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Load Testing Results and Conclusions for Two Window Well Covers

By *Windows Well Covered – Custom Window Well Covers of*

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EXECUTIVE SUMMARY

Window well covers are widely used as a safety measure over egress window wells in residential construction. Window well covers are currently not required by the building code and have no established load testing requirements. The primary purpose of this report was to present the load testing results of two of the worst case window well cover configurations, as provided by *Windows Well Covered – Custom Window Well Covers*, while utilizing the existing building code load requirements for residential construction. The window well cover specimens were tested using the building code typical residential uniform live load of 40 pound per square foot (psf) and a point load of 250 lb. A combination of 50 lb sand bags and various weight plates were utilized to achieve the required uniform load and point load.

The two specimens tested under this report were constructed out of L 1¼" X 1¼" X 3/16 inch thick aluminum stays with a custom 1 1/2" deep aluminum Z back member. The aluminum frame is then covered with a 0.15 inch thick layer of UV polycarbonate riveted into the frame. The two window well cover specimens were tested on a concrete window well measuring 5'-8" wide and 3'-5" deep with an area of 17.6 ft². As a result, the minimum load to achieve 40 psf was:

$$17.6 \text{ ft}^2 \times 40 \frac{\text{lb}}{\text{ft}^2} = 704 \text{ lb minimum to achieve 40 psf}$$

All load tests were sustained for a minimum of 1 minute to prevent inaccurate results. Failure of either of the specimens was defined as:

The window well cover, under the uniform 40 psf load or 250 lb point load, slips off the window well walls, the structural aluminum members or UV polycarbonate yields and deflects in a manner to cause permanent damage to the window well cover and requires replacement.

Both specimens sustained a uniform live load of 45 psf (40 psf minimum) and 260 lb (250 lb minimum) point load for a minimum of one minute without any slip off the window well walls, yielding of the aluminum frame or UV polycarbonate, or permanent deflection of the aluminum frame or UV polycarbonate. Additionally, no permanent damage to the window well cover was noted nor was a replacement warranted. The testing clearly shows that the window well covers provided by *Windows Well Covered – Custom Window Well Covers* can easily sustain residential building code uniform static live load and point loads without needing replacement for what is considered to be a large window well. The specimens are hence certified for 40 psf uniform live load and 250 lb load for a maximum span of 6'-0" for window well widths up to 3'-6" and 6'-8" span for window well widths up to 3'-0". Four aluminum stays spaced no further than 1'-6" on center are required for window well covers with spans greater than 6'-0". Window wells larger than the window well utilized in this test are uncommon and will require additional load testing.

The window well testing was limited to static loading only. No dynamic load testing was performed. Dynamic load testing typically requires a lab setting with much more sophisticated equipment. The window well specimens were tested on concrete window wells. The test results remain valid for other types of window wells such as corrugated metal wells, fiberglass wells, masonry wells, and wooden wells that are in good condition and well maintained. The window well testing performed should not be interpreted that window well covers are intended to be walking surfaces or play surfaces for children or adults. The window well covers will, however, sustain reasonable incidental static loading such as briefly stepping on or walking on the window well cover or falls on the window well cover from ground level.

INTRODUCTION

Window well covers are widely used as a safety measure over egress window wells in residential construction. Although not currently required by most building codes, they are highly recommended to mitigate falling hazards into the window well. In addition, window well covers can reduce the likelihood of flooding and/or clogged window well drains when the design utilizes an impervious surface such as UV polycarbonate. Window well covers are also recommended for pest control and energy efficiency reasons depending on how the cover is designed. Since window well covers are not currently required by the building code there are currently no established load testing requirements. In addition, there are currently no established ASTM (American Society for Testing and Materials) test methods for window well covers.

The primary purpose of this report was to test two of the worst case window well cover configurations, as provided by *Windows Well Covered – Custom Window Well Covers*, while utilizing the existing building code load requirements for residential construction. The section titled “Methodology” provides further details explaining how the window wells were load tested. Photographs 1 and 2 below illustrate the two window well specimens tested.



Photograph 1 - Specimen 1 Window Well Cover



Photograph 2 – Specimen 2 Window Well Cover

METHODOLOGY

The window well covers tested in this report were tested for residential live loads per the 2024 International Building Code (IBC) and International Residential Building Code (IRC) which both reference ASCE (American Society of Civil Engineers) 7 for loading requirements. The typical live load for residential homes is 40 pounds per square foot (psf). In addition, a concentrated load of 250 pounds (lb) was applied at the weakest location on the window well cover representing the typical weight for an adult.

