20 August 2014

Mr. Nico Corbo
Senior Engineer
MIDDLE ATLANTIC PRODUCTS
300 Fairfield Road
Fairfield, NJ 07004

Project 147518 Middle Atlantic Products, 2014 Seismic Testing

Re: Consolidated Seismic Capacities for Middle Atlantic Seismic Riser Bases (SRB)

Dear Mr. Corbo:

At your request, Simpson Gumpertz & Heger Inc. (SGH) has reviewed the results of previously conducted seismic tests for an assortment of Middle Atlantic Products (Middle Atlantic) Seismic Riser Bases (SRBs) and has consolidated the findings of the testing herein. In some cases, the capacities provided for older building construction code criteria have been updated in accordance with the 2005 and 2010 Editions of ASCE Standard 7 (ASCE 7-05 and ASCE 7-10, respectively).

The following test reports serve as a basis for this letter:

- Letter to Mr. Keith Carney, Middle Atlantic Products (Middle Atlantic). "Seismic Certification of the Middle Atlantic Products Seismic Riser Bases". Halcrow, Inc. Project No. DRMAP3. 3 May 2011.

- Letter to Mr. Nico Corbo, Middle Atlantic Products. "Observed Seismic Performance Testing of the SNE Series Single Bay Seismic Riser Bases (SRB)." Simpson Gumpertz & Heger Inc. Project No. 147518, 14 August 2014.

Background

The MRK, WRK, DRK, BGR, WMRK, and SNE Series SRBs are all of identical construction and geometry for the footprint and height ranges considered despite the pairing with different Middle Atlantic enclosure series. A number of these SRBs were tested statically supporting MRK, DRK, WMRK, or SNE Series rack enclosures to verify lateral seismic adequacy and their performance is documented in the reference reports. The exact sizes tested are shown in Table 1 based on the footprint width. Foot print depth is that of the enclosure series tested. Enclosure anchorage and the transfer of enclosure lateral loads to the bases are identical for all four enclosure series. Therefore, the testing results for specific bases associates with specific rack enclosure models are also more generally applicable for all Middle Atlantic SRBs for the purposes of defining available seismic capacity of these units.

Middle Atlantic seismic riser bases come in three basic configurations capable of supporting one, two, or three rack enclosures ganged together side-by-side. For each configuration, there are two individual models available corresponding to the height of the riser. One model is for riser heights between 14 in. and 24 in., and the other is for heights between 9 in. and 13.99 in. The bases selected for testing represent the extreme configurations or worst case conditions for the entire series from a seismic perspective. Specifically, the tallest riser bases with the largest (48 in.) and smallest (24 in.) footprint depths were selected for testing, supporting the tallest rack enclosures (with up to 48 rack spaces), although a few were tested with enclosures up to 55 spaces. Some intermediate sizes were also tested to confirm results for the bounding configurations. The anchorage details for all configurations and models are identical, regardless of height or type of riser supported. Therefore, the testing results are applicable for all bases bounded by these footprint dimensions. The matrix in Table 1 lists the exact model sizes that were tested for seismic adequacy.

Table 1
SRB (SEISMIC RISER BASE) SERIES MATRIX OF SEISMICALLY TESTED UNITS[1, 2, 3]

SRB Type	Footprint Depth					Riser Height
	24 in.	31 in.	36 in.	42 in.	48 in.	
SRB-1	MRK	-	MRK, WMRK, SNE24, SNE30	-	DRK, WMRK, SNE24, SNE30	≥ 9 in. & < 14 in.
	MRK	MRK	MRK, WMRK	DRK	MRK, DRK, WMRK	≥ 14 in. & ≤ 24 in.
SRB-2	-	-	-	-	DRK	≥ 9 in. & < 14 in.
	-	-	-	-	MRK, DRK	≥ 14 in. & ≤ 24 in.
SRB-3	MRK	-	MRK, WMRK	MRK	WMRK	≥ 9 in. & < 14 in.
	MRK	-	MRK, WMRK	MRK	MRK, WMRK	≥ 14 in. & ≤ 24 in.

[1] The tallest of each series represented the worst seismic load case for a given footprint (defined by the width and depth of the enclosure).
[2] Lateral test load based on enclosure weight, weight of contents, and test inclination. This is equivalent to code seismic base shear.
[3] The primary frame and anchorage is structurally identical for all enclosures listed.

Test Procedure

Each tested SRB was loaded with an appropriately matched and loaded MRK, DRK, WMRK, or SNE Series rack enclosure. The enclosures were loaded with rack-mounted weights, positioned such that 50% of their total weight was placed in the bottom third of the enclosure rack height, 25% in the middle third, and 25% in the top third. The enclosures were anchored to the riser base and the riser base was anchored to the test frame using the appropriate seismic anchorage kits. This loading arrangement is consistent with the seismic certification of the enclosure itself.

After anchorage, the test observer made initial observations and measurements of geometry. Then, the entire assembly was slowly tipped to a target angle to simulate lateral seismic loading. At maximum inclination, the test observer examined the riser and enclosure for any signs of distress or extreme deformations. The observer measured drift at the height of the riser and height of the enclosure. The assembly was then lowered back to its original at-rest position and both the riser and enclosure were again examined for signs of permanent deformation or distress. The observer again measured the units, in the lowered position, to estimate final drift. Each riser and enclosure assembly were tested first in the side-to-side direction, than rotated 90 degrees and tested for back-to-front loading. Detailed SRB test results are reported in the referenced letters.

