

**Creative Systems, Inc.**  
**www.ghsport.com**

# **GHS Salvage Training Manual**

## **GHS 打捞作业训练手册**

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中英文对照

**Rv. 1 - 7/2011 版本**

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## 1.0 INTRODUCTION 简介

Scenarios encountered in salvage operations are a challenge with many factors affecting how to proceed. Fire, rescue of personal, weather conditions, location, equipment available are some of these factors. The job of the naval architect during a rescue is to provide information needed by the operators. Ground reactions, forces needed to lift or roll, amount of floatation devices, effects of deballasting, offloading or shifting cargo and longitudinal strength are some of the areas of concern. Of course, no book or manual will be able to cover every possible scenario. This manual is to demonstrate some of the features and capabilities of GHS that may be useful to a naval architect involved with salvage.

由于受到很多因素的影响，打捞作业是一项极具挑战性的工作。这些因素包括火灾、人员救援、天气条件、地理位置、可利用设备等。工程师的工作是在救援过程中给操作者提供必要的信息。这些需注意的信息包括搁浅时的反作用力、吊装或翻转时的力、浮力设备数量、排放压载水的效应、卸载移动货物和总纵强度。当然，没有一本书或手册能够涵盖所有可能发生的情况。本手册旨在演示 GHS 的某些功能和能力，在打捞作业中，这些功能和能力可能有助于工程师。

It is assumed the user has a good understand of and experience using GHS. Basic concepts, understanding of the geometry model, commands for straight forward stability calculations and the command syntax and working in the GHS environment should be familiar to the user. In addition, macros, passing parameters and user variables will be used throughout this manual and the user should have some experience with them. The additional modules needed, and provided in the Salvage bundle, are Condition Graphics, Load Editor and Longitudinal Strength.

本手册需用户对 GHS 有一定的理解和操作经验，用户熟悉：基本理论、理解模型、稳性计算命令、命令语法和 GHS 工作环境，此外，手册还运用宏、临时参数和用户变量，也需用户熟知并运用。打捞软件包需提供额外附加模块，包括图形模块、转载编辑器模块和总纵强度模块。

### 2.0 GEOMETRY MODEL 模型

If you are lucky, a geometry file exists and is available. If not, one will need to be created. If you have created geometry files in the past, you are probably aware that there are many ways to do so. If there are other programs that you are more familiar with that can create a .GF file directly or export to a format Model Converter accepts, that may be the approach to take. Keeping in mind that many factors are involved in salvage work, such as estimations, approximations and variables beyond human control. As time is usually critical, the geometry file does not need to be stability analysis ready. The tanks to be used for ballast or are flooded can be modeled as needed. If the tank capacity is known, a simple block shape in the general location may be suitable. Accounting for tank loads as point loads and applying free surface corrections will save time. Sail parts can be simple rectangles. Superstructure modeled as a sail part may need to be remodeled as a displacer if submerged and providing buoyancy.

要是运气好，有现成可用的模型，否则，需新建模型。如果你过去建过模型的话，那你应该知道可以通过很多办法建模，你可以用自己熟悉的软件程序直接建 GF 模型或者转换成 GF 模型。请记住，打捞工作受很多因素影响，例如基于现场的判断，预估和不可操控变数。通常由于时间紧迫，模型还没完全准备好用于稳性计算，那么可以只建需要用到的舱室用于压载和舱室浸没。如果知道舱容，在大致位置建立简单形状的舱室即可。用点载荷和自由液面修正计算舱室装载比较节省时间。上建部分可简化成矩形。如上建部分浸没时提供浮力，上建部分需建成浮体。

Geometry modeling will not be discussed in this manual other that stated above. For the scenarios presented below, the standard models, FV.GF and SV.GF will be used.

模型建模之前已经介绍过，本手册不再重复。标准模型 FV.GF 和 SV.GF 用于下面方案。

## 3.0 GROUNDING WITH SEVERE HEEL 横倾搁浅

This section demonstrates the recovery of a grounded hard chine vessel that is on its side. How to setup the initial condition, define ground points, determine the force needed to right the vessel and finding the maximum ground reactions will be discussed. Fig. 3 shows the initial condition.