The existing window wells at the test site consisted of concrete well walls. The loading on the concrete well walls are orders of magnitude lower than the capacity of the walls. Thus, compressive deflection of the window well walls and the structural capacity of the window well walls are adequate and will have a negligible influence on the test results. The window well utilized was roughly the shape of an octagon cut in half. The span, width, and other relevant dimensions of the window well are shown below in Figure 1. The window well is part of a home built in the last 5 years. Modern building codes have dictated the increasing size of egress window wells. The window well utilized for the test thus represents the higher end size of most window wells encountered.

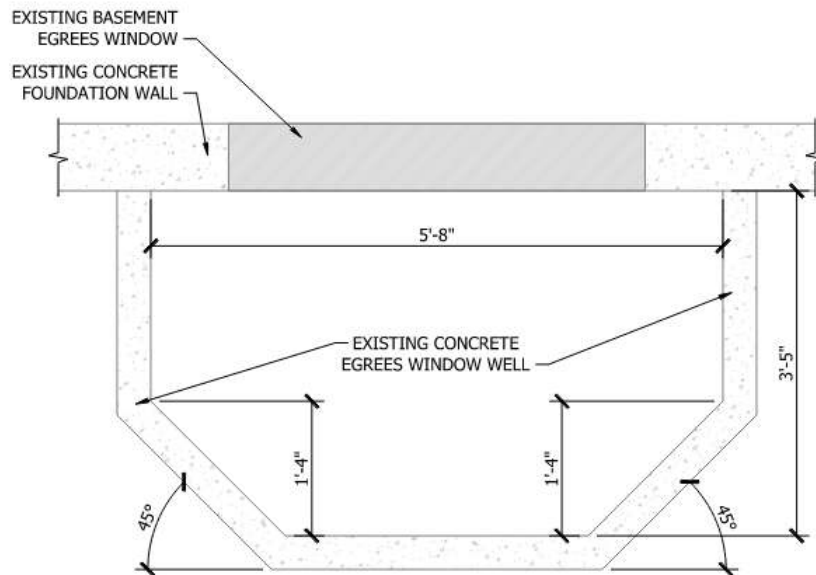


Figure 1 - Dimensions of Egress Window Well Utilized

The calculated window well area is $[5.66 \text{ ft} \times 3.42 \text{ ft}] - [1.33 \text{ ft} \times 1.33 \text{ ft}] = 17.6 \text{ ft}^2$

Corresponding to a minimum load of: $17.6 \text{ ft}^2 \times 40 \frac{\text{lb}}{\text{ft}^2} = 704 \text{ lb}$ minimum to achieve 40 psf

The point load was positioned along the side edge of the window well specimens per Figure 2 below where the load will be mostly supported by the UV polycarbonate overlay. 50 lb sand bags were utilized to achieve the minimum uniform 40 psf live load. Weight plates ranging from 45 lb, 35 lb, and 25 lb were utilized to achieve the 250 lb point load of an adult standing on the window well. All load tests were sustained for a minimum of 1 minute to ensure the window well specimen withstands sustained loading.

