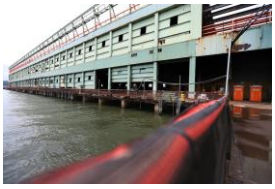
FLUIDS

Unit 18 Dr. John P. Cise, Professor of Physics, Austin Com. College, 1212 Rio Grande St., Austin Tx. 78701 jpcise@austincc.edu & New York Times , August 9, 2016 by David W Dunlap

Pier 57 Goes Down in History as a Place Where Concrete Floats



Pier 57 in Manhattan

INTRODUCTION: This pier in New York City is on top of three floating barge like concrete caissons. Each of Two concrete "box like" caissons have dimensions of 360 ft. long, 127 ft. wide, and 33 ft. high. (see article below). The purpose of this application is to confirm the maximum buoyant force of the caisson 47,000 tons as seen in article below.

QUESTIONS: (a) Find volume in ft.^{3} of the concrete caisson? ,(b) Find the weight of water which can be displaced by the caisson? This is the maximum Buoyant force available to support the pier.

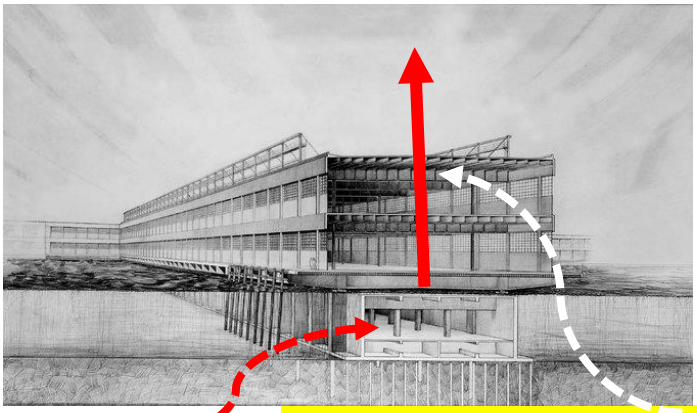
You'll have an easier time reading this column if you accept that **colossal concrete boxes — one and a half blocks long and three stories high — can float in water.** This is not a column about the $350 million renovation of the abandoned Pier 57 in Manhattan by RXR Realty and Youngwoo and Associates, under a 97-year lease from the Hudson River Park Trust, with new offices for Google and a new food market run by Anthony Bourdain. Instead, it is a column about the amazing Pier 57 itself. The secret to this engineering masterwork, designed by Emil H. Praeger and built by the New York City Marine and Aviation Department, is hidden below the pier shed on the Hudson River and the head house at the foot of West 15th Street. The secret is that Pier 57 does not stand on a conventional pile field. Instead, most of **its weight is supported on three buoyant concrete boxes, called caissons, anchored permanently below the water line.**

Inside one of the caissons at Pier 57

Two caissons — intended to support the pier shed — were **(((360 feet long, 127 feet wide and 33 feet high.)))** They weighed 27,000 tons each. A smaller caisson, 367 feet by 80 feet, was designed to support the perpendicular head house at the front of the pier, making a T shape.

A drawing from 1950 shows the engineering masterwork of the pier.

When the caissons were finished, water was piped back into the basin and the caissons



QUESTIONS CONTINUED: (c) Convert the maximum buoyant force obtained in (b) to tons of water? (d) Comment on results?

HINTS: V = l w h , weight density D = weight/vol. , D_{WATER} = see article. , 2000 lb. = 1 ton

ANSWERS: (a) 1,508,760 ft.^{3} , (b) 94,146,624 lb., (c) B = 47,073 tons , (d) This technique of making a pier was first used in WW2 to make beach landing docks on the coast of France when allied troops invaded.

floated upward. How?"**Buoyancy is an upward force equal to the weight of the water an object displaces,"** saidGuy Nordenson, a structural engineer and a professor of architecture and structural engineering at Princeton University. **(((Water has a density of 1 gram per cubic centimeter, or 62.4 pounds per cubic foot)))**. Solid concrete would sink but the caissons are hollow boxes. Even though the larger ones weigh 27,000 tons, **(((they displace about 47,000 tons of water,)))** far more than their own weight. "The density of the total volume — air plus concrete — is less than the density of the equivalent volume of water," said Gregory J. Clancy, the vice president for development at RXR. Mr. Clancy said he had found no other examples of this type of construction, which earned Pier 57 a place on the National Register of Historic Places.