本章节演示侧边搁浅的船恢复到正常状态的过程。下面将讨论如何设置初始工况、定义搁浅点、复原力以及找出最大搁浅反作用力。初始工况如图 3 所示。

### 3.1 WEIGHT 重量

One piece of information needed is the weight or displacement and center of gravity at the time of the grounding. If draft and trim is known prior to grounding, that information can be used to get the displacement and LCG. VCG may be obtained from a stability book or ship's log if available. For this exercise, a lightship weight, center and loads are assumed to be known. When taking information from the ship's log or pre casualty condition, a correction for any shifted cargo will be necessary.

其中一条信息是搁浅时船的重量或排水量，以及重心位置的信息。搁浅前，如果知道吃水和纵倾角，可以得到排水量和 LCG。VCG 可以从稳性报告或船舶的航海日志（如果有）获得。在本练习中，假设已知船的重量，重心和载荷。如果这些信息是从航海日志或者船破损前的工况得到的，那么需进行修正。

### 3.2 WATERPLANE 水线面

To establish the grounded condition, the waterplane and ground points need to be defined. Let's consider setting the waterplane first. In cases such as this, draft mark readings are unavailable. The DRAFT command is not practical. There are two approaches to defining the waterplane. In GHS, the trim expressed in degrees is the arc tangent of the distance between the waterline at two longitudinal locations divided by the distance between the two locations.

定义水线面和搁浅作用点，设定搁浅工况。首先我们设置水线面，假设吃水标记读数不可用，此时 DRAFT 命令不可用。还有两种方法定义水线面。在 GHS 中，纵倾以度数表示，指两纵向位置的水线间长除以这两个位置之间距离的反正切值。

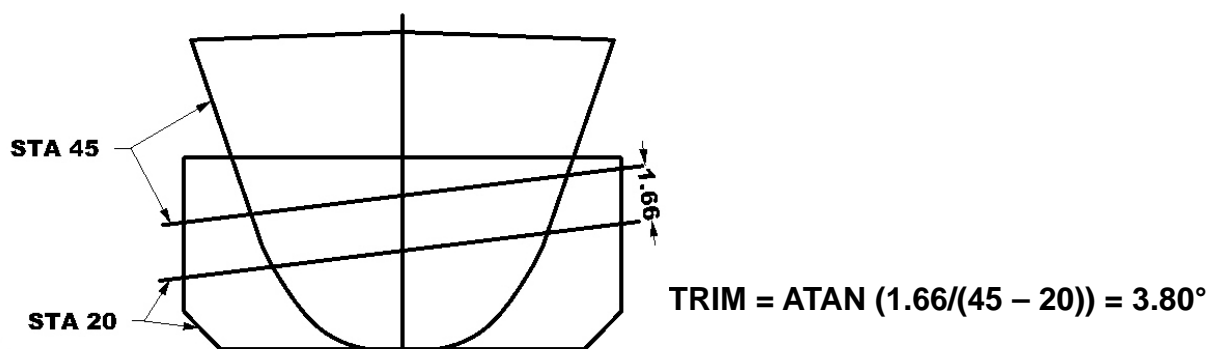


Figure 1

This can be determine from observations in the field. In this example, notice that the keel is exposed and it is parallel to the baseline. By measuring the height of the keel

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above the water at two locations and the distance between them, the trim angle can be calculated as illustrated above. The heel can be approximated by visual inspection. Lastly, the depth is set by giving the height of a known point on the vessel. To do this, a critical point must be define at the point in question. We will use the heel of the skeg and set the height to that observed.

可以通过观察确定。在本例中，可见舳龙骨已露出水底，且平行于基线。通过测量这两个位置高于水面的舳龙骨高度和两者之间的距离，可计算得出如上图所示的纵倾角。横倾角可以通过观察近似得出。最后，通过船上已知点高度设定吃水，在需考虑位置设置一个进水点，通过观察得到的尾部横倾和高度。

```
CRTPT (4) "END OF SKEG" 30.8a 0 0 /NOFLOOD  
HEIGHT (4) 2
```

An easier method of defining a ground plane, even for extreme attitudes, is to use the WPL3 wizard. The wizard will prompt the user for the location of three points on the vessel and the height of the points above the waterplane. Then designate the three points as either port, stbd, fwd or aft. Then the wizard will solve for the correct depth, trim and heel for the heights given and report any difference. If the differences are large, the most common cause is improper assigning of points to locations. The convergence factors can be adjusted for small changes. The range is 0.01 to 2.0 for both trim and heel convergence factors.

