Predictions of the Resistance and Squat of AMECRC Series Monohulls

L. Lazauskas, Cyberiad, leo@cyberiad.net
First Draft: 23 April 2013

Summary

Predictions of resistance and squat of the AMECRC Series of model hulls are compared to measured values.

Introduction

The geometry and experimental data for the AMECRC series are described in a several AMECRC reports, e.g. [1],[2],[3].

"The parent hull of the AMECRC series has the same characteristics as the parent hull of the MARIN High Speed Displacement Hull Form series" [3].

The performance of the AMECRC series has been reported in several papers by Doctors and his co-workers, (e.g. [4],[5],[6],[7]) and the thesis by Robards [8].

Note that experimental values of sinkage are not available for this series, and trim measurements are only available for a small set of hulls.

Comparison with Other Predictions

Wave Resistance

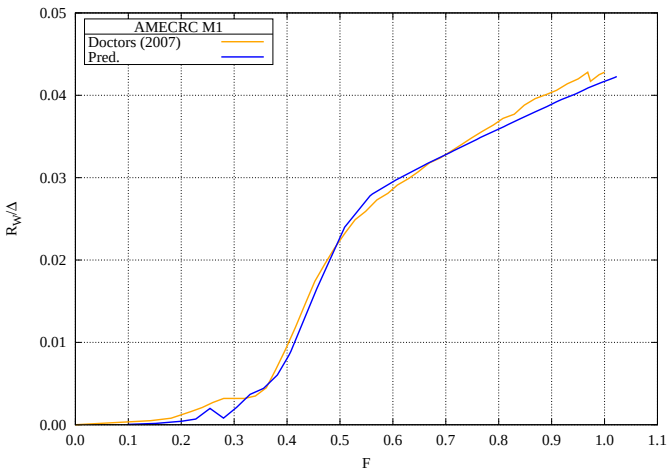

Figure 1: Specific wave resistance of the AMECRC M1 hull.

Figure 1 compares our predictions of the wave resistance of the M1 hull with those reported by Doctors [7].

Total Resistance

Figure 2 compares our predictions of the total resistance of the M1 hull with those reported by Doctors [7] and by Robards [8]. No form factors have been used in any of the predictions. Flotilla performs quite well with this hull, as does Doctors [7].

Both the experiments and the predictions of the total resistance for the M8 hull seem unusual. Figure 3 shows that Robards [8] also has difficulty with this stubby ($L/B = 4$) hull. The experiments did

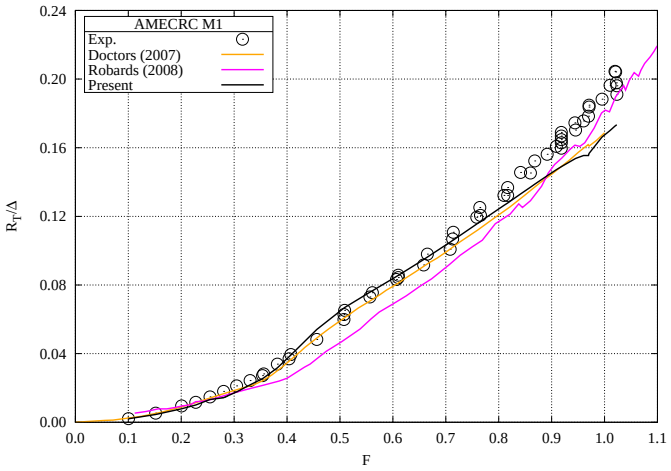

Figure 2: Specific total resistance of the AMECRC M1 hull.

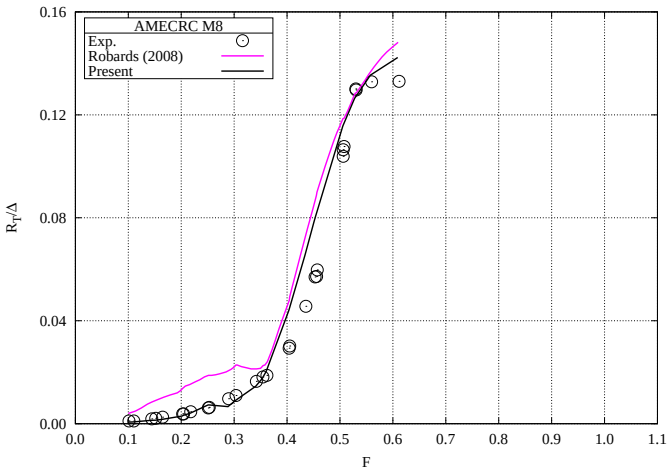

Figure 3: Specific total resistance of the AMECRC M8 hull.

not continue into the higher Froude numbers, presumably because of problems with wave-breaking and swamping.

Notes

Results for the M2 hull are not as reliable as others in the set [2].

There are some unusual spikes in the predicted trim for high Froude numbers because the hulls are travelling at close to the critical depth-based Froude number.

Acknowledgements

Part of this research was supported by the Australian Institute of Sport, Rowing Australia, and CSIRO. Thanks to Gregor Macfarlane of the Australian Maritime College for providing the geometry of the hulls.

References

[1] Bojovic, Predrag., "Presentation of the AMECRC systematic series calm water testing results", Australian Maritime Engineering Cooperative Research Centre, July 28, 1995.

[2] Bojovic, P., "Influence of displacement and LCG variation on calm-water performance", Australian Maritime Engineering Cooperative Research Centre, Report AMECRC IR 96/4, 1996.

[3] Bojovic, P. and Goetz, G., "Geometry of AMECRC systematic series", Australian Maritime Engineering Cooperative Research Centre, Report AMECRC IR 96/6, 1996.

[4] Doctors, Lawrence J., Phillips, Stephen and Day, Alexander H., "Focussing the wave-wake system of a high-speed marine ferry", *6th International Conference on Fast Sea Transportation (FAST '06)*, Southampton, England, Sept. 4–9, 2001.

