General Load Monitor

G.L.M. : the on-board stability calculator ...

DEMONSTRATION OPERATOR'S MANUAL

Distributed by:

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GLM Menu Diagram

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Vessel Information & configuration
set Title of condition
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Vessel information & configuration Menu

Information about the model
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Environment: Specific gravity of the water
Printer setup
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condition Files Menu

File this condition
Retrieve this condition
Delete a condition
Main Menu

Reporting Menu

Output device selection
Type of report
enter a Note
Run the Report
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Output device selection Menu

Screen only
Printer
File on disk

Weight item setup Menu

List weight items
Add or replace a weight item
Delete a weight item

Type of report Menu

Both weight list & stability
Weight list only
Stability only

Printer setup Menu

0 - No setup
1 - Epson
2 - Epson FX
3 - Epson LQ
4 - IBM Proprinter

Custom

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Copy a report to output device
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General Load Monitor ™

General Load Monitor @ (GLM) is a special configuration of the General HydroStatics TM (GHS) program to be used by vessel operators as an on board stability calculator. The program requires only a basic understanding of DOS commands and file handling in order to operate. The program has a menu-oriented user interface and is easily mastered. Appropriate loading information is input into the system and the stability of the vessel quickly computed. Loaded conditions can be saved on disk for later reference and a hardcopy output can be printed.

GLM is based on the approved Stability Booklet as provided by the vessel's Naval Architect. The GLM system includes a geometric model of the vessel. The model is created by the Naval Architect or Creative Systems, Inc. The details of the model depend on the information provided by the Naval Architect. It is important that the vessel operator review the model carefully and confirm that the model accurately reflects the vessel's present condition and the information provided in the stability booklet.

GLM provides an accurate and speedy means for calculating the stability of the vessel in any loaded condition. The user inputs all fixed weights and tank loads. GLM then determines the total displacement and center of gravity for the vessel along with drafts, trim and heel. The stability of the vessel is evaluated against a maximum allowable VCG curve. GMt and the natural roll period of the vessel are also computed. A righting arm curve can be calculated for each condition. GLM will inform the vessel personnel whether or not a loaded condition meets the required stability criteria. The system can be configured to simulate damaged conditions and, optionally, longitudinal strength calculations.

Results for each loaded condition should agree with the numbers provided in the Stability Booklet. Stability Booklets compiled using the General HydroStatics TM program should agree almost exactly with the GLM results. In cases where the Stability Booklet has been prepared using other hydrostatics software, the user may see slight differences in the results. In such cases, GLM has been configured to be within 2% of displacement, within 0.2 feet of KMt and within 0.2 feet (or 1% of the length of the vessel, whichever is greater) of LCB/LCF when compared with the Stability Booklet. The Stability Booklet should always take precedence over GLM when unexplained differences occur. These diffrences should be reported immediately to the Naval Architect.

More importantly, results for each loaded condition should agree with the observed condition of the vessel. If discrepencies occur, the user should first check to insure that his input and observations are correct. The Naval Architect should be notified if the actual trim, heel or draft of the vessel do not agree with the results predicted by GLM. This may be due to inaccuracies in the Stability Booklet, the GLM configuration or the fact that the vessel's lightship condition has changed since the time of the stability test.

The GLM system is not to be used for making operational decisions until approved by the Naval Architect. The apprval should be in the form of a letter from the Naval Architect attesting to the accurancy of the GLM installation. The letter should be kept with this manual at all times. The GLM system should be updated when either the stability booklet is modified or the vessel is substantially altered. GLM can be updated by contacting your Naval Architect or Creative Systems, Inc.

THE STABILITY BOOKLET

GLM is not a replacement for the Stability Booklet. The user should be familiar with the Stability Booklet and refer to it often. The GLM information Sheet at the back of this manual shows important information from the Stability Booklet that was used in the GLM configuration for this vessel. GLM is based on the following items in the Stability Booklet.

Lightship

The Lightship weight of the vessel is calculated by the Naval Architect from information obtained during the stability test. An Operational Lightship is often defined which may include crew and effects, provisions, spare parts, tools and miscellaneous tanks such as the lube oil or hydraulic oil tanks. The Operational Lightship weight should be defined in the Stability Booklet and the user should be familiar with the fixed weights and tanks that have been included in this calculation. The user should be sure not to add fixed weights into GLM that have already been included in the Operational Lightship.

Drafts

The GLM system is configured to calculate drafts that will correspond to those observed by the user. The Stability Booklet should provide information describing the longitudinal location of the draft marks and vertical position from which the drafts are measured. Drafts are normally measured from the lowest point on the hull. This is usually the bottom of the keel but may refer to a sonar dome or other such object if fitted. Drafts are not always measured from the vertical baseline and the user should not confuse the vertical reference for draft measurements with the vertical baseline for measuring centers of gravity as they are not always the same. (see the discussion concerning The Origin in the next section)
GLM calculates drafts at the centerline of the vessel. If there is a port or starboard list on the vessel when the observed drafts are taken, the port and starboard drafts must be averaged before comparing them with the GLM output.