另一种更简便的方法就是用 WPL3 向导定义一个搁浅平面，甚至是极端条件下的平面。该向导需用户输入船上三个点的位置坐标和高于水线面的高度，再定义三个点的状态：左舷、右舷、船艏和船艉。根据高度，向导求解出修正后的吃水、纵倾和横倾，并分析出其差异。如果差异很大，最常见的原因就是位置定义不正确。如果差异不大，可用缩放系数进行微调，纵倾和横倾的缩放系数范围为 0.01~2.0。

Once the waterplane is set, ground points can be defined. In fact, the depth is required before any ground points can be defined. This is needed so the waterplane and the point of contact, or "the bottom", have a reference to one another via the ground point on the vessel and the given penetration. Doing so allows simulation of rising or falling tides.

水线面设置完成后，就可以定义搁浅点。原则上，定义搁浅点之前需定义吃水。水线面和接触点或“底部”，可通过船上的搁浅点位置和点渗透深度互相参考。这样就可以模拟涨潮和退潮。

### 3.3 GROUND POINTS 搁浅点

Defining the number and location of ground points and adjusting the input parameters will require some judgment. On sand or mud bottoms, an array of ground points may be needed to reasonably determine loads on the hull. Rocks or reefs would necessitate fewer ground points. An underwater survey will assist in determining the location of ground points and the condition of the bottom.

根据经验判断，设定搁浅点的顺序和位置，调整输入参数。在沙或泥底，需设置一排搁浅点，这样可以合理的反映作用在船体上的载荷。遇到岩石或礁石时，用较少的搁浅点即可。水下调查有助于确定搁浅点位置，了解底部情况。

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For this example, the ground points supporting the vessel are:

本例中，支撑船的搁浅点如下：

```
GROUND "FWD CHINE" * 27.0F 8.42 4.36
GROUND "FWD HULL SIDE" * 27.0F 10.00 10.00
GROUND "AFT CHINE" * 23.1A 11.63 4.78
GROUND "AFT HULL SIDE" 23.1A 11.93 8.89
```

As the vessel is righted, the hull may come in contact with the ground at different locations.

船在扶正的过程中，船可能和水底产生不同的接触位置。

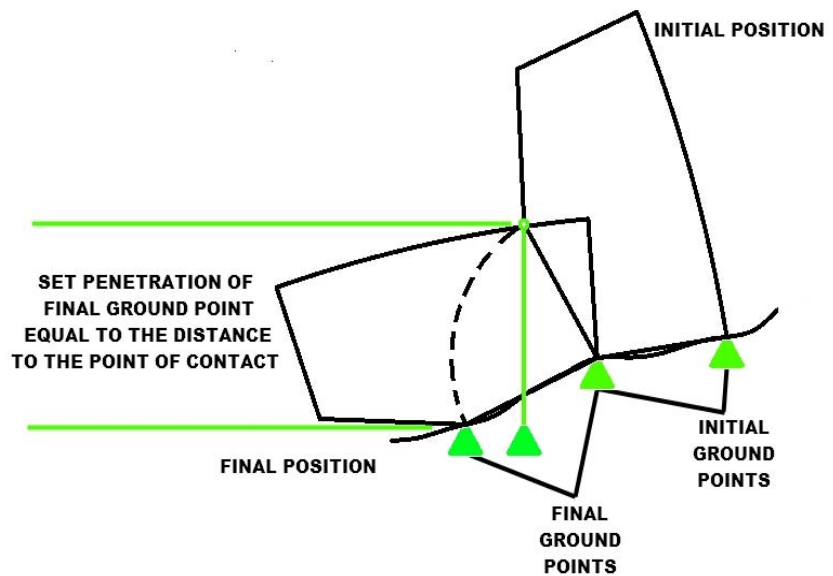


Figure 2

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Therefore, additional ground points are needed. Defining these ground points can be complicated due to variations in the bottom topography, hull shape and the uncertainty of the attitude the vessel will take during the rolling procedure. Two contact points are assumed in this case. One at the bow and one on the skeg. Since they are not in contact at this stage, the penetration is set at a negative value equal to the vertical distance from the ground point to the bottom where contact is expected. See figure 2.

