

# Save the Stack

Structural Investigation of Asarco Stack



## Executive Summary

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### Subject:

Structural Investigation of the 826' tall Asarco Stack

At the request of the Save the Stack group, our office performed structural analysis and design checks of the 826' tall ASARCO stack to verify if the stack meets the minimum standard requirements of the International Building Code 2009 and the American Concrete Institute Code Requirements for Reinforced Concrete Chimneys ACI 307-08.

The stack consists of two concrete annular columns, the interior liner and the exterior shell. The liner is 826 foot tall with a tapered cross section that starts at the base with an outside diameter of 35 feet and 4 inches and 36-inch wall thickness. It tapers to the top to a cross section of 16 feet and one half inch with 10 inches of wall thickness. The shell is 818 feet tall with a tapered cross section. The outside diameter is 62 feet 6 inches at the base with 36 inches of wall thickness. The top cross section has an outside diameter of 31 feet 3 inches and wall thickness of 9 inches. The material properties used in the analysis were taken from the construction documents and corroborated with the Schmidt Hammer testing presented in the inspection report prepared by Industrial Access Inc.

The structural analysis was performed utilizing the wind and seismic loads procedures in the ACI 307-08 and adjusted to match the base shear in accordance with the IBC design loads reference codes ASCE 07-02 and ASCE 07-05. The reinforcement in the annular columns was taken from the construction documents and the strength of the columns was calculated along the length of the columns at 12 to 13-foot intervals. The summary of the findings of our study are presented as follows:

818-foot Concrete Shell

	ACI 307-08 Wind $M_u$ , k-ft	ASCE 07-02 Seismic $M_u$ , k-ft	ASCE 07-05 $M_u$ , k-ft	ACI 307-08 $\phi M_n$ , k-ft
At base	512,750	250,901	203,623	825,345
At mid height	174,461	80,310	65,177	396,264
At top	801	4,256	3,454	22,698

826-foot Concrete Liner

	ACI 307-08 Wind $M_u$ , k-ft	ASCE 07-02 Seismic $M_u$ , k-ft	ASCE 07-05 $M_u$ , k-ft	ACI 307-08 $\phi M_n$ , k-ft
At base	Not applicable	139,488	113,112	352,553
At mid height	Not applicable	48,465	39,301	94,296
At top	Not applicable	9,260	7,508	28,664

Wind loading is not applicable to liner since it is shielded from wind by shell.

The factored moments  $M_u$  represent the demand from either design wind or earthquake load combinations, and the design strength is represented by the  $\phi M_n$ . The design strength was found to be higher than the demand for both the shell and liner along the length of the structures for the wind and seismic load combinations. Therefore, it is demonstrated that the stack is adequate to resist the code requirements in accordance with ACI 307-08 and IBC 2009.

The complete report with calculations and detailed information is being prepared and will follow shortly.

Sincerely,




11-07-12  
Javier M. Carlin, P.E.




11-07-12  
Henry K. Ng, P.E.