[5] Doctors, Lawrence J., "Wave generation of high-speed ships", *The Australian Naval Architect*, Aug. 2002.

[6] Doctors, Lawrence J., "A numerical study of the resistance of transom-stern monohulls", *5th International Conference on High-Performance Marine Vehicles (HIPER '06)*, Launceston, Tasmania, Nov. 8–10, 2006.

[7] Doctors, Lawrence J., "A numerical study of the resistance of transom-stern monohulls", *Schiffstechnik*, Vol. 54, No. 3, 2007, pp. 134–144.

[8] Robards, Simon William, "The hydrodynamics of high-speed transom-stern vessels", *M. Engineering thesis*, The University of New South Wales, Nov. 2008.

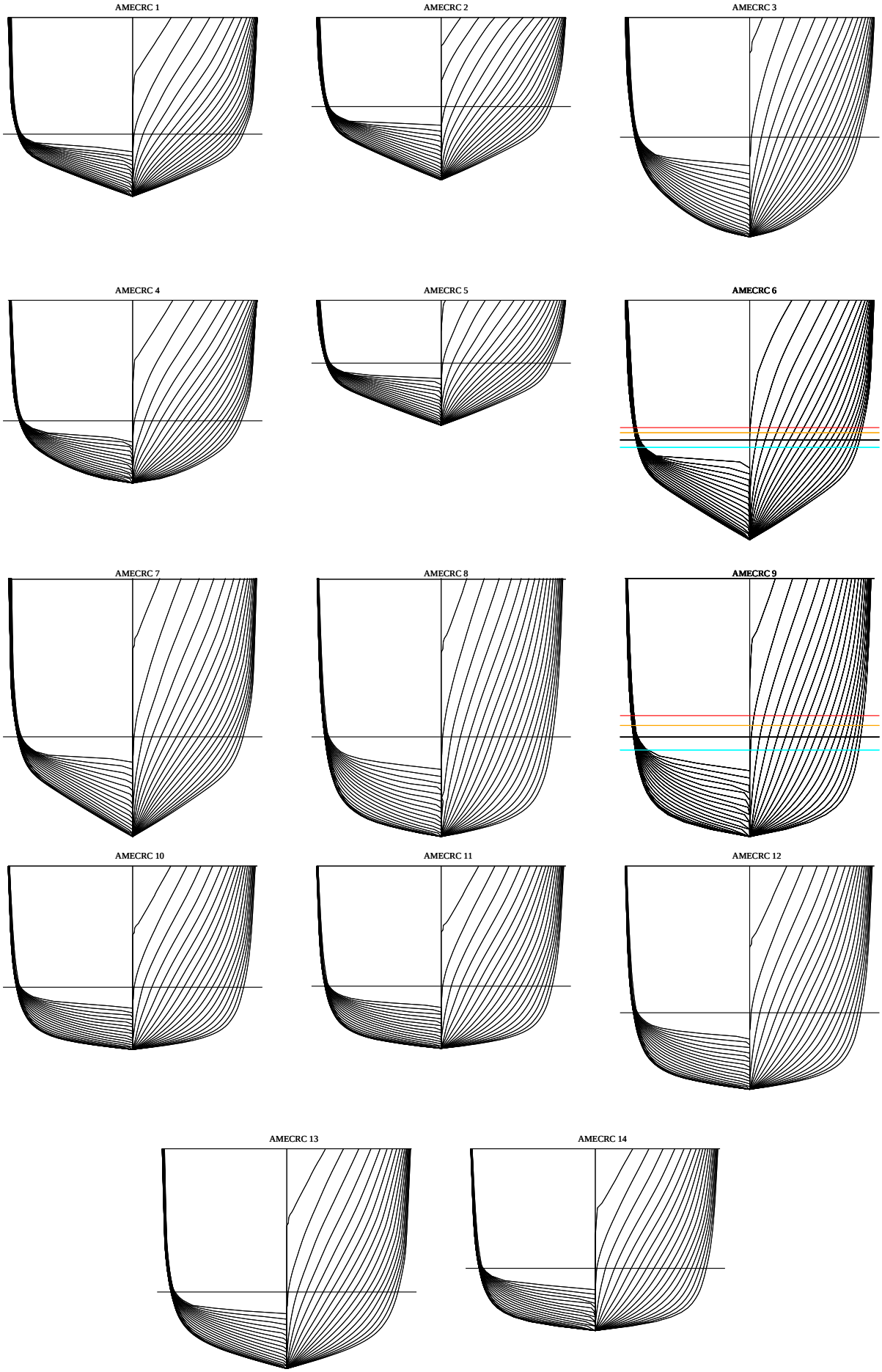

Figure 4: AMECRC Model Series.

