A Simple Formula Example

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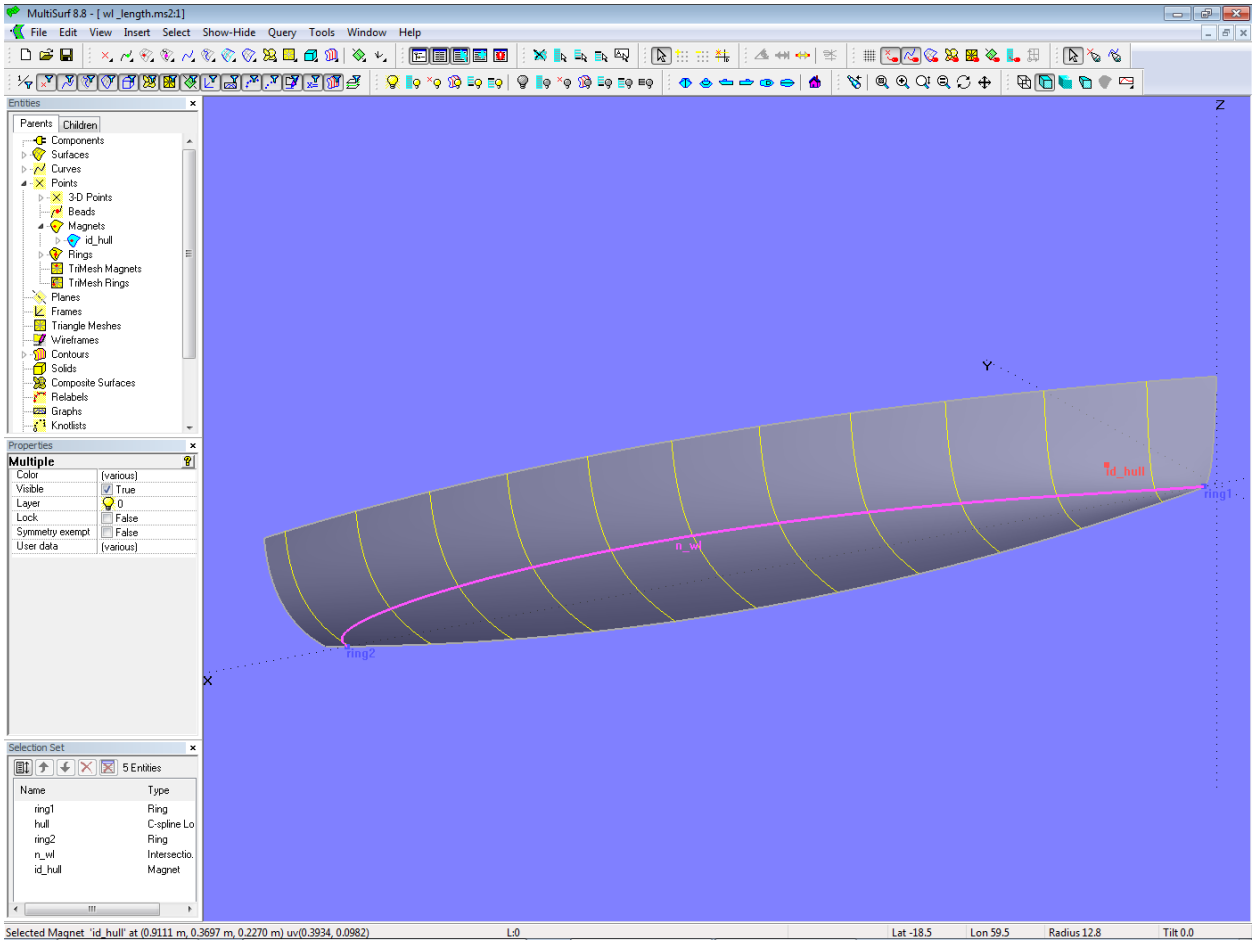
MultiSurf provides a wide variety of mathematical functions. The complete set is listed below.