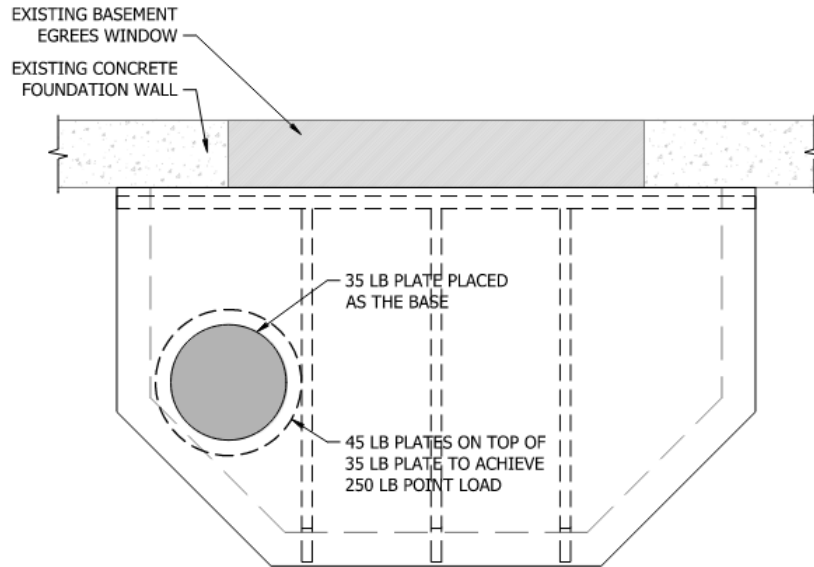


Figure 2 - Point Load Layout and Location on Test Specimens

Two specimens were tested as part of this report. The specimens both utilized Type 6061-T6 extruded aluminum. The “stays” consists of aluminum L 1¼” X 1¼” with a 3/16 inch thickness. The aluminum back member consists of a custom 1½” deep aluminum Z section. The UV polycarbonate overlaying the aluminum frame is 0.15 inch thickness. The UV polycarbonate on both specimens had a minimum of 1.25” of bearing measured from the inner edges of the window well walls. Both specimens have notches cut into the vertical leg of the L members to fit the cover flat onto the window well edges. Specimen 1 utilized an unnotched back member. The back member on Specimen 2 is notched reducing the back bar depth to 0.75” where it rests on the window well. The two specimens are further detailed as shown in Figure 3 and Figure 4.

