

# M.B.C. Management

CONSTRUCTION • MANAGEMENT • DESIGN

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April 6, 2007

Mr. John Dyke  
Woods Hole Oceanographic Institute  
Woods Hole, Mass.

Re: Structural Analysis  
Break Away Harness  
Vertical Towed Array

Dear Mr. Dyke:

MBC Management (MBC) performed a structural analysis of the break away harness on the vertical towed array. The harness is constructed two parallel two inch (2") wide by one and one-fourth (1 1/4") structural aluminum channels offset from the centerline of force by nine and three-quarters inches (9 3/4"). The channels are connected to the front pin assembly and the vertical tube by flat plates. The front and back flat plates are connected along the center-line of force with two three-eighth inch (3/8") rods. The three-eighth rods have 3/8"-24 SAE fine threads cut on each end which will define a failure point. The front pin assembly is connected to the top of the vertical tube with two five-sixteenth inch (5/16") chains, at the top end of the chain there are three-sixteenth inch (3/16") anchor shackles. Two loading conditions were used for the structural analysis, the first loading condition was under normal working line load of two thousand pounds (2000 lb), the second loading condition was under maximum line load of twelve thousand pounds (12,000 lb). A computer model was constructed of the structure and processed through the STAAD.Pro computer program, a proprietary program of Research Engineers, Intl., to determine the forces and stresses that would be expected due to the applied loads. The harness was analyzed to determine the initial failure mode and the sequential component failure to complete separation of the harness.

#### Normal Working Load Condition:

The harness was analyzed with a estimated normal working line load of two thousand pounds (2000 lb) tension. The analysis of the harness showed that the maximum stresses would not exceed the allowable stresses. The results are as follow:

Component	Max Stress	Safety Factor
2" Channel	120 psi	180
3/8" Rod	2,943 psi	7.33
5/16" chain	774 lb	7.1
3/16" shackle	774 lb	~3.5

**Maximum Load Condition:**

The harness was analyzed with a estimated maximum line load of twelve thousand pounds (12,000 lb) tension. The analysis of the harness showed that the maximum stresses would exceed the allowable stresses. The results are as follow:

Component	Max Stress	Safety Factor
2" Channel	799 psi	27
3/8" Rod	17,661 psi	1.22
5/16" chain	4,647 lb	1.18
3/16" shackle	4,647 lb	Failure

The failure mode analysis showed that the 3/16" anchor shackles would fail at an approximate tow line tension of eleven thousand four hundred pounds (11,400 lb). Upon the failure of the anchor shackle the harness would rotate down to a point that the three-eighth rods were aligned with the tow line. The three-eighth rods would then increase in tension to a level of twelve thousand nine hundred fifty pounds (12,950 lb), (6,475 lb each), and fail at the root of the 3/8"-24 fine thread. At that point the tow line tension would transfer to the two inch channel assembly, which would fail at a tow line tension of three thousand seven hundred pounds (3,700 lb).

It is the opinion of MBC Management that the break away harness would perform very well under normal working load conditions. It is also Our opinion that failure would start at a tow line tension of 11,400 pounds with complete failure at a tow line tension of 12,000 pounds.

Copies of the STAAT PRO output file will be provided at your request.

If you have any questions please feel free to call.

Respectfully,

*Paul E. Malek, PE*

Paul E. Malek, PE  
Principal

