Observed behavior

Onset of failure was signaled by a buckling of the three intermediate ribs, directly along the centerline of the test span (see photo 3.) The bucking occurred just after eight buckets of water had been placed in the pool, corresponding to a nominal 26 psf over the footprint of the pool. The buckling was audible. It was also visible through the clear bottom of the pool, and appeared to be permanent.

The two overlapping edge ribs remained intact, but deflected. It took the addition of four more buckets to buckle and fail the edge ribs, corresponding to a nominal footprint load of 40 psf.

The panel seemed to go into hammock action with the addition of more water, and got hung up on parts of the support system. Total collapse was deemed to have occurred at 15 buckets or about 50 psf (see photo 4.)

It seems apparent from this experiment that there is not a clear cut point of collapse, and that the mode of failure occurs in stages, with the weakest link being the first to suffer permanent distress. It is hoped that these findings can place this structural behavior into some perspective, and provide some kind of benchmark for further discussion.

Please consider me available to expand further on these findings or if additional questions arise.

Respectfully submitted,

George W. Zuurbier, P.E.
Fellow, American Society of Civil Engineers
Sr. Member, National Academy of Forensic Engineers

COMMONWEALTH OF VIRGINIA
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GWZ/al

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September 22, 2009

To: Mr. Stan K. Massie
Building Official, Wytheville, VA

From: George W. Zuurbier, P.E.
GWZ Engineering

Re: Roof Panel Test Report

Dear Mr. Massie,

This report describes the testing of a ribbed steel roof panel of the type often used on manufactured carports and storage sheds. These are often available in the Wytheville area, and are furnished by various manufacturers and building suppliers. They are based on various assurances of load capacities, from which it becomes necessary to decide if there is compliance with local building codes.

In an attempt to reconcile rather widely varying predicted uniformly distributed load capacities based on theoretical analyses, it was decided to conduct a simple load test using available materials and equipment. This test was conducted on September 16, 2009, in the equipment yard of the Wytheville Public Works Department, with observed behavior and findings documented herewith, as requested.

This test was exploratory, rather unsophisticated and approximate in nature, but still addressing the basic parameters of uniformly distributed loading, such as that imposed by snow and ice accumulation, and of accompanying span length on commercially available ribbed steel panels.

The test was set up on a nominal five foot span using a single three foot wide ribbed panel flanked by two half-panels with overlapping edge ribs (see photo 1.) A uniform roof load was replicated by placing a nominal four-foot diameter transparent and flexible "kiddie's pool" over the center of the panel. This covered about 90% of the panel area, and it is judged that failure loads would be just slightly lower if the remaining irregular corner areas had been covered.

The test panel was confirmed by micrometer to be 29 gage (0.135 in.) thickness, painted two sides, with edge and intermediate ribs of commercial configuration about an inch high. These were actually leftover panels from two material protection sheds that were installed elsewhere in the equipment yard, and for which more details of geometry and material strength can be tracked if needed.

Load was applied by placing water in the kiddie pool using filled 5-gallon buckets, and by counting the number of buckets. Each bucketful weighed about forty pounds, and was calculated to add about 3.3 psf to the panel for every five gallon bucket. A check was also made by measuring the depth of water with a ruler. It was found that deflection of the panel tended to distort the load and distribution due to the "ponding" effect. This was low in early stages, and could be expected also in natural loading. It was disregarded, and loads were considered nominal calculated distributed loads.