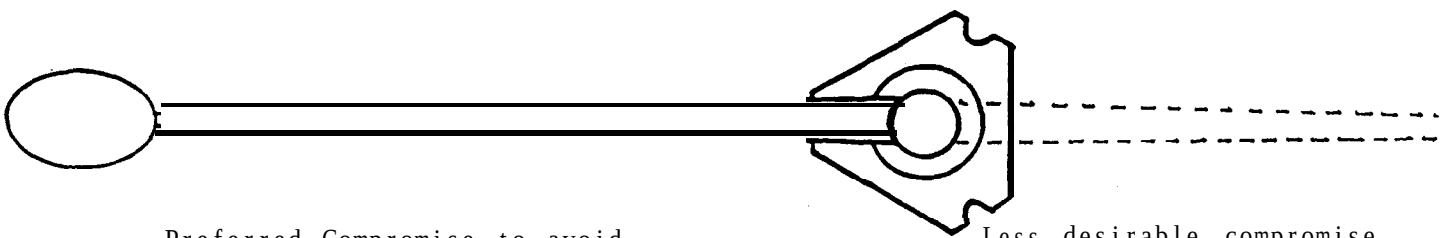
L. A. Staron

Attachment

Luminaire Slip Base Orientation

Best Breakaway
Performance,
Acceptable

Direction
of Adjacent
Traffic

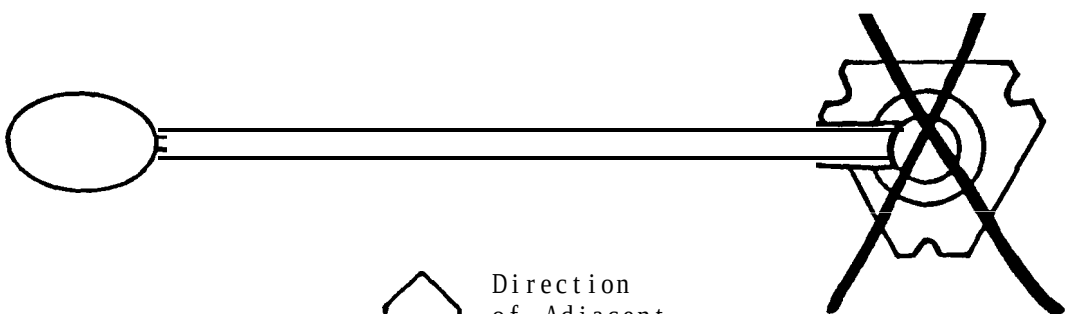


Preferred Compromise to avoid
Undesirable orientation, Acceptable

Less desirable compromise,
Acceptable

Location of
Adjacent Traffic

Location of
Adjacent Traffic



Worst Breakaway
Performance,
Not Recommended

Direction
of Adjacent
Traffic

U.S. Department
of Transportation
**Federal Highway
Administration**

400 Seventh St., S.W.
Washington, D.C. 20590

Refer to: HNG-14

SEP 30 1993

Dennis H. O'Brien, P.E.
Manager of Product Planning
Industrial & Construction Products Division
Valmont Industries, Inc.
Valley, Nebraska 68064-0358

Dear Mr. O'Brien:

Thank you for your letter of September 2 requesting clarification of acceptable mounting heights for breakaway luminaire supports. In general, dimensions such as mounting height, pole diameter and mass, bolt size and torque, should not exceed those of the tested hardware. We place these limitations in our hardware acceptance letters to assure that the hardware used in the field is no less forgiving of the errant motorist than the hardware used in the crash tests. In our memorandum of June 15, 1989, to the Federal Highway Regional Administrator in Portland, Oregon, where we discussed luminaire support recommendations, however, we stated:

> "... the advice is not nearly as forceful on the issue of height as it is on the need to limit weight. After considering the likely effect of a 60-foot pole in comparison to a 55-foot pole, we conclude there would be little difference for an impacting vehicle. Therefore, we would recommend allowing 60-foot mounting heights (base of pole to level of luminaire.) However, we also believe this should be considered an absolute maximum in the absence of further study and testing to investigate the effects of pole height and weight."

We still believe this to be sound advice, even under the 1985 American Association of State Highway and Transportation Officials breakaway criteria. Therefore, luminaire supports which are considered breakaway by way of our Geometric and Roadside Design Acceptance letters LS-16 and LS-25 dated June 29, 1990, and October 10, 1991, respectively may use a nominal mounting height of up to 18.3 m (60 feet) as requested in your letter.

You also wished to alert us to the need for increasing the pole wall thickness when the height is raised. This causes us some concern, as the crash tested hardware found acceptable by way of LS-25 weighed 409 kg (902 pounds) This approaches the 454 kg (1000-pound) maximum mass we have set for breakaway luminaire supports to control the risk to vehicle occupants from a pole's

falling on a vehicle's roof. We will not sanction pole plus mast arm plus luminaire masses in excess of 454 kg (1000 pounds) without automobile crash tests to confirm their acceptability.

Sincerely yours,

L. A. STARON

Lawrence A. Staron
Chief, Federal-Aid and Design Division

Supplement to Geometric and Roadside Design Acceptance Letters
LS-16 and LS-25