因此，需设置其他搁浅点。由于多样的海底地形、船型和船翻转过程中造成的不确定性，定义搁浅点可能会很困难。假定两个接触点，一个在船艏，一个在船艉。此时，由于搁浅点触底，穿透值设定为负值，该值等于搁浅点到船底部接触点的垂直距离。如图 2 所示。

```
GROUND "KEEL AT BOW" * 23.0F 0 0 /PEN:-11.5  
GROUND "END OF SKEG" * 30.8A 0 0 /PEN:-10.0
```

Now equilibrium and the reactions can be found by solving and viewing the status.

现在，可以求解和观察当前的平衡和反作用力。

```
SOLVE  
STATUS GHS  
STATUS CRT
```

If a Condition Graphic view is desired, the following command will produce the image in Figure 3.

如果想要得到装载图像，那么下面的命令将产生如图 3 所示图像。

```
DISP (*) STATUS BODY @27f @23.1a @30.8a, PROFILE: OUTBOARD
```

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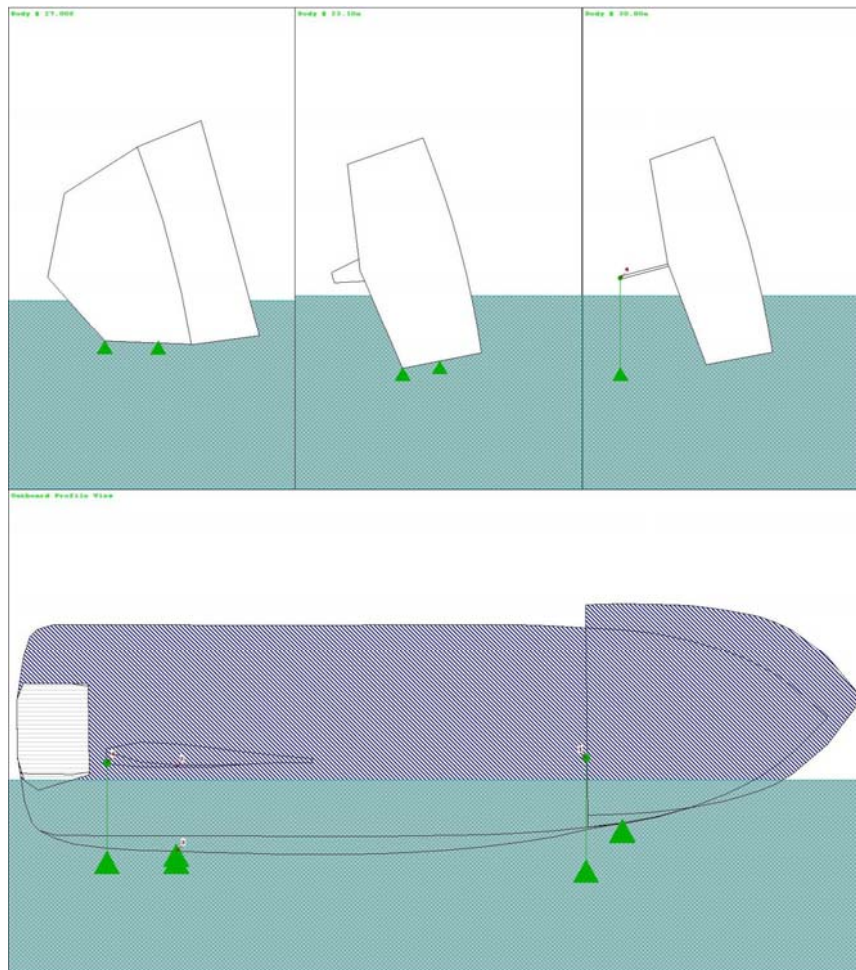


Figure 3

In the body view at 30.8a (top right), the anticipated ground point at the end of the skeg is displayed as a small circle and a vertical line extends from that to a green triangle representing the depth to the bottom. As the vessel rolls, the green triangle will be displayed in a different horizontal position but will remain directly under the end of the skeg.