Hull	L (m)	L/B	B/T	C_∇	C_B	C_M	C_P	C_{VP}	C_{WP}	S/L^2	B_T/B	T_T/T	C_{AT}
M1	1.60	8.00	4.00	8.67	0.393	0.622	0.616	0.497	0.790	0.119	0.966	0.230	0.823
M2	1.60	6.52	3.39	7.10	0.403	0.621	0.627	0.505	0.799	0.157	0.969	0.251	0.828
M3	1.60	8.06	2.50	7.16	0.443	0.702	0.616	0.562	0.789	0.142	0.964	0.280	0.781
M4	1.60	8.00	4.00	8.32	0.444	0.702	0.617	0.562	0.789	0.119	0.965	0.282	0.783
M5	1.60	4.00	4.00	5.46	0.392	0.622	0.622	0.497	0.790	0.241	0.965	0.230	0.827
M6 90%	1.60	8.19	2.60	7.75	0.375	0.613	0.601	0.480	0.781	0.133	0.949	0.186	0.758
M6	1.60	8.11	2.50	7.48	0.392	0.625	0.616	0.496	0.791	0.138	0.964	0.227	0.794
M6 112%	1.60	8.03	2.39	7.22	0.409	0.638	0.631	0.512	0.800	0.144	0.972	0.267	0.822
M6 120%	1.60	7.98	2.31	7.04	0.422	0.647	0.641	0.523	0.806	0.149	0.974	0.296	0.838
M7	1.61	4.03	2.50	4.70	0.392	0.622	0.615	0.496	0.789	0.278	0.965	0.227	0.843
M8	1.61	4.03	2.50	4.35	0.495	0.786	0.615	0.629	0.787	0.292	0.963	0.322	0.749
M9 90%	1.60	8.06	2.65	7.11	0.479	0.779	0.601	0.615	0.778	0.139	0.940	0.276	0.721
M9	1.60	8.00	2.50	6.87	0.495	0.786	0.615	0.629	0.787	0.146	0.963	0.322	0.755
M9 110%	1.60	7.95	2.37	6.65	0.509	0.792	0.628	0.641	0.794	0.152	0.975	0.362	0.782
M9 120%	1.60	7.91	2.25	6.46	0.522	0.797	0.640	0.653	0.799	0.159	0.981	0.397	0.803
M10	1.60	8.07	4.00	8.07	0.495	0.786	0.615	0.629	0.787	0.121	0.963	0.323	0.754
M11	1.61	4.03	4.00	5.08	0.495	0.786	0.615	0.629	0.787	0.244	0.963	0.322	0.756
M12	1.61	8.06	3.25	7.53	0.494	0.786	0.615	0.628	0.787	0.129	0.963	0.322	0.752
M13	1.61	6.05	3.25	6.44	0.446	0.707	0.615	0.565	0.789	0.170	0.965	0.276	0.789
M14	1.60	6.00	4.00	6.63	0.495	0.786	0.616	0.629	0.787	0.164	0.963	0.323	0.759

Table 1: Principal geometric particulars of AMECRC model hulls.

Hull	x_B/L	z_B/T	x_F/L	$1000I_L/L^4$	$1000I_T/L^4$	$\overline{\mathrm{GM}}_{\mathrm{L0}}/L$	$\overline{\mathrm{GM}}_{\mathrm{T0}}/B$
M1	0.0777	-0.319	0.110	7.17	0.108	4.67	0.485
M2	0.0913	-0.316	0.120	9.32	0.203	3.32	0.380
M3	0.0776	-0.347	0.110	7.11	0.105	2.59	0.173
M4	0.0776	-0.348	0.110	7.18	0.108	4.13	0.412
M5	0.0774	-0.317	0.110	14.40	0.867	2.32	0.486
M6 90%	0.0658	-0.315	0.105	6.75	0.099	3.13	0.255
M6	0.0697	-0.316	0.103	6.95	0.104	2.90	0.227
M6 112%	0.0728	-0.319	0.100	7.12	0.109	2.67	0.196
M6 120%	0.0747	-0.321	0.097	7.23	0.112	2.51	0.174
M7	0.0773	-0.315	0.110	14.20	0.845	1.44	0.228
M8	0.0775	-0.371	0.111	14.20	0.840	1.13	0.130
M9 90%	0.0736	-0.371	0.113	6.96	0.103	2.49	0.158
M9	0.0774	-0.373	0.111	7.14	0.107	2.29	0.129
M9 110%	0.0804	-0.374	0.109	7.28	0.111	2.12	0.102
M9 120%	0.0827	-0.377	0.107	7.40	0.114	1.97	0.076
M10	0.0774	-0.372	0.111	7.09	0.105	3.72	0.352
M11	0.0774	-0.373	0.111	14.20	0.844	1.84	0.352
M12	0.0774	-0.373	0.111	7.09	0.105	3.02	0.248
M13	0.0776	-0.348	0.110	9.48	0.250	2.51	0.297
M14	0.0775	-0.373	0.111	9.53	0.255	2.76	0.352

Table 2: Principal hydrostatic particulars of AMECRC model hulls.