Trim

GLM is configured to calculate the trim of the vessel over the length between the draft marks. This should correspond to the difference between the observed drafts.

Free-Surface Effect

GLM can handle the free-surface effect in one of four ways :
1) By calculating the actual moments of transference (i.e. the actual shift in the centers of gravity of the liquid as the vessel heels). Where the moment of transference is used, there will be no ‘‘ free-surface ’’ adjustment to the VCG in the stability report described in the ***Reporting*** section of the manual. In this case, the actual shift of the VCG has already been taken into account.
2) By calcutating the free-surface moment for each slack tank.
3) By calculating a maximum free-surface moment to be used in every loading condition based on a ‘‘ worst case ’’ condition for one centerline tank or one pair of port and starboard tanks for each consumable or liquid cargo carried on board.
4) A combination of 2) and 3).
The Stability Booklet should provide information regarding the calculation of the free-surface effect. While the moment of transference method is the most accurate means of handling the free-surface phenomenon (and can be easily calculated by GLM), many regulatory agencies still prefer to see the more simplistic free-surface moment calculation.
Either the actual free surface moments for all tanks containing liquids, or a user-defined free-surface moment, is used in Load Editor TM for determining the free-surface adjustment (*FSA*) and *GMt*. GLM handles the free-surface effect in the same manner as the Stability Booklet when calculating righting arm curves in the ***Reporting Menu***. The user should refer to the ***Loading : create/update condition Menu*** and the ***Reporting Menu*** for more on this subject.

Fixed (non-liquid) weights

Fixed weights may include crew and effects, provisions, stores, cargo, fishing gear, spare parts etc. Miscellaneous tanks not included in the model may be included in this list. Some of these items may be included in Operational Lightship and will therefore not appear in the fixed weight item list. The fixed weight item list is not all inclusive and the user should check to see that all fixed weight items on the vessel have been accounted for in either Operational Lightship or the weight item list. The user may add, delete or replace fixed weights as necessary. (See the ***Weight item setup Menu***)

Stability Criteria

Different vessels are required to meet certain stability criteria depending on their size and service. The Stability Booklet should state specifically the stability criteria used to evaluate the vessel’s stability. GLM is configured, when possible, to evaluate the stability of the vessel with regards to all the applicable criteria. GLM evaluates the stability of the vessel in tow ways:
1) The initial evaluation of the vessel’s stability is based on a maximum allowable VCG curve where the VCG of a loaded condition is compared against the maximum allowable VCG for the current displacement and trim. (See the section on ***Loading: create/update condition***)
2) The second, and most thorough, evaluation of the vessel’s stability is the calculation of a righting arm (or GZ) curve. GLM will evaluate the righting arm curve and tell the user by exactly how much the loaded condition passes or fails each of the stability criterion. If more than one stability criterion are applicable to the vessel, GLM may be configured to produce more than one righting arm curve. Each curve will evaluate a separate criterion. (See the section ***Reporting***)

NOTE: The user should review the GLM Information Sheet at the back of this manual to see how the items discussed in this section are configured for this vessel.

THE VESSEL MODEL

GLM contains a geometric model of the vessel. The model is made up of Parts, Components and Shapes. An example of this may be the Part called *Hull*, composed of individual components describing the *hull, skeg, keel, bow thruster, forecastle, poop deck* etc. Each component is in turn defined by a unique geometrical shape.

The Origin

The origin is the point from which all distances on the vessel are measured. The location of the origin is at the discretion of the Naval Architect who constructs the model. The longitudinal origin is often located at Frame 0. For most U.S. vessel, this is at, or near the bow. For vessels built outside of the U.S., Frame 0 is often located at, or near, the stern. The location of the longitudinal origin is not restricted to Frame 0 and it may be located amidships.

Longitudinal distances are measured positive aft of the origin (e.g. 120 or 120a) and negative forward of the origin (e.g. -120 or 120f). A ‘‘ f ’’ or ‘‘a’’ following the number can be used in lieu of the ‘‘+’’ or ‘‘-’’ designation when referring to forward or aft.

The transverse origin is normally located along the centerline of the vessel. Transverse distances are measured positive to starboard (e.g. 15 or 15s) and negative to port (e.g. -15 or 15p). A ‘‘p’’ or ‘‘s’’ following the number can be used in lieu of the ‘‘+’’ or ‘‘-’’ designation when referring to port or starboard.

