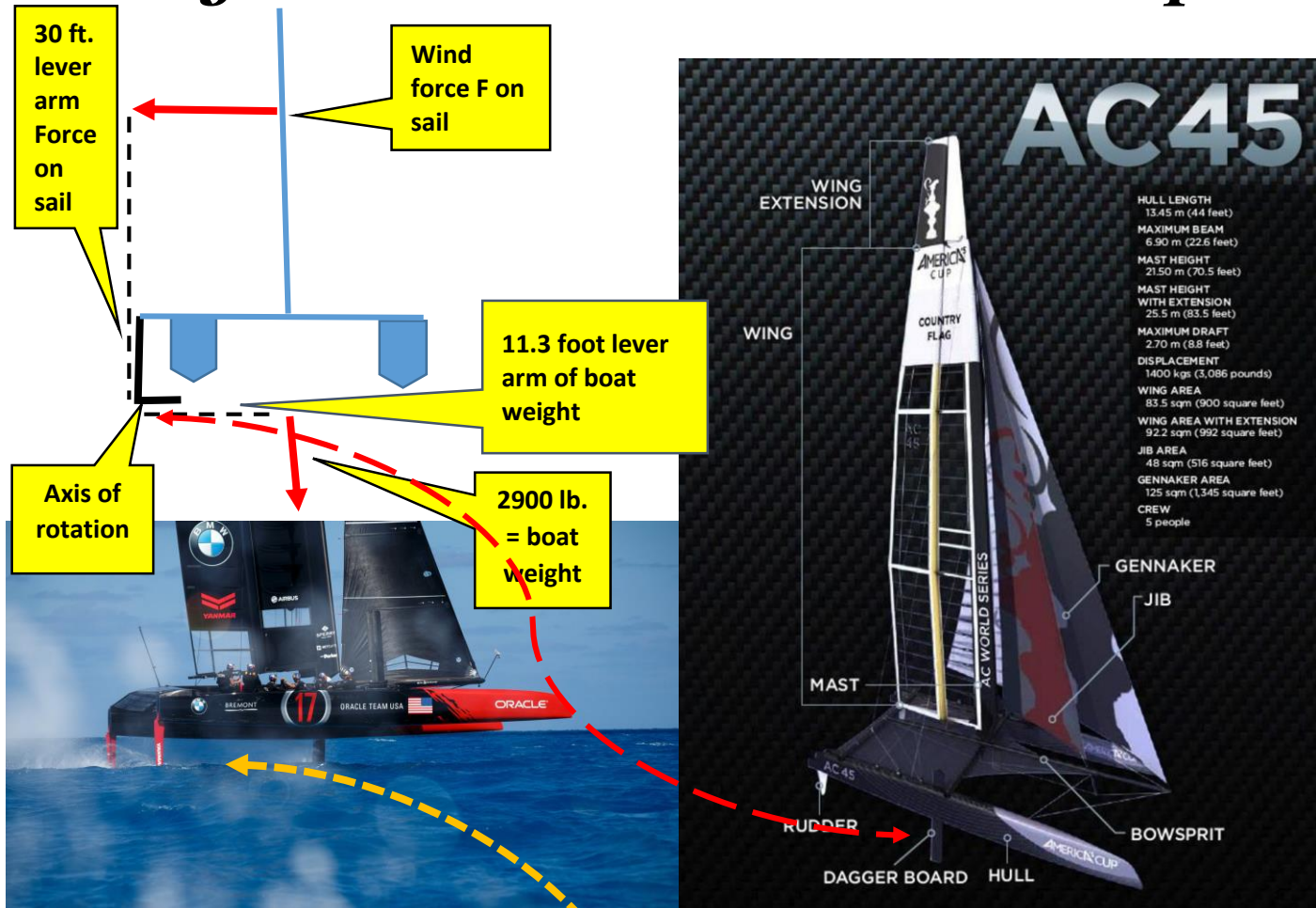


ROTATIONAL EQUILIBRIUM

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Testing on the Water in America's Cup



When the AC 45 foiling catamarans hit the Hudson River on Thursday morning, it was the culmination of almost a week's work by skeleton shore crews. Riggers have been splicing lines of aramid fibers and rebuilding winches under headlamps in Jersey City while the sailors rest each night. This is the America's Cup World Series, where points count for earning the right to challenge Oracle Team U.S.A. in the fall of 2017 in the America's Cup in Bermuda. But the races that spectators will be watching off Battery Park this weekend are only part of the effort required to win the Cup. This weekend's races feature AC 45s, built to be identical, while larger, more customized AC 50s are used in the finals. But the first of the new AC 50 boats have yet to be built, and teams have been testing innovative wing and foil systems on modified AC 45s referred to as "sport boats" at their bases in Bermuda and around the world. After the World Series event in New York, the crews head to Chicago, where they will race on Lake Michigan in June. The small gap between the races provides little time for rest. Teams are allowed to start sailing AC 50s in late January. This year's World Series ends in November, and through the end of the year, the 45s will be inventing and fine-tuning the systems that the 50s will use.

INTRODUCTION: When hydro foiling these sailboats have the dagger board as axis of rotation. See graphic and picture. The clockwise torque of boats weight is balanced by counterclockwise torque of force of wind on sail.

QUESTIONS: (a) Find force of wind F on sail? , (b) Find net force of water horizontally ON dagger board & two rudders?

HINT: To be in rotational equilibrium $\Sigma T = 0$. , To be in static equilibrium $\Sigma F_x = 0$

ANSWER: (a) $F = \sim 1,092 \text{ lb.}$, (b) $\sim 1,092 \text{ lb}$