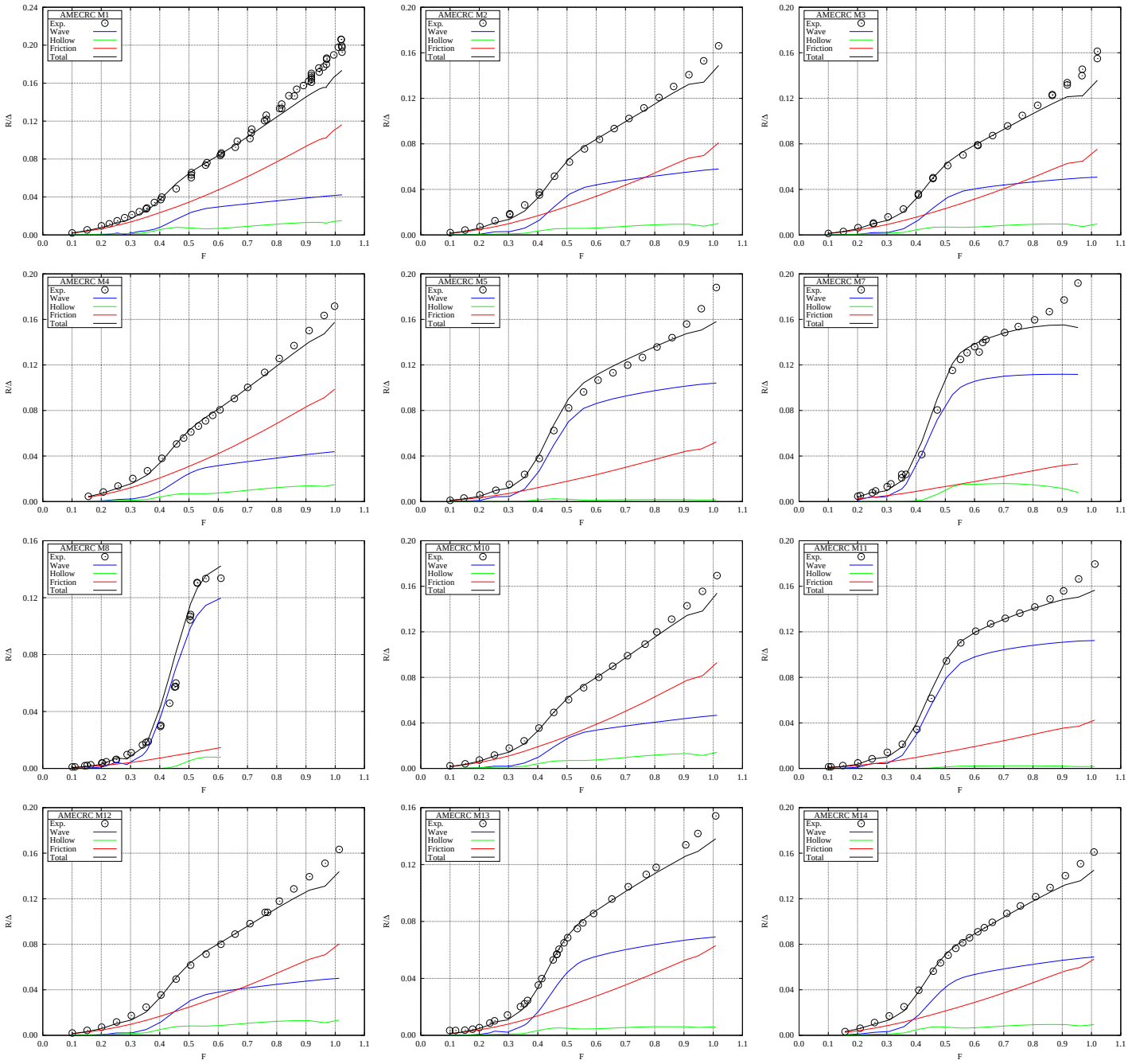

Figure 5: Specific total resistance of AMECRC model monohulls.

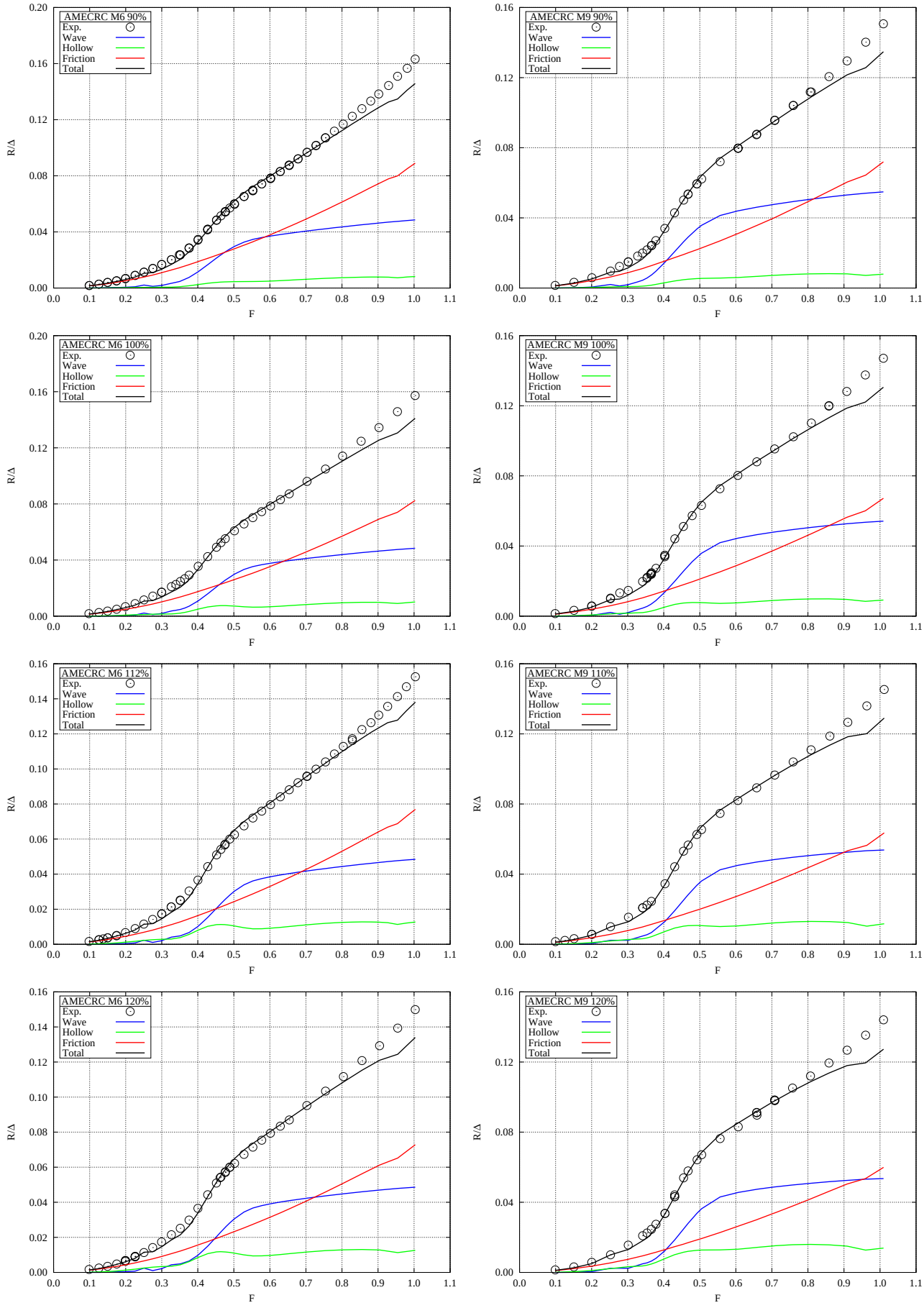

Figure 6: Effect of draft on the specific total resistance of AMECRC models M6 (left) and M9 (right).

