Torque readings from measurements on Rick's Overbalance Water Wheel

To determine the rotational torque of the water wheel, one must first determine the water fill weight for a tube of the pipe scale that will be utilized. Naturally, the water fill weight in each of the 12 tubes should be identical, and the below fill weights correspond to the water weight within a single tube.

Figuring the weight of tube water-fills for differing pipe scale builds of Rick's Overbalance Water Wheel

First the comparative water fill weights for different scale builds are determined:

Note: 1 cubic inch of water weighs 0.58 ounce

The math: ((Pi x I.D. radius squared) x fill height) x 0.58)/16 = water weight in pounds (lbs)

Pipe	Pipe ID	Pipe OD	Area sq in	Fill height	cubic inches	lbs water
3"	3.068"	3.500	7.3927	18.6577"	137.931	5.000
4"	4.026"	4.500	12.7300	24.8707"	316.604	11.477
6"	6.065"	6.625	28.8902	37.3154"	1,078.049	39.079
8"	7.981"	8.625	50.0270	49.7414"	2,488.413	90.205
10"	10.020"	10.750	78.8543	62.1768"	4,902.908	177.730
12"	11.938"	12.750	111.9317	74.6308"	8,353.552	302.816

Note that I calculated fill height based upon the scale of pipe being used. Therefore, fill height for 4" pipe is 1.333 x 18.6577, and 6" pipe is 2 x 18.6577, and any other scale's fill height can be found using that scale's correct multiplier.

With the water fill weight of each tube known, the applied torque for each tube can be determined by multiplying that weight by the distance from the center point of that weight to the vertical centerline of the water wheel and converting that distance to feet. For example, a water fill weight of 5 pounds with a water weight center point located one foot from the vertical centerline will have an applied torque of 5 foot-pounds, and that force will be applied downwards, vertically. Torque for all tubes with a water weight center point to the left of the vertical water wheel centerline will first be determined, summed for total applied torque, and then compared to the total applied torques as figured for tubes with water weight centers to the right of the water wheel's vertical centerline.

If there is a difference in applied torque between these totals then the amount of difference can be said to be rotational torque, and the rotational torque divided by the total torque of the group with the lower amount of torque will determine the percentage of overbalance condition that exists.

note: The below figures are based upon measuring the scaled down drawing (refer to dodecagon wheel figure 5.jpg), in millimeters, from the center point of water fill weight in each tube, horizontally to the vertical centerline of the water wheel. I took these measurements onscreen with a 200% zoom-in for greater accuracy in measuring. Depending upon one's computer screen size, resolution (dots per inch), and zoom amount, the measurements could differ but the final tallies for rotational torque and overbalance percentage should remain the same, or at least very close.

note: inches = drawing scale in millimeters divided by 4.054 for 3" tubes, 3.041 for 4" tubes, 2.027 for 6" tubes, 1.520 for 8” tubes, 1.216 for 10” tubes, and 1.014 for 12’ tubes. feet = inches divided by 12

Torque for all tubes with water weight centers shown left of the water wheel's vertical centerline

tube	mm	inches	feet x lbs water	torque in foot-lbs
A	132mm	32.56	2.713 x 05.000 =	13.565 (3" diameter tube)
		43.41	3.618 x 11.477 =	41.524 (4" tube)
		65.12	5.427 x 39.079 =	212.082 (6" tube)
		86.84	7.237 x 90.205 =	652.814 (8” tube)
		108.55	9.046 x 177.731 =	1607.755 (10” tube)
		130.18	10.848 x 302.817 =	3288.290 (12” tube)
B	140mm	34.53	2.878 x 05.000 =	14.390 (3" tube)
		46.04	3.837 x 11.477 =	44.037 (4" tube)

tube	mm	inches	feet x lbs water	torque in foot-lbs
B (continued)				
	140	69.07	5.756 x 39.079 =	224.939 (6" tube)
		92.11	7.676 x 90.205 =	692.414 (8” tube)
		115.13	9.594 x 177.731 =	1705.151 (10” tube)
		138.20	11.517 x 302.817 =	3487.543 (12” tube)
C	111mm	27.38	2.282 x 05.000 =	11.410 (3" tube)
		36.50	3.042 x 11.477 =	34.913 (4" tube)
		54.76	4.563 x 39.079 =	178.317 (6" tube)
		73.03	6.086 x 90.205 =	548.988 (8” tube)
		91.28	7.607 x 177.731 =	1352.000 (10” tube)
		109.58	9.132 x 302.817 =	2765.325 (12” tube)
D	46mm	11.35	0.946 x 05.000 =	04.730 (3" tube)
		15.13	1.261 x 11.477 =	14.472 (4" tube)
		22.69	1.891 x 39.079 =	73.898 (6" tube)
		30.26	2.522 x 90.205 =	277.497 (8” tube)
		37.83	3.153 x 177.731 =	560.386 (10” tube)
		45.41	3.784 x 302.817 =	1145.860 (12” tube)

Total torque on left side = 44.095 ft lbs (3 inch tubes)
= 134.946 ft lbs (4 inch tubes) = 3.060 x 3" tube
= 689.236 ft lbs (6 inch tubes) = 15.631 x 3" tube
= 2171.713 ft lbs (8 inch tubes) = 49.251 x 3” tube
= 5225.292 ft lbs (10 inch tubes) = 118.500 x 3” tube
= 10687.018 ft lbs (12 inch tubes) = 242.363 x 3” tube