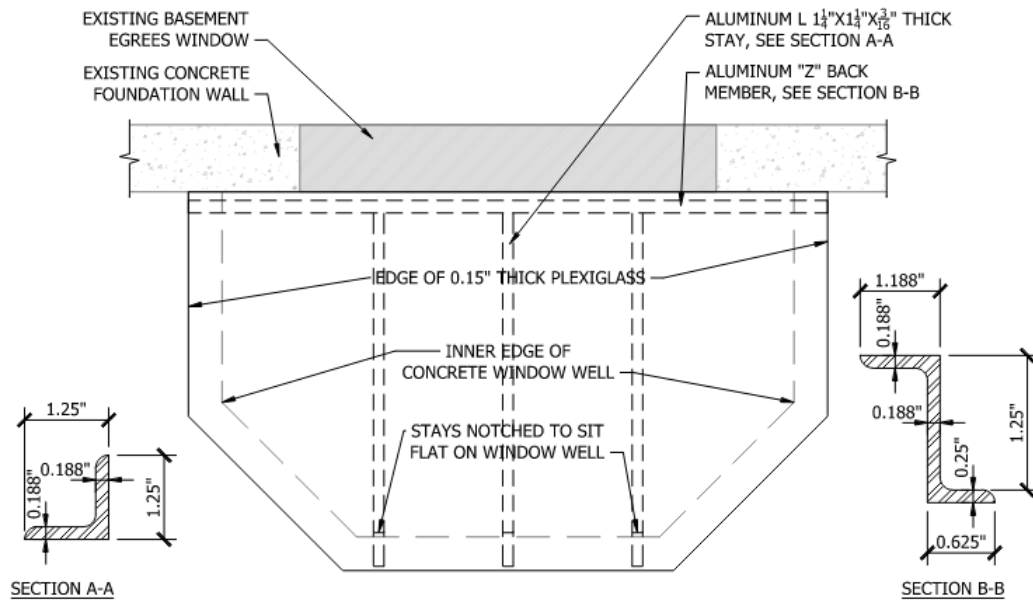


Figure 3 - Specimen 1 Details

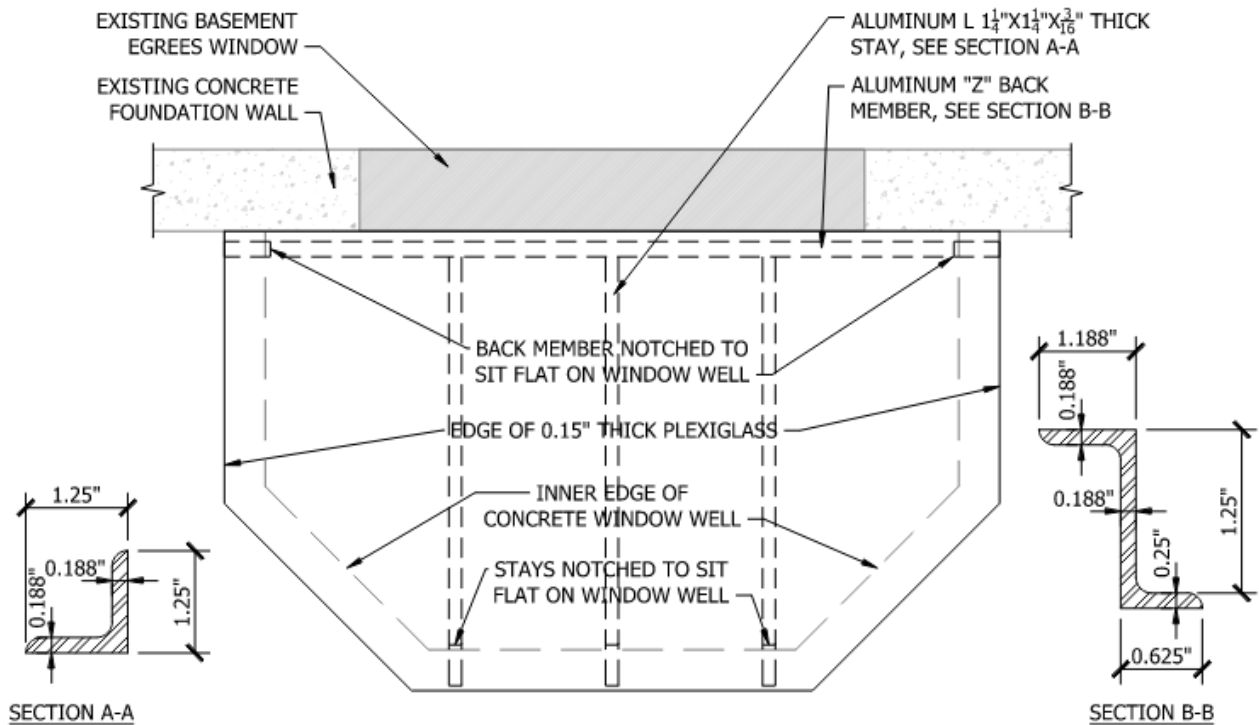


Figure 4 - Specimen 2 Details

In addition to the load tests described above. An additional test was performed on Specimen 1 to attempt to find the failure load. Further information and the results of the tests can be found in the next section.

Failure of the window well covers was defined as follows:

1. The window well cover, under the uniform 40 psf live load, slips off of the window well walls, the structural aluminum members or UV polycarbonate yields and deflects in a manner to cause permanent damage to the window well cover and requires replacement.
2. The window well cover, under the 250 lb point load, slips off of the window well walls, the structural aluminum members or UV polycarbonate yields and deflects in a manner to cause permanent damage to the window well cover and requires replacement.

The window well testing results have the following limitations:

1. The test is static loading only. No dynamic load testing was performed. Dynamic load testing requires much more sophisticated equipment and typically requires a lab setting to be performed properly.
2. The window well walls in this test consisted of concrete window well walls to minimize the effect of compressive deflections on the test results. Other window well materials such as corrugated metal wells, fiberglass wells, masonry wells, and wooden wells are not expected to materially affect the performance and load rating of the same window well cover specimens.
3. Window well covers are not intended to be walking or play surfaces. They are required to be unobstructed to ensure ease of removal in the event an emergency requires a person to egress via a window well to evacuate a home. The testing aims to mimic incidental static loading on window well covers, which could include: brief stepping or walking on the cover or falling on the cover from the ground level.
4. The same loading on smaller window wells than mentioned above, utilizing the same window well specimen design with the same back member and aluminum stays, are approved for the static uniform live load and point loads discussed previously in this section. Smaller spans may utilize fewer stays as long as the spacing between stays is limited to 1'-6" on center.
5. The load testing results and conclusions apply where the UV polycarbonate bears (overlaps) the inner edges of the window well walls a minimum of 1.25" with the stay count and spacing as described in other sections of this report.
6. The notches on the back member of specimen 2 is analogous to a beam notched at the bearing ends. This practice is common as the bending stresses at the bearing ends are negligible. Thus, the notches do not affect the strength or performance of the overall cover.

TEST RESULTS

The test results for the two specimens are shown in Tables 1 & 2 with corresponding pictures showing the loaded specimens. Table 3 shows the results of the failure load testing of specimen 1.

Table 1: Specimen 1 Load Testing Results

<u>Test Type</u>	<u>Actual Load</u>	<u>Total Time Loaded</u>	<u>Pass/Fail</u>	<u>Notes</u>
40 psf uniform load	800 lb [45 psf]	1 minute	Pass	No permanent damage or deflection noted.
250 lb point load	260 lb	1 minute	Pass	No permanent damage or deflection noted.

See Photographs 3 and 4 below illustrating the load tests performed.