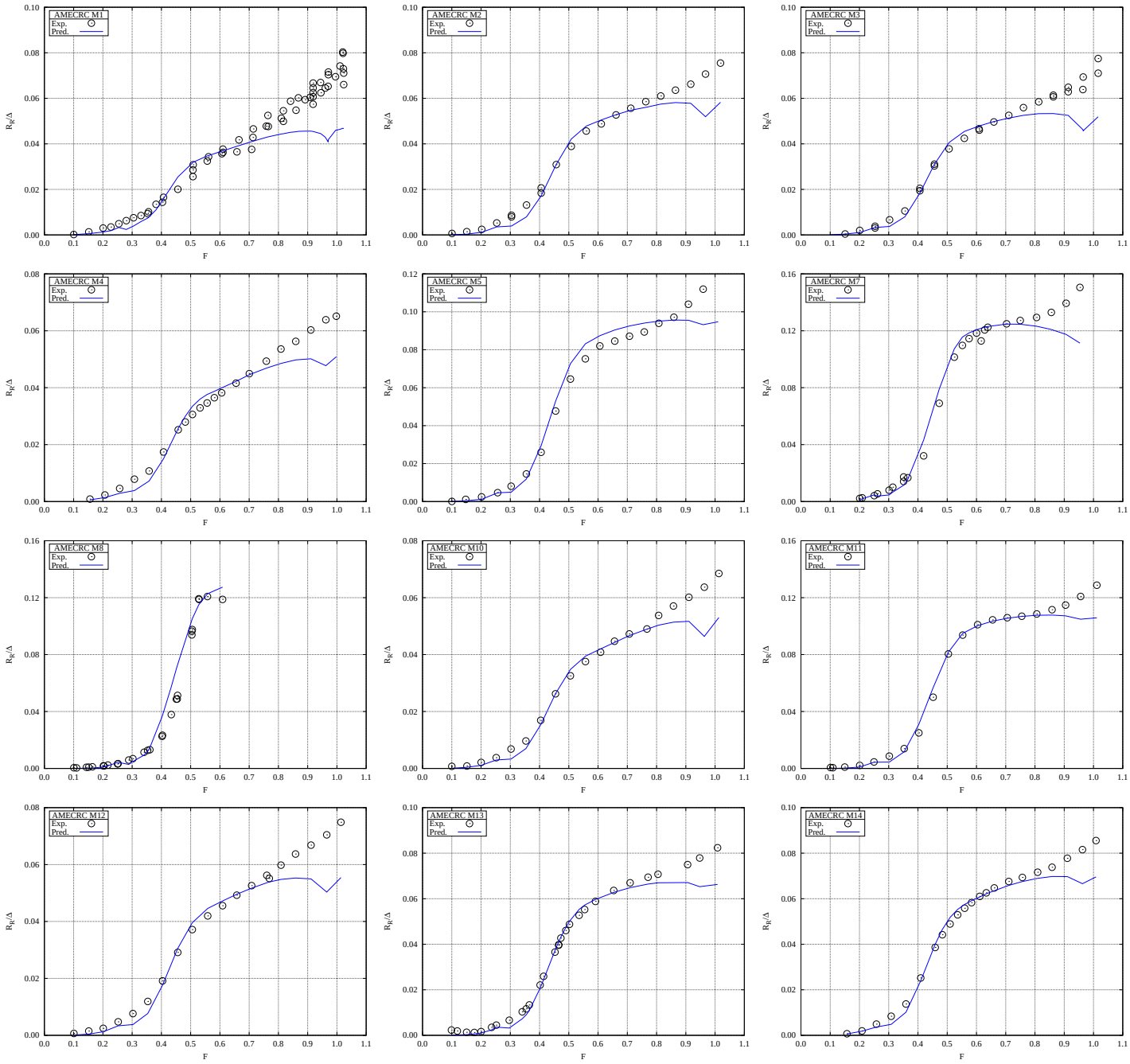

Figure 7: Specific residuary resistance of AMECRC model monohulls.