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Torque for all tubes with water weight centers shown right of the water wheel's vertical centerline

tube	mm	inches	feet x lbs water	torque in foot-lbs
E	27.0	06.66	0.555 x 05.000 =	02.775 (3" tubes)
		08.88	0.740 x 11.477 =	08.493 (4" tubes)
		13.32	1.110 x 39.079 =	43.378 (6" tubes)
		17.76	1.480 x 90.205 =	133.503 (8” tubes)
		22.20	1.850 x 177.731 =	328.802 (10” tubes)
		26.65	2.221 x 302.817 =	672.557 (12” tubes)
F	93.5	23.06	1.922 x 05.000 =	09.610 (3" tubes)
		30.75	2.563 x 11.477 =	29.416 (4" tubes)
		46.13	3.844 x 39.079 =	150.220 (6" tubes)
		61.51	5.126 x 90.205 =	462.391 (8” tubes)
		76.89	6.408 x 177.731 =	1138.900 (10” tubes)
		92.30	7.692 x 302.817 =	2329.268 (12” tubes)
G	5.5	01.36	0.113 x 05.000 =	00.565 (3" tubes)
		01.81	0.151 x 11.477 =	01.733 (4" tubes)
		02.71	0.226 x 39.079 =	08.832 (6" tubes)
		03.62	0.302 x 90.205 =	27.242 (8” tubes)
		04.52	0.377 x 177.731 =	67.005 (10” tubes)
		05.43	0.453 x 302.817 =	137.176 (12” tubes)
H	35.5	08.76	0.730 x 05.000 =	03.650 (3" tubes)
		11.67	0.973 x 11.477 =	11.167 (4" tubes)
		17.51	1.459 x 39.079 =	57.016 (6" tubes)
		23.36	1.947 x 90.205 =	175.629 (8” tubes)
		29.19	2.433 x 177.731 =	432.420 (10” tubes)
		35.04	2.920 x 302.817 =	884.226 (12” tubes)

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tube	mm	inches	feet x lbs water		torque in foot-lbs
I	60.00	14.80	1.233 x 05.000	=	06.165 (3" tubes)
		19.73	1.644 x 11.477	=	18.868 (4" tubes)
		29.60	2.467 x 39.079	=	96.408 (6" tubes)
		39.47	3.289 x 90.205	=	296.684 (8" tubes)
		49.34	4.112 x 177.731	=	730.830 (10" tubes)
		59.23	4.936 x 302.817	=	1494.705 (12" tubes)
J	65.0	16.03	1.336 x 05.000	=	06.680 (3" tubes)
		21.37	1.781 x 11.477	=	20.441 (4" tubes)
		32.07	2.673 x 39.079	=	104.458 (6" tubes)
		42.76	3.563 x 90.205	=	321.400 (8" tubes)
		53.45	4.454 x 177.731	=	791.614 (10" tubes)
		64.17	5.348 x 302.817	=	1619.465 (12" tubes)
K	54.5	13.44	1.120 x 05.000	=	05.600 (3" tubes)
		17.92	1.493 x 11.477	=	17.135 (4" tubes)
		26.89	2.241 x 39.079	=	87.576 (6" tubes)
		35.86	2.988 x 90.205	=	269.533 (8"tubes)
		44.82	3.735 x 177.731	=	663.825 (10" tubes)
		53.80	4.483 x 302.817	=	1357.529 (12" tubes)
L	29.0	07.15	0.596 x 05.000	=	02.980 (3" tubes)
		09.54	0.795 x 11.477	=	09.124 (4" tubes)
		14.31	1.193 x 39.079	=	46.621 (6" tubes)
		19.08	1.590 x 90.205	=	143.426 (8" tubes)
		23.85	1.988 x 177.731	=	353.329 (10" tubes)
		28.63	2.386 x 302.817	=	722.521 (12" tubes)

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Total torque on right side = 38.025 ft lbs (3 inch tubes)
= 116.377 ft lbs (4 inch tubes) = 3.06 x 3" tubes
= 594.509 ft lbs (6 inch tubes) = 15.63 x 3" tubes
= 1829.808 ft lbs (8 inch tubes) = 48.12 x 3” tubes
= 4506.725 ft lbs (10 inch tubes) = 118.52 x 3” tubes
= 9217.447 ft lbs (12 inch tubes) = 242.40 x 3” tubes

Rotational torque: (Left side of wheel vertical centerline minus Right side)
Left 44.095 - Right 38.025 = 6.070 ft lbs (3 inch tubes)
Left 134.946 - Right 116.377 = 18.569 ft lbs (4 inch tubes)
Left 689.236 - Right 594.509 = 94.727 ft lbs (6 inch tubes)
Left 2121.713 - Right 1829.808 = 291.905 ft lbs (8 inch tubes)
Left 5225.292 - Right 4506.725 = 718.567 ft lbs (10 inch tubes)
Left 10687.018 - Right 9217.447 = 1469.571 ft lbs (12 inch tubes)

Percentage overbalance = (rotational torque divided by right side torque) x 100
= 16% for any pipe size.

Direction of rotation = counter-clockwise (facing side A of water wheel)
= clockwise (facing side B of water wheel)