如剖视图 30.8a（右上）图所示，小圆圈表示在尾鳍末端预先设置的搁浅点，垂直线至绿色三角形的距离表示搁浅点至船底深度。当船翻转时，绿色三角形显示在不同的水平位置，但其位置将一直保持在尾鳍端部正下方。

### 3.4 PULLING 拖拉

The `PULL` command can be used to model the effect of cables attached to the vessel and tension applied. Within GHS, the magnitude of the force, the located of attachment and its direction is converted into heeling and trimming moments and a vertical force. The azimuth angle is measured counterclockwise from the starboard direction.  $0^\circ$  is to starboard,  $90^\circ$  aft and  $180^\circ$  is to port. An angle of  $0^\circ$  is to starboard when the vessel is upright and will result in a heeling moment to starboard. Consider the vessel oriented in a north-south direction with the bow heading north. An azimuth angle of 0 degrees implies a pull force to the east and remains in that direction regardless of the heel of the vessel. The arm is the distance from the point of attachment to the centroid of the submerged lateral plane except when ground points are present and providing a reaction. When the attachment point is below the centroid of the lateral plane, the arm

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is negative and the heeling moment is to port. The following commands and macros will demonstrate this.

【Pull（拖拉）】命令可以用来模拟缆绳拖拉船。在 GHS 中，力的大小、作用点和作用方向等效成横倾力矩、纵倾力矩和垂直力。方位角由右舷逆时针方向测算，0° 指右舷方向，90° 指船尾方向，180° 指左舷方向。当作用于船的力方向为 0° 向右时，会产生向右舷方向的横倾力矩。假定船位于南北方向且船首向北，施加方向向东角度 0° 的拉力，保持拉力方向不变（不考虑船的横倾）。当搁浅点存在且提供作用力时，力臂指作用点到水下侧面中心点的距离。当作用点在水下侧面中心点之下时，力臂是负值，横倾力矩向左。命令和宏如下所示。

```
CLEAR
READ FV.GF

MACRO SHOW
SO
ST WEIGHT LPLANE CRT PULL
HMMT REPORT
\\\\\\\\
/

MACRO DO
HE *+10
SO
.SHOW
/

CRTPT OFF
CRTPT "PULL ATTACH POINT" 0 12.27 12.63 /NOFLOOD

DR 8
VCG 10
PULL "PULL FORCE" 20 0 12.27 12.63 0 -10
SO WE LCG HEEL
FIX HEEL
.SHOW

.DO (5)
```

The elevation angle is relative to the waterplane. Given the length of leads in salvage operations, this may be considered constant with little effect on the results. If large change in the elevation occurs, the pull definition will need to be revised. This may be the case if a crane is applying the pulling force. The use of ground points may be better for this scenario and is discussed later.

倾斜角是相对于水线面的角度。在打捞作业中引入某长度概念，此长度可视为常数且对结果几乎无影响。如果发生大角度倾斜角，需修改定义拉力。此种情况可能类似与起重机施加拉力。对于本程序，用搁浅点定义可能会更好，这将在后面讨论。

In this example, the arm to compute the heeling moment will be taken to the ground points. If more than one ground point with different elevations and/or reactions are present the arm is taken to a point with respect to the heights of the ground points and magnitudes of the reactions. The following commands and macros will demonstrate this.