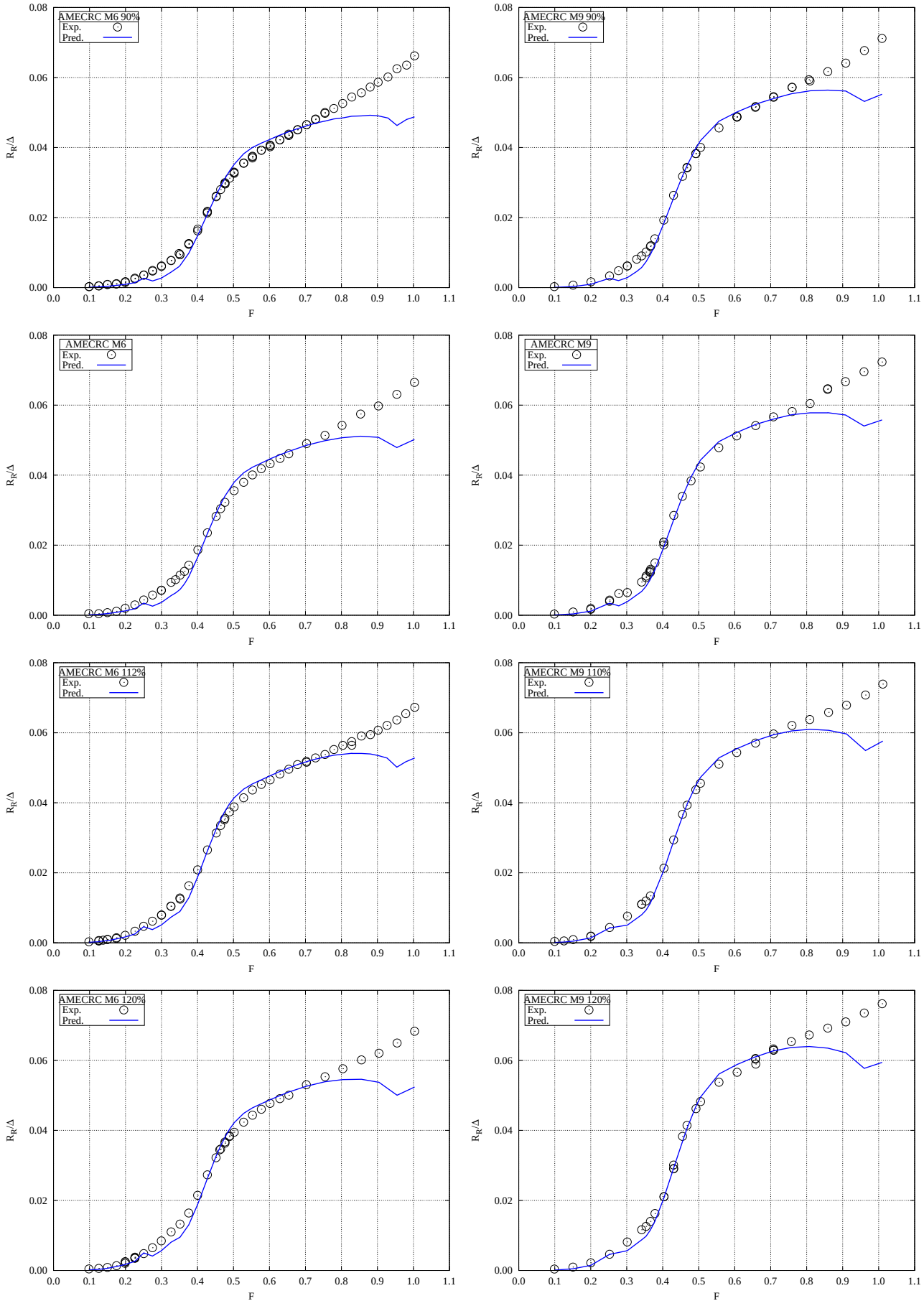

Figure 8: Effect of draft on the specific residuary resistance of AMECRC models M6 (left) and M9 (right).

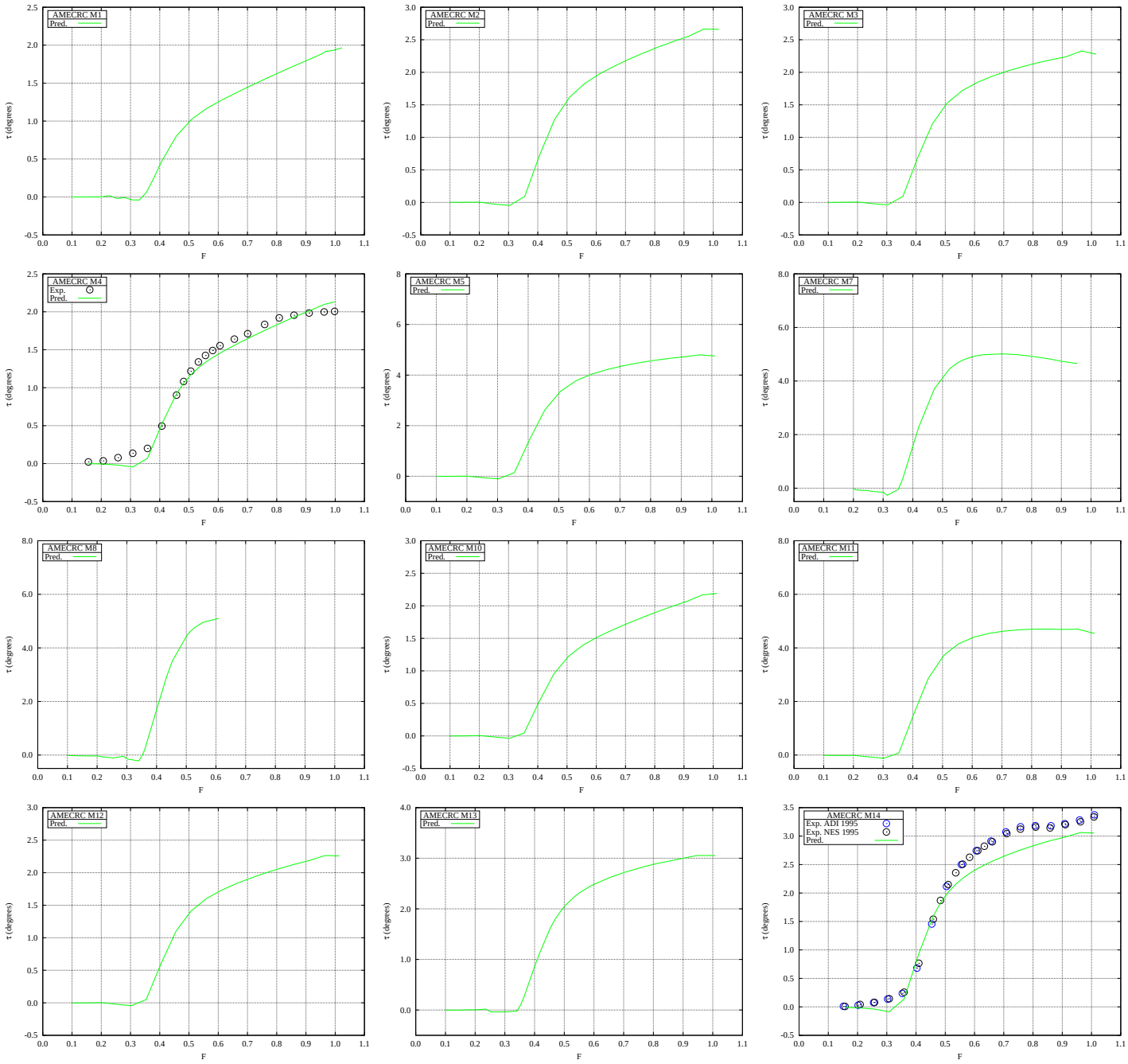

Figure 9: Trim of AMECRC model monohulls.

