Appendix F: Quality Assurance

This appendix describes the quality assurance processes used to ensure Maxsurf Stability gives reliable and accurate results.

Quality Assurance

Many Maxsurf Stability users ask us how we know that Maxsurf Stability produces the correct results. This following explains how Bentley Systems, Incorporated has verified that Maxsurf Stability gives accurate results and what steps we take to make sure that each version of the software we ship is as reliable as possible.

Quality Principles

While it is impossible to ensure that any software product is completely free of bugs, we follow a series of engineering and testing principles and procedures to ensure that Maxsurf Stability will produce results which are consistent with the level of accuracy and thoroughness a professional engineer applies to design work. To this end we follow a development and testing path which includes use of structured programming techniques, verification of the underlying algorithms, testing of the computer implementation of those algorithms, testing of real world problems in-house and beta testing in the field at Maxsurf Stability user sites.

Structured Programming

The best defence against bugs in software is to use structured programming techniques that have been proven to improve software reliability. Without going into the technical details of our software development methodology, we summarize by saying that we utilize structured code, object oriented design, data hiding and encapsulation and fault tolerant programming practices to enhance our software's reliability. Maxsurf Stability is a complex software system of over 400,000 lines of code and we believe our history of reliability reflects the effort we have put into using reliable coding practices.

Verification of Algorithms

When new design or analysis algorithms are introduced into Maxsurf Stability, we first carry out testing on the algorithms on Reference Designs – these are proven test cases with known analytical solutions, see Reference Calculations.

Reference Designs

A folder of reference hull shapes is included with Maxsurf and Maxsurf Stability. These designs are of simple geometric shapes and can be used to validate calculations performed by Maxsurf Stability. Below is a table of results derived analytically from these shapes compared with results obtained from Maxsurf and Maxsurf Stability at different precisions.

Hydrostatics calculations for various reference designs, comparison of Maxsurf and Maxsurf Stability with analytical values

sphere 10m diam at 5m draft										
	Volume m^3	WP Area m^2	VCB m	LCB m	Trans. I m^4	Long. I m^4	Volume	WP Area	Trans. I	Long. I
Analytically derived	261.79939	78.53982	-1.875	0	490.873852	490.87385	% error	% error	% error	% error
Maxsurf Stability High Precision	261.764	78.534	-1.875	0	488.6807269	489.14247	-0.01%	-0.01%	-0.01%	-0.02%
Maxsurf Stability Low Precision	260.34279	78.357	-1.874	0	488.564741	488.93873	-0.56%	-0.23%	-0.47%	-0.39%
Maxsurf Hi Precision	261.532	78.341	-1.875	0	490.57	485.761	-0.10%	-0.25%	-0.06%	-1.04%
Maxsurf Low Precision	257.105	77.849	-1.871	0	483.191	480.89	-1.79%	-0.88%	-1.57%	-2.03%
10m Cylinder 10m diam. at 5m draft										
	Volume m^3	WP Area m^2	VCB m	LCB m	Trans. I m^4	Long. I m^4	Volume	WP Area	Trans. I	Long. I
Analytically derived	392.699	100	-2.122	0	833.333333	833.33333	% error	% error	% error	% error
Maxsurf Stability High Precision	392.673	100	-2.121	0	833.257	833.308	-0.01%	0.00%	0.01%	0.00%
Maxsurf Stability Low Precision	391.991	100	-2.121	0	833.333333	833.33333	-0.18%	0.00%	0.00%	0.00%
Maxsurf Hi Precision	392.522	100	-2.122	0	833.333	833.333	-0.05%	0.00%	0.00%	0.00%
Maxsurf Low Precision	389.874	100	-2.118	0	833.333	833.333	-0.72%	0.00%	0.00%	0.00%

Box 20m long 10m beam at 5m draft

	Volume m^3	WP Area m^2	VCB m	LCB m	Trans. I m^4	Long. I m^4	Volume	WP Area	Trans. I	Long. I
Analytically derived	1000	200	-2.5	0	1666.666666	6666.6667	% error	% error	% error	% error
Maxsurf Stability High Precision	1000	200	-2.5	0	1666.666666	6666.6667	0.00%	0.00%	0.00%	0.00%
Maxsurf Stability Low Precision	1000	200	-2.5	0	1666.666666	6666.6667	0.00%	0.00%	0.00%	0.00%
Maxsurf Hi Precision	1000	200	-2.5	0	1666.667	6666.667	0.00%	0.00%	0.00%	0.00%
Maxsurf Low Precision	1000	200	-2.5	0	1666.667	6666.667	0.00%	0.00%	0.00%	0.00%

Parabolic Wigley type Hull, LWL=15m,B=1.5m,D=0.9375

	Volume m^3	WP Area m^2	VCB m	LCB m	Trans. I m^4	Long. I m^4	Volume	WP Area	Trans. I	Long. I
Analytically derived	9.375	15	-0.352	0	1.92875	168.75	% error	% error	% error	% error
Maxsurf Stability High Precision	9.368	14.998	-0.352	0	1.92527	168.4685	-0.07%	-0.01%	-0.04%	-0.01%
Maxsurf Stability Low Precision	9.351	14.98	-0.352	0	1.92418	168.3773	-0.26%	-0.13%	-0.24%	-0.22%
Maxsurf Hi Precision	9.372	14.999	-0.351	0	1.927	168.63	-0.03%	-0.01%	-0.09%	-0.07%
Maxsurf Low Precision	9.302	14.942	-0.351	0	1.91	167.621	-0.78%	-0.39%	-0.97%	-0.67%