Often used are the following ones:

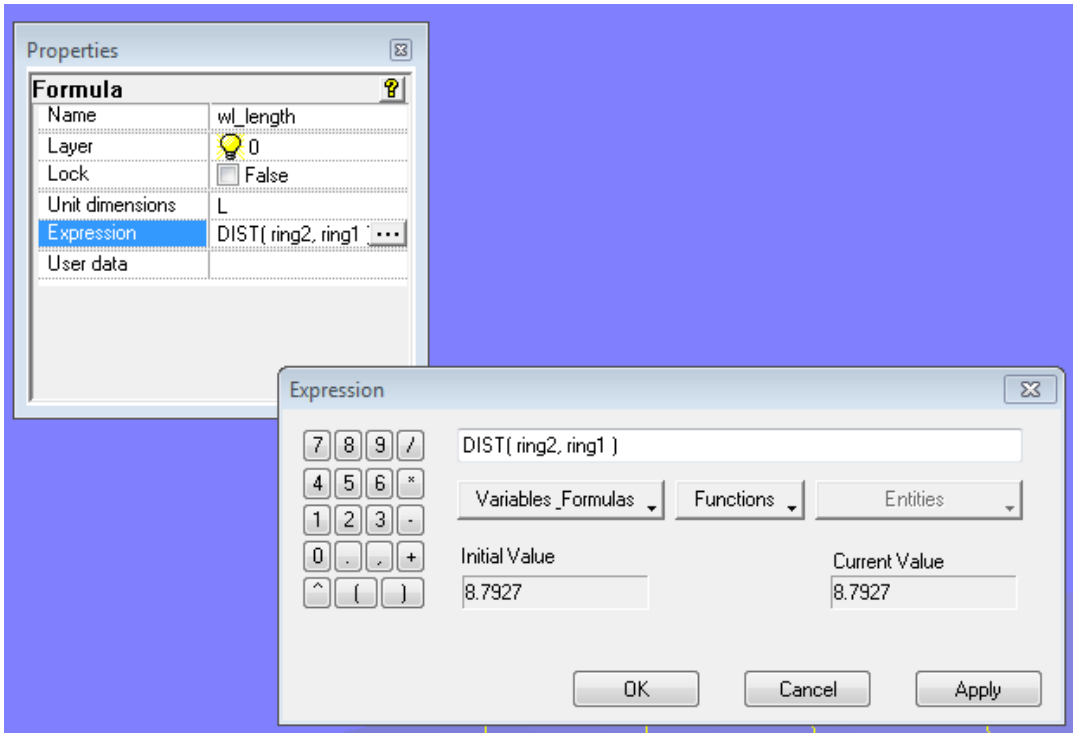
- XPOS, YPOS, ZPOS: returns the XYZ position of a point
- TPOS returns the t position of a point
- ARCLEN: return the girth length between two curve points
- AREA: returns the area of a surface
- CENTROID: returns the XYZ coordinates of center of area

Let us consider a simple example. Open model wl_length.ms2.



The model shows hull surface “hull”. We want to measure the waterline length.

- Create Magnet “id_hull” in the bow area.
- Intersect the hull by the *Z=0 plane. This is the Intersection Snake “n_wl”.
- Put ring1 at the start of the intersection snake.
- Put ring2 at the end of the intersection snake.
- Create the Formula “wl_length” using this expression:



Here the function DIST has been used.

Since both rings have coordinates Y = 0 and Z = 0 an alternative is to use the function XPOS. The expression for the formula “wl_length” would then read: XPOS(ring2) – XPOS(ring1).

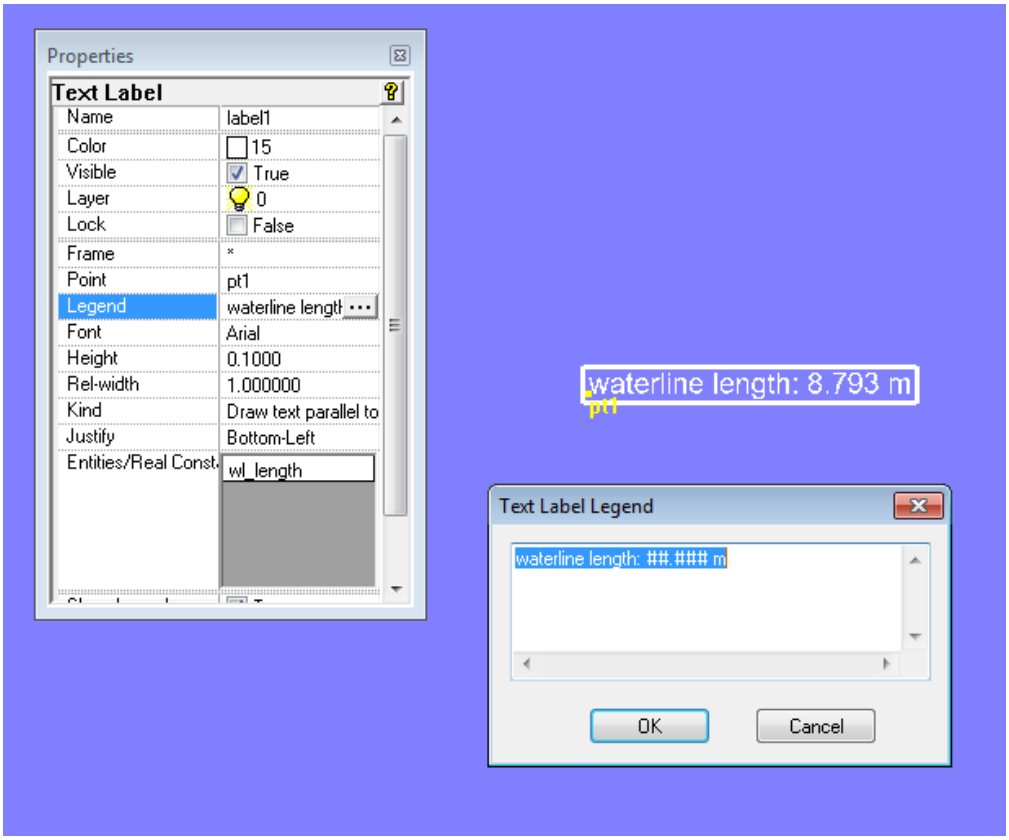
In order to display the result of our calculation (i. e. the value of variables and formulas) we have two options:

- Real Values
- Text Label

For Real Values display use the Tools menu or the shortcut letter key V.

To present the content of variables by the entity Text Label follow thes steps.

- Create a point serving as the handle of the Text Label (here this is point pt1)
- Insert the Text Label entity. Note, that the property “Legend” provides input for a discription as well as for the formating of the displayed value.



More complex use of variable and formulas is made in the models sloop_rig.ms2, J22.ms2 and main_dimensions.ms2.

Mathematical functions available in MultiSurf

Name	Argument(s)	Result	Synopsis
ABS	1, any units	Same units as argument	*Absolute value*
ACOS	1: unitless	unitless	arc cosine (radians)
ACOSD	1: unitless	unitless	arc cosine (degrees)
ALARM	2: any units	Unitless	*ALARM has 2 arguments ALARM(x,y). The alarm "goes off" (goes into error) if (1) it is set (x > 0) AND (2) y < 0. Using a formula or expression for y, you can build various warning limits into a model.*
ANGLE	3: point, point, point	Unitless (degree)	*Angle of three points (angle at pt2 between the directions to pt1 and pt3)*
ARCLEN	3: curve, unitless, unitless	Length	*Arc distance along curve, from t1 to t2*
AREA	2: surface, use_sym (0 or 1)	Area = L^2	*Area of surface, CompSurf, or TriMesh*
ASIN	1: unitless	unitless	arc sine (radians)
ASIND	1: unitless	unitless	arc sine (degrees)
ATN	1, unitless	Radian (unitless)	*Arc tangent*
ATND	1, unitless	Degree (unitless)	*Arc tangent (in degrees)*
ATN2	2, both with same units	Radian (unitless)	*Arc tangent(y/x)*
ATN2D	2, both with same units	Degree (unitless)	*Arc tangent(y/x) (in degrees)*

BBOX	1. Entity or Entity List 2. Real scale factor 3. Real sign 4. Index, 1 to 3 for X, Y, or Z component	Length	*The BBOX function gets information about the bounding box of an entity, or a set of entities specified by an Entity List. A bounding box is the smallest rectangular solid, aligned with the global coordinate system, that encloses the selected entities.*
BSPL	1. KnotList, or *UNIFORM for uniformly spaced knots. 2. K, polynomial order (2 for linear, 3 for quadratic, 4 for cubic, etc.) 3. N, number of basis functions. 4. I, index indicating which basis function to evaluate (1 to N). 5. T, parameter (nominal range 0 to 1, but can be any real value)	unitless	*The BSPL function evaluates the so-called "B-spline basis functions", which are the mathematical foundations of B-spline and NURBS curves and surfaces.* *Example: BSPL(*UNIFORM, 3, 5, 2, 0.40) returns 0.3200* *In this case the knots are uniform (0, 0, 0, 1/3, 2/3, 1, 1, 1); the B-splines are quadratic (K = 3); there are N = 5 of them; I = 2 selects the second basis function; T is 0.40.* *Errors:* *222. NURB has too few knots for its order and number of control points.* *223. NURB has too many knots for its order and number of control points.* *234. Insufficient spacing between knots.* *556. BSPL function: order less than 1.* *557. BSPL function: number of basis functions less than 1.* *558. BSPL function: index is out of range (1 to number of basis functions).*
CEIL	1: any units	Same units as argument	*CEIL(x) is the smallest integer that is greater than or equal to x*
CENTROID	3: entity, use_sym (0 or 1), index (1-3, for X,Y,Z coordinate)	Length	*Coordinates of centroid*
CLEAR	2: point, graphic entity	Length	*Clearance*
COS	1, radian (unitless)	Unitless	*Cosine*
COSD	1, degree (unitless)	Unitless	*Cosine (of angle in degrees)*
COSH	1: unitless	unitless	hyperbolic cosine
CURV		1/Length	*Curvature of host curve or snake, at t location of bead/ring.* *If t is on a breakpoint, hi_side (0 or 1) controls*