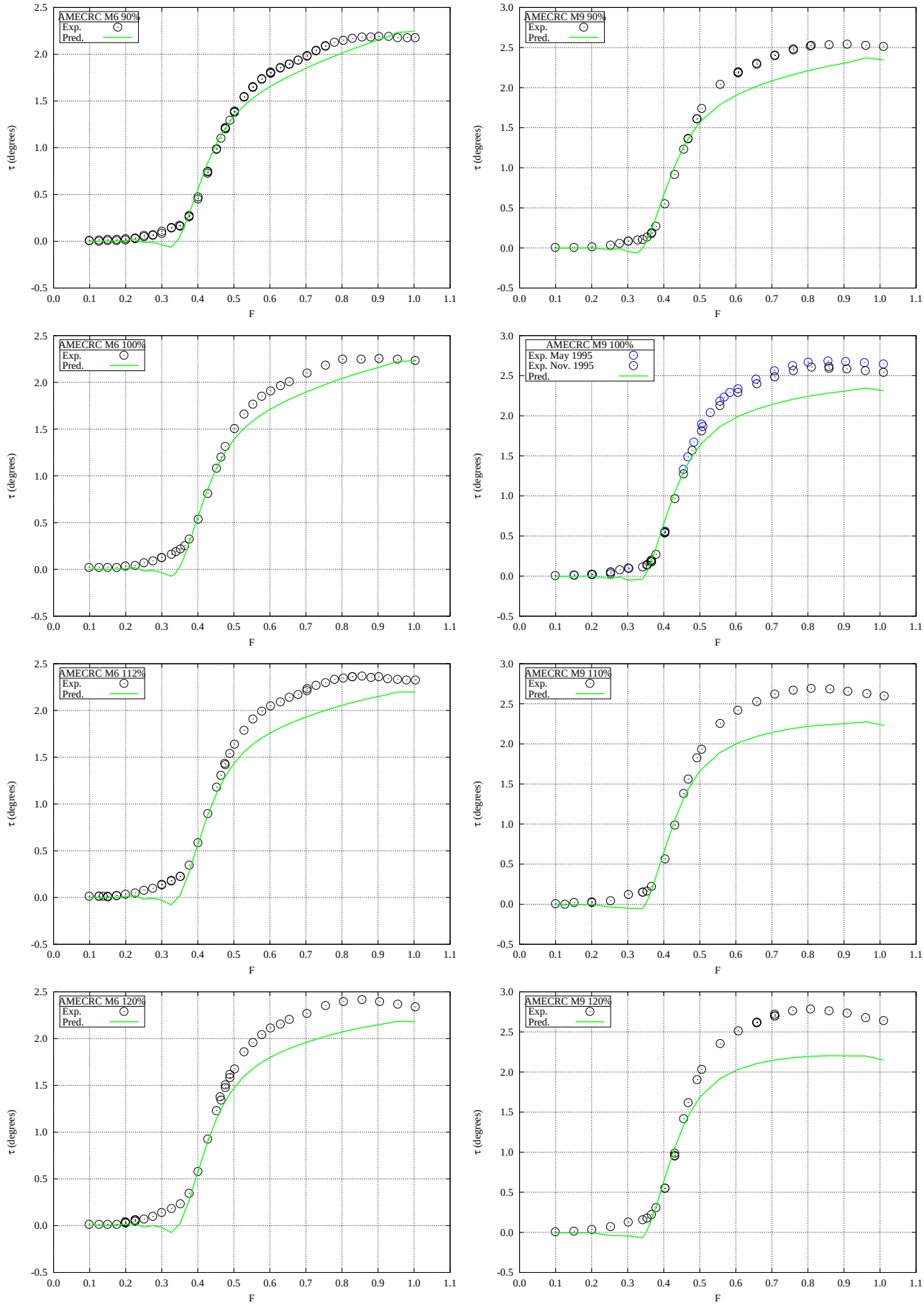

Figure 10: Effect of draft on the trim of AMECRC models M6 (left) and M9 (right).

