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ACRO METAL STAMPING COMPANY — ACRO BUILDING SYSTEMS COMPANY

Tests on a Roofing Guard Rail System QSV Roof Bracket with Post Model #12070

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Manufacturer of Precision Metal Stampings, Ferrous, Non-Ferrous and Plastic.
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SCOPE OF TEST PROGRAM

Load testing was performed to determine the capacity of a #12070 roof guardrail bracket. A series of load tests were conducted in 1996 as part of product development and culminated in a series of repeated tests on a final design.

TEST SPECIMENS

A production model of the #12070 roof bracket guard rail was used with the guard rail post. The bracket consisted of steel. The post consisted of 1 inch square steel tubing of 0.096 inches. Four complete bracket and post systems were tested in the final phase of testing after conducting 10 preliminary tests as part of product development.

TEST PROCEDURES

The bracket and post were positioned with the base of the bracket vertical and attached by 4 16d common nails into a vertical Hem-fir nominal 4 by 4 post with a specific gravity of 0.49 and a moisture content of 9%. The wood post was attached to the steel frame of the test setup. The steel guard rail post projected out and upward from the base bracket at an angle of approximately 45 degrees from the horizontal. The load was thus applied to the post parallel to the roof slope. The guard rail post was laterally braced by wood guides at 17 ½ inches horizontally from the base bracket allowing the post to displace only in the vertical direction. Load was applied by a hydraulic actuator within 3 inches of the top of the steel post and approximately 30 inches horizontally from the base. Load was applied gradually and monotonically such that the test lasted approximately 5 minutes. The capacity of the hydraulic actuator was 5,000 lbs with a 7 inch stroke. Data recorded included time, load and stroke. Data recording was accomplished with an electronic data acquisition system recording data approximately 4 times per second.

CERTIFICATION

Load and stroke capabilities of the test machine have been certified by a third party within the past 6 months according to ASTM Standard E4 and traceable to the National Institute of Standards and Technology.

TEST RESULTS

The maximum loads and stroke deformations for the four tests are shown below:

QSV #11 - 309 lbs at 4.6 inches of deformation
QSV #12 - 303 lbs at 6.1 inches of deformation
QSV #13 - 246 lbs at 5.1 inches of deformation
QSV #14 - 319 lbs at 7.1 inches of deformation

All test specimens easily exceeded 200 lbs. of applied load. The assemblies showed a tendency to absorb considerable energy and displayed a large amount of ductility before reaching their peak load. Full collapse of the bracket system never occurred during the 7 inch stroke capability of the hydraulic test system. Failure modes associated with peak load consisted of a combination of nail pull out of the roof base plate, elastic and potentially some inelastic bending of the roof base plate and inelastic bending of the post. It appeared that test QSV #13 reached its peak load early as a result of nail pull out, emphasizing the need for careful nailing into sound wood to obtain full capacity of the roof bracket system.

The loads recorded were established for one angle setting of the roof bracket corresponding to a roof pitch of approximately 45 degrees. The capacity of the bracket system will be influenced by the roof pitch. The weakest condition for the post corresponds to a flat roof where the angle between the roof bracket and the post is 90 degrees. In this case, it is estimated that the posts would sustain a load parallel to the roof and now perpendicular to the post of 70 percent of the peak loads shown above. However, as roof slope decreases, nail pull out is less likely to occur.