The quantity of weight for each test was based on the riser bases' target content capacity rating, as noted Table 2, the self-weight of the enclosure and riser, as well as the seismic design force requirements for nonbuilding components as determined from the following building codes:

- 2005 Edition of ASCE Standard 7 (ASCE 7-05) which is the basis for the 2006 & 2009 International Building Codes (IBC), and 2007 & 2010 California Building Codes (CBC)

- 2010 Edition of ASCE Standard 7 (ASCE 7-10) which is the basis for the 2012 International Building Code (IBC) and 2013 California Building Code (CBC)

The seismic design force was determined using the largest mapped accelerations within the Continental US (as provided in ASCE 7-05 or ASCE 7-10, respectively), an assumed Site Class D condition, and assumed top floor or rooftop installations, where amplification of seismic shaking is greatest. The capacities were computed for High Importance installations and for Standard installations. The High Importance category applies to installations within or attached to Occupancy Category IV facilities as defined in the IBC, CBC, and ASCE 7; installations required to function for life-safety purposes after an earthquake; and components supporting any hazardous substances. Design for these High Importance installations use an importance factor (Ip) of 1.5. The Standard installation category includes all other installations and uses an importance factor of 1.0. This approach provides capacities that are generic in nature, covering all possible installations. As such, enclosures installed at sites with less seismicity or on lower floors may have content capacities greater than those provided.

Observations

The tested seismic riser bases and enclosure anchorage connections for all the units tested and listed in Table 1 were reported to have performed adequately under the lateral loading, remaining structurally sound throughout the test and functional for purpose after test completion. At maximum inclination, the tested riser bases did not show any obvious signs of structural distress. No visible permanent deformations were observed after completion of the tests. No difficulty was reported in the removal of the enclosures off any of the seismic riser bases following testing. However, evaluation of the operability of actual equipment installed on the racks supported by the riser bases is beyond the scope of these test programs and the responsibility of the end-user.

Table 2
SRB (Seismic Riser Base) Series Seismic Certified Content Capacity (pounds)[4, 5, 6]

Seismic Riser Base[1,2,3]	High-Importance Installations[7]		Standard Installations	
	ASCE 7-05 2006/09 IBC 2007/10 CBC	ASCE 7-10 2012 IBC 2013 CBC	ASCE 7-05 2006/09 IBC 2007/10 CBC	ASCE 7-10 2012 IBC 2013 CBC
SRB-1-XXX-YYZZ	1,010	9,40	1,530	1,425
SRB-2-XXX-YYZZ	1,760	1,635	2,670	2,485
SRB-3-XXX-YYZZ	2,420	2,250	3,680	3,425

[1] XXX - MRK, DRK, WRK, BGR, WMRK, or SNE Series rack enclosures

[2] YY – SRB depth in inches

[3] ZZ – SRB height in inches

[4] Capacities provided are for anchored MRK, DRK, WRK, BGR, WMRK, or SNE Series seismic riser bases (SRBs) supporting up to three rack enclosures with up to 48 rack spaces in height. Content capacity includes all weight installed atop the SRB, including enclosures contents and enclosure self-weight. SRB and enclosure must be anchored in accordance with Middle Atlantic recommendations. Selection and installation of SRB anchor bolts are the responsibility of the end user and are not addressed in this evaluation. In many cases, additional seismic capacity may be found by directly referencing the test reports for the specific SRB tested.

[5] Capacities provided are applicable for SRBs supporting rack enclosures with 50% of the enclosure contents are positioned in the bottom third of rack, 25% in the middle third, and 25% in the top third. The self-weight of the rack itself must also be considered.

[6] Capacities are based on worst case seismicity (S_{DS} = 1.90g for ASCE 7-05; S_{DS} = 2.04g for ASCE 7-10) and top floor or rooftop installation. Additional seismic capacity may be available based on a site-specific evaluation of the installation location.

[7] High Importance Installations include any installation where ASCE 7 defines a component importance factor (Ip) of 1.5; including (but not limited to) Occupancy Risk Category IV structures.

Conclusions

Based on the referenced test reports, we conclude that the MRK, WRK, DRK, BGR, WMRK, and SNE Series SRBs have sufficient seismic adequacy to support the enclosure weight capacities (enclosure self-weight plus contents weight) listed in Table 2 for the various building construction codes considered. These capacities are valid for enclosures up to 48 rack spaces in height.

Table 2 lists the minimum capacity of all tests documented in the referenced reports within each general riser base size (whether it supports 1, 2, or 3 enclosures). Additional capacity may be

found by specifically referencing the test reports for the specific enclosure series of interest or by conducting a site-specific evaluation considering site seismicity and installation location.

Please note that the observations and conclusions noted herein are applicable only to the SRBs referenced above supporting appropriate rack enclosures and anchored in accordance with Middle Atlantic's recommendations. Selection and installation of rack enclosure anchor bolts are the responsibility of the end-user and are not addressed in this evaluation. Any changes to the enclosure design, fabrication, materials, and anchorage may invalidate these observations and conclusions.

Please feel free to contact me directly (510-45-4449 or wmbruin@sgh.com) if you would like to discuss the contents of this letter report in further detail.

Sincerely,

8/20/2014

William M. Bruin, P.E.
Senior Principal
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