The vertical origin is normally located along the baseline of the vessel. This may, or may not, correspond to the bottom of the keel. Vertical distances are measured positive above the vertical origin and negative below. The user should not confuse the vertical baseline with the vertical reference for draft measurements as they are not always the same. (See the discussion concerning drafts in the previous section)

The user can, and should always, view the model to determine the location of the origin. When viewing the model, the origin is shown in blue or a dashed-line on monochrome monitors. The location of the longitudinal, transverse and vertical centers of gravity for all weights will be measured from the origin and it is imperative that the user know its exact location. (See the section on ***Vessel information & configuration*** on how to view the model)

Watertight envelope

The model is primarily a geometric representation of the buoyant volume defining the vessel’s watertight envelope. This should be the same watertight envelope used in the Stability Booklet for the stability calculations. Parts such as ramps and bow thrusters are normally included as deductions to the buoyant volume of the vessel.

Superstructure not included in the watertight envelope of the vessel may be included as ‘‘sail’’ parts. ‘‘Sail’’ parts are used only for calculating lateral plane areas for heeling moments due to wind. This information is used in evaluating the Weather Criterion or SevereWind and Roll Criterion where applicable. ‘‘Sail’’ parts are shown in magenta (red) in Load Editor ™ and should not be confused with damaged tanks. Both are shown in magenta because neither are included in the buoyant volume of the vessel.

Tanks

Tanks carrying liquid consumables and ballast that are not part of Operational Lightship are included in the model. Smaller tanks (i.e. lube oil, hydraulic oil etc.) may be included in Operational Lightship and therefore left out of the model.

The specific garvity of the contents in each tank is also included in the model. The specific gravity is used to define the contents of each tank and to calculate the weight of the liquid in the tank. The user should refer to the GLM Information Sheet at the back of this manual to see the list of available ‘‘Contents’’ for the vessel.

Sounding tubes (including sight glasses) may be included in the model. If so, tank soundings may be input directly into GLM with no need for the user to consult the tank sounding tables. The volume, weight, centers of gravity and free-surface moment, if required, will be computed automatically taking into account the trim and heel of the vessel. If sounding tubes are not included in the model, tank tables must be consulted by the user and the volume or weight of liquid in the tank input directly by the user. In either case, centers of gravity and free-surface moments, if required, are automatically calculated. (See the ***Loading : create/update Menu*** section on how to load tanks)

GLM can be configured to evaluate damage conditions for use in damage control. In addition to damaging tanks, internal compartments such as the engine room, passageways, void spaces etc. may be modeled as tanks so that they can also be flooded for simulating damage conditions. This is not necessary for calculating intact stability under normal operations. (See the ***Loading : create/update Menu*** section concerning damaged tanks)

Cargo holds

Cargo holds can be handled in one of two ways. The cargo can be input as fixed weights or the holds can be modeled as tanks. When input as fixed weights, cargo holds are included in the same manner as fixed weight items described in the previous section.

When holds are modeled as tanks, the specific gravity of the intended cargo is included in the model. The specific gravity is used to define the contents of the hold and to calculate the weight of the cargo in the hold. Cargo holds that are modeled as tanks are considered ‘‘forzen’’ and are not included in the free-surface moment calculations.

From an operational point of view, cargo holds are not generally loaded in the same manner as a tank. For example, a fish hold on a large factory trawler may be loaded from the aft end forward with one product and from the forward end aft with another. To say that the hold, modeled as a ‘‘tank’’, is 25% full would calculate the weight and centers of gravity as if the contents of the hold were a liquid. The calculated centers of gravity would be much different than what is actually in the hold. Most importantly, the VCG could be calculated lower than it actually is. The error is relative to the size of the hold. There would also be problems with determining an average specific gravity for a variety of combinations of products.

There are two ways of working around these problems. The first option is to enter the cargo weights and their estimated centers of gravity as fixed weights on the weight item list. This must be done when holds are not modeled as tanks. if the holds are modeled as ‘‘tanks’’ and the user decides to enter their loads as fixed weights, the user should be sure not to load the holds both as fixed weights and as ‘‘tanks’’.

The second option is for the hold to be modelled in smaller sections, or ‘‘cells’’ that can be loaded as individual ‘‘tanks’’ depending on how the hold is loaded. This will lead to the same errors as mentioned above but on a much smaller, and acceptable, scale.

Critical Points and Downflooding

Critical points are defined in the model to simulate locations on the vessel where downflooding may occur as the vessel heels. The angle of downflooding (i.e. the angle of heel where the point of downflooding is submerged) is important in many stability criteria. GLM will calculate the angle of downflooding but will not simulate actual flooding unless specifically instructed to do so.

NOTE: The user should review the GLM Information Sheet at back of this manual to see how the items discussed in this section are configured for this vessel.