Photograph 3 - Specimen 1 Uniform Load Test



Photograph 4 - Specimen 1 Point Load Test

Table 2: Specimen 2 Load Testing Results

<u>Test Type</u>	<u>Actual Load</u>	<u>Total Time Loaded</u>	<u>Pass/Fail</u>	<u>Notes</u>
40 psf uniform load	800 lb [45 psf]	1 minute	Pass	No permanent damage or deflection noted.
250 lb point load	260 lb	1 minute	Pass	No permanent damage or deflection noted.

See Photographs 5 and 6 below illustrating the load tests performed.



Photograph 5 - Specimen 2 Uniform Load Testing



Photograph 6 - Specimen 2 Point Load Testing

Table 3: Specimen 1 Failure Load Testing Results

<u>Test Type</u>	<u>Actual Load</u>	<u>Total Time Loaded</u>	<u>Pass/Fail</u>	<u>Notes</u>
Uniform Load	1250 lb [71 psf]	1 minute	Fail	No permanent damage or deflection to UV polycarbonate but torsional buckling and permanent deflection present on stays and back member.
Point Load	400 lb	1 minute	Fail	No permanent damage or deflection to UV polycarbonate but torsional buckling and permanent deflection present on stays and back member.

See Photographs 7 and 8 below illustrating the load tests performed.



Photograph 7 - Specimen 1 Failure Uniform Load Test



Photograph 8 - Specimen 1 Failure Point Load Test

DISCUSSION AND CONCLUSIONS

Specimen 1 passed both the uniform and point load testing without any permanent damage or deflection to the window well cover. Specimen 2 performed just as well passing both the uniform and point load testing without any permanent damage or deflections. The current window well designs provided by *Windows Well Covered – Custom Window Well Covers* are adequately designed to resist typical residential uniform live loads and point loads for a typical large window well opening. In addition, the window well covers did not have any permanent damage or deflection. Larger window wells than the well tested in this report will require a custom design and window well cover solution and are not within the scope of this report.

Specimen 1 did not exhibit catastrophic failure when loaded up to 1250 lbs (71 psf uniform load) or with a 400 lb point load. Some permanent damage was noted on the stays and back member, specifically torsional buckling and yielding of the aluminum legs on the L and Z sections. This qualifies as a failure since the window well would require replacement if such loading were to occur on the window well cover however this test demonstrated that the weakest window well specimen provided by *Windows Well Covered – Custom Window Well Covers* can sustain loading significantly higher than the minimum residential uniform live load and point load.

The specimens are hence certified for 40 psf uniform live load and 250 lb point load for a maximum span of 6'-0" for window well widths up to 3'-6" and 6'-8" for window well widths up to 3'-0". The maximum span and width was determined based on the actual load sustained during the load testing (45 psf). The window well geometry in this test consisted of an octagon cut in half. Other common window well shapes such as rectangular or half circle window well shapes are certified as follows:

- a. Rectangular window wells with a maximum span of 6'-0" and widths up to 3'-6".
- b. Rectangular window well with a maximum span of 6'-8" and widths up to 3'-0".
- c. Half circle window wells with a maximum radius of 3'-4".
- d. Four aluminum stays spaced no further than 1'-6" on center are required for window well covers with spans greater than 6'-0".

All of the load testing that occurred as part of this report was static loading. Dynamic loading was not part of the scope of this test as dynamic load testing typically requires a lab setting with much more sophisticated measurement tools and devices. This complexity, in addition to the numerous ways window well covers are designed and constructed, dictates that a standard test method be determined and standard loading be determined for the many possible scenarios that can occur. The window well testing performed should not be interpreted that window well covers are intended to be walking surfaces or play surfaces for children or adults. The window well covers will, however, sustain reasonable incidental static loading such as briefly stepping on or walking on the window well cover or falls on the window well cover from ground level. Incidental dynamic loading from children (weighing less than 50 lb) jumping on window well covers or adults falling from ground level is highly unlikely to cause failure of the window well cover.

The window well covers provided by *Windows Well Covered – Custom Window Well Covers* as part of this test are, in our professional opinion, a properly designed and engineered solution that not only provides a translucent cover for your window wells, but also are capable of withstanding greater than the building code required static live loads and point loads keeping both children and adults safe when incidental loading events occur.

REFERENCES

International Building Code, 2024 Edition. International Code Council, Country Club Hills, Illinois.

International Residential Code, 2024 Edition. International Code Council, Country Club Hills, Illinois.

Minimum Design Loads and Associated Criteria for Buildings and Other Structures, ASCE 7, 2022 Edition.
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