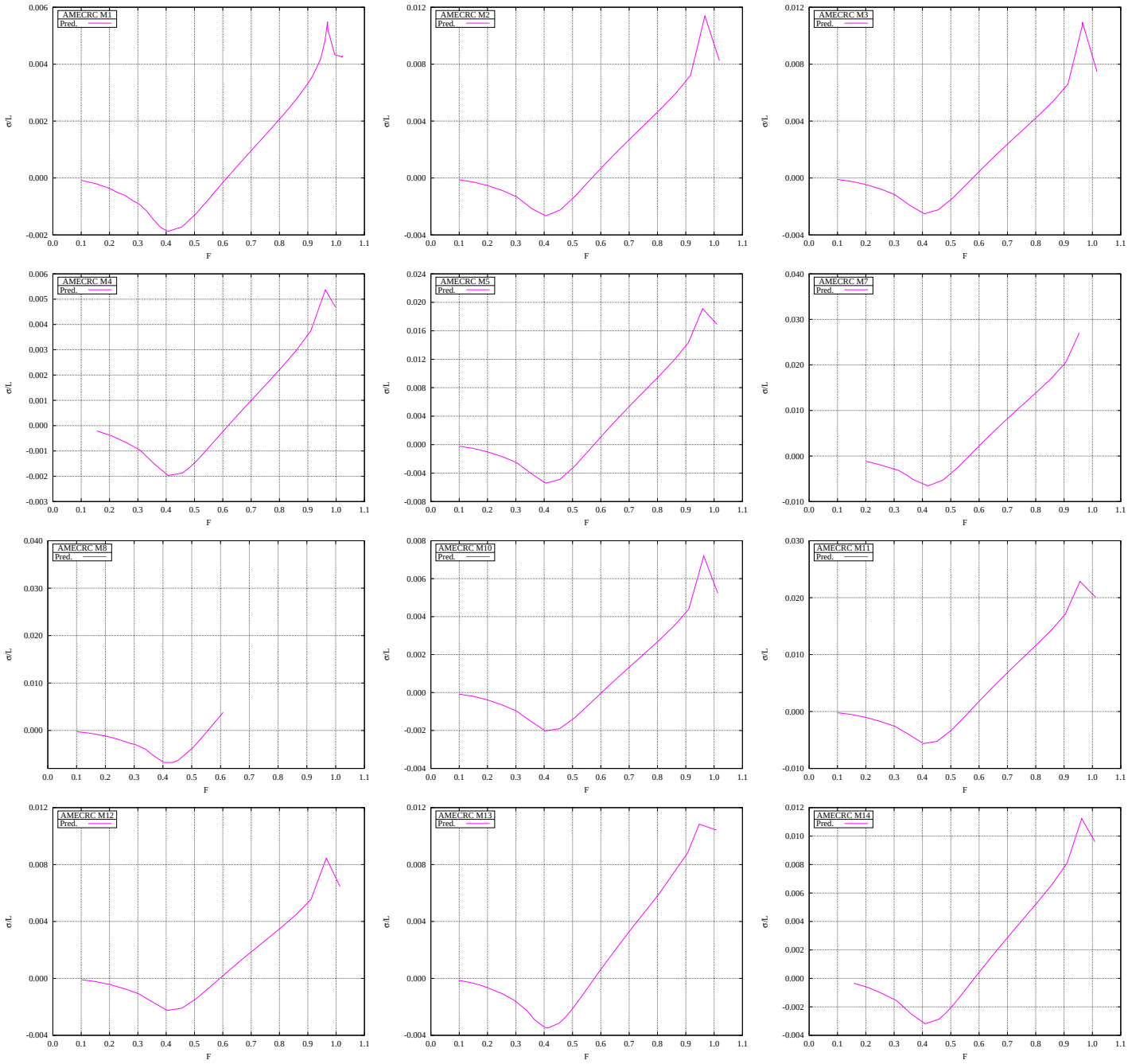

Figure 11: Sinkage at midships of AMECRC model monohulls.

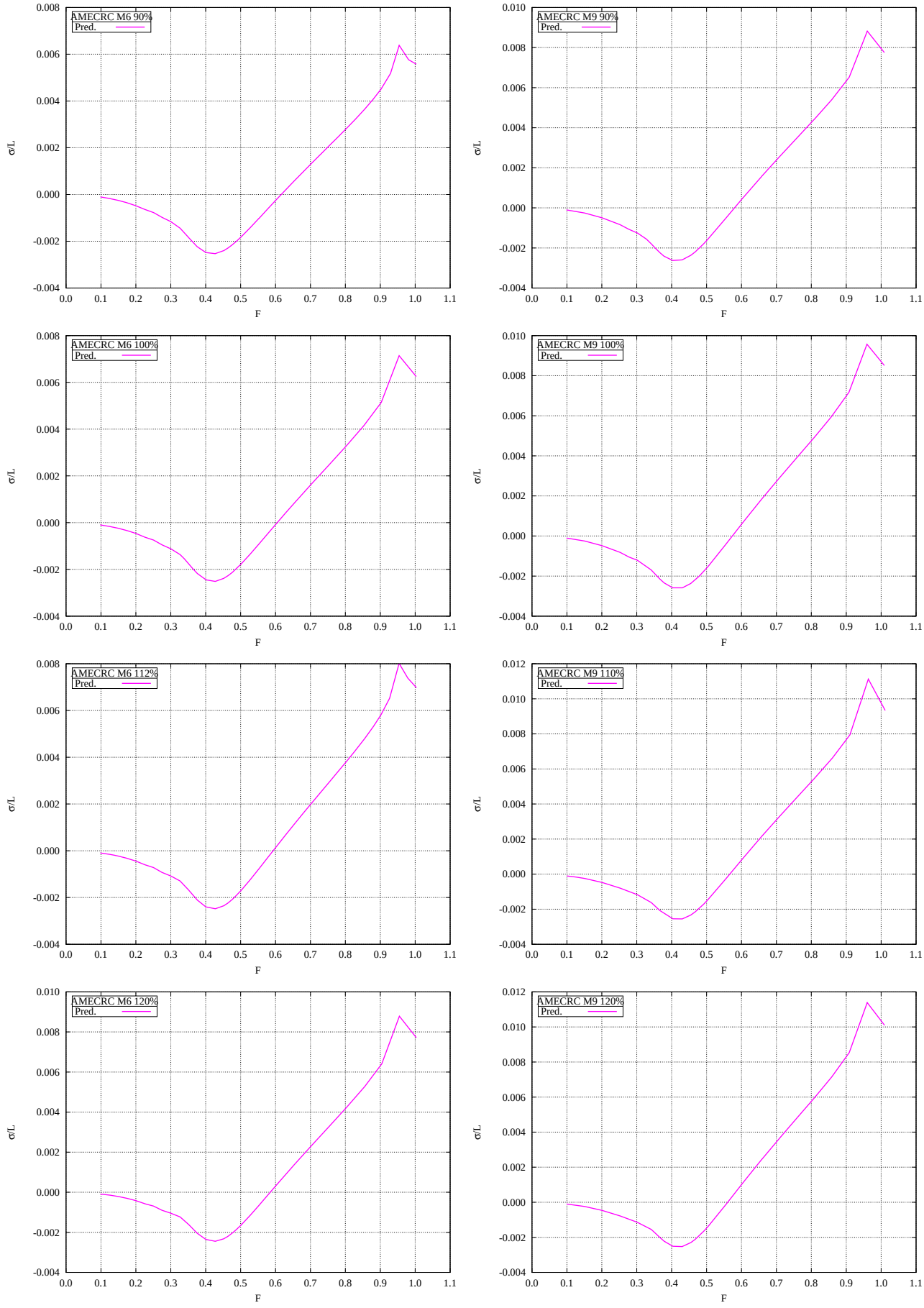

Figure 12: Effect of draft on the midship sinkage of AMECRC models M6 (left) and M9 (right).