			whether curvature is measured below or above the break. *kind: 0 is 3-D curvature of curve or snake; 1 is normal curvature of snake; 2 is geodesic curvature of snake.*
CURVINT	3: curve, t, real	L times units of real	integral of real times ds along curve ds is the element of arc length along the curve t is a Variable real is a Formula descended from t
DIST	2: point, point	Length	*Distance between points*
ERROR	1: entity	Unitless	*Error code attached to entity (0 if no error).*
EXP	1, unitless	Unitless	*Exponential*
FLOOR	1: any units	Same units as argument	*FLOOR(x) is the greatest integer that is less than or equal to x*
FRAMEPOS	3: point, frame, index (1-3, for x,y,z coordinate)	Length	*Coordinates of point in frame*
GRAPH	2: graph, unitless	Unitless	*Evaluation of graph*
HYDRO	6: sp.gr., Zcg, sink, trim, heel, index	various, depending on index	fixed-position hydrostatics based on the visible contours index is 1 to 29; selects one of 29 results, e.g. index = 6 for displacement volume; index = 15 for wetted surface
IF	3: any units	Same as units of selected argument	*If arg1 >0, arg2; else arg3*
LOG	1, unitless	Unitless	*Natural logarithm*
LOG10	1, unitless	Unitless	*Base-10 logarithm*
MASS	3: entity, use_sym, index	M ML	*Mass, if use_sym is not 0, includes symmetry images* *Index = 0 returns Mass* *Index = 1, 2 or 3, the value returned is the mass moment with respect to X, Y or Z. This is the product of mass times the X, Y or Z coordinate of the centroid. Unit dimensions are ML*
MAX	2, both with same any units	Same units as arguments	*Maximum*
MIN	2, both with same any units	Same units as arguments	*Minimum*
PI	1; any units	Unitless	*PI has 1 argument, but its value is immaterial; PI(x) = pi for any x*
ROUND	1, any units	Same units as argument	*Rounding to integer*
ROUND2	1, any units	Same units as argument	*(x, places) rounds x to the specified number of decimal places. E.g., ROUND2(PI(0),2) is 3.140000.*
SIGN	1: any units	Unitless	*SIGN(x) is +1 when x > 0, -1 when x < 0, 0 when x = 0*
SIN	1, radian (unitless)	Unitless	*Sine*
SIND	1, degree (unitless)	Unitless	*Sine (of angle in degrees)*
SINH	1: unitless	unitless	hyperbolic sine
SQRT	1, unit dimensions all multiples of 2	Unit dimensions of argument divided by 2.	*Square root*
STRAIN	2: Surface/TriMesh, index	Unitless	

			Surface/TriMesh is a surface or TriMesh entity *index = 0 or 1, for minimum or maximum strain* *This function reports the strain range for an Expanded Surface or Expanded TriMesh.*
SURFCURV	5: magnet, hi_side_u, hi_side_v, kind, angle	L^-1 for kind = 0 or 2; L^-2 for kind = 1	Surface curvature kind = 0, normal curvature kind = 1, Gaussian curvature kind = 2, mean curvature
SURFINT	4: surface, u, v, real	L^2 times units of real	integral of real times dA over surface dA is the element of area on the surface u and v are Variables real is a Formula descended from u and v
TAN	1, radian (unitless)	Unitless	*Tangent*
TAND	1, degree (unitless)	Unitless	*Tangent (of angle in degrees)*
TANH	1: unitless	unitless	hyperbolic tangent
TPOS	1, bead or ring	Unitless	*t parameter*
UNITMASS	1: entity	M for a point ML^-1 for a curve ML^-2 for a surface ML^-3 for a solid	unit weight property of entity
UPOS	1, magnet or ring	Unitless	*u parameter*
VELOCITY	3: curve, t, hi_side	Length	*Rate of change of arc length with respect to t* *If t is on a breakpoint, hi_side (0 or 1) controls whether velocity is measured below or above the break.*
VOLUME	2: solid, use_sym (0 or 1)	Volume = L^3	*Volume of solid*
VPOS	1, magnet or ring	Unitless	*v parameter*
XPOS	1, point	Length	*X coordinate*
YPOS	1, point	Length	*Y coordinate*
ZPOS	1, point	Length	*Z coordinate*