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在此例中，力臂用来计算到搁浅点的横倾力矩。如果有多个搁浅点，高度和反作用力都不一样，那么力臂根据一个具有代表性的点计算，此点可代表这些搁浅点的高度以及反作用力。命令和宏如下所示。

```
CLEAR

ENTER PM
TITLE 100' X 40' X 10' RECTANGULAR BARGE
CREATE HULL
  ENDS 0 100
  OUT 20
  BOT 0
  TOP 10
/
WRITE RECTANG.GF
QUIT

MACRO FIND
SO
ST WEIGHT GROUND LPLANE CRTPT
HMMT REPORT
\\\\\\CLOSE CONDITION GRAPHIC WINDOW TO CONTINUE\
DISP STATUS PROFILE `CLOSE CONDITION GRAPHIC WINDOW TO CONTINUE
/

CRTPT (1) "BOW CORNER" 0 20 0
CRTPT (2) "STERN CORNER" 100 20 0
CRTPT (3) "PULL LINE ATTACH PULL" 50 -10 10

DR 6
VCG 5
SO WE LCG
HEEL 90
FIX HEEL

DE -10
GROUND "BOW BOTTOM" * 0 20 0 /PEN:0
GROUND "BOW DECK" * 0 20 10 /PEN:0
GROUND "STERN BOTTOM" * 100 20 0 /PEN:-10
GROUND "STERN DECK" * 100 20 10 /PEN:-10
SO
LCG 40 `SHIFT LCG FWD TO INCREASE REACTIONS AT BOW FOR DEMO
PULL "PULL FORCE" 5 50 -10 10 0 0
.FIND

ADD "TO REMOVE AFT GROUND REACT" -260 50 0 5
.FIND

ADD "TO REMOVE FWD GROUND REACT" -150 0 0 5
.FIND
```

In the first step, the barge is grounded at the bow and the stern. The height of the ground points are at 10 and 20 feet below the waterplane. The LCG was moved forward to simply increase the reaction at the bow. If the reactions were equal, the arm would be taken to a point at the hull side at amidships and the arm would be approximately 29.80 feet. The effective point of grounding is closer to the bow due to the different reactions and the arm is 26.63 feet. It is left to the user to verify the difference in the heeling arms.

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第一步，驳船船首和船尾搁浅，搁浅点高度在水线以下 10 和 20 英尺处。前移 LCG 增加船首反作用力。如果首尾反作用力相等，那么力臂作用点在舷侧船中，大概在 29.80 英尺处。由于反作用点位置不同，有效搁浅点更靠近船首，此时力臂是 26.63 英尺。由于力臂位置的不同，而导致横倾力臂的不同，留给用户自行验证。

Erroneous results may occur when the arm is taken to the ground points produces a heeling moment sufficient to un-ground the vessel. This will cause the arm to be taken to the centroid of the lateral area, which is usually above the ground point. This lower heeling moment produced may be insufficient to un-ground the vessel. It is important the user is aware of this treatment of the PULL command for cases when this could occur.

可能发生取自搁浅点的力臂生成的横倾力矩使船脱离搁浅的错误结果。发生的原因是力臂取自侧面面积的质心，质心通常在搁浅点之上。而较低的横倾力矩不足以使船脱离搁浅。当这种情况发生时，用户需知道用【pull】命令去解决问题。

The friction produced by any ground points is not taken into account. Additionally, if sliding occurs that may change the height of the ground points, the problem gets more difficult.

搁浅点产生的摩擦不予考虑。此外，由于滑动而改变了搁浅点高度，那么这个问题就会变得更复杂。

Since the amount of force needed is unknown, the pull can be initially set as zero.

由于拉力大小未知，可设置初始拉力为零。

```
PULL "WINCH LINE AT BOW" 0 30.8f 12.0p 21.2 180 -5  
PULL "WINCH LINE AT STERN" 0 23.1a 12.25 13.55 180 -5
```

The above defines the attach point at the deck edge. The azimuth angle of 180° sets the direction of the force to port. The elevation angle of -5° is relative to the waterplane and is downward in this case.

上面把连接点定义在甲板边缘，在左舷设置 180° 方位角的力，相对水线面的倾斜角-5°，方向向下。

The pull force is constant until changed or removed by the user. If the lines go slack during the rollover, GHS does not take that into account. It is important to understand that once the pull force is define, it is in effect until the user deletes it.

除非用户更改或删除，否则拉力是恒定不变的。如果在拖拉的过程中绳索松了，GHS 不会考虑到这种情况。用户需知道，一旦拉力被定义，拉力一直起作用直至删除该拉力。

### 4.0 LOAD EDITOR FOR WINDOWS (LEW) WINDOWS 装载编辑器 (LEW)

Load Editor is a valuable tool for salvage cases as it provides the user the ability to analyze the problem interactively and may expedite trial and error approaches when needed. Load Editor can be configured in many ways. One of the built in features of Load Editor the server will find useful is to have a Condition Graphics window open that is updated when changes are made within Load Editor. To do this, the views of interest to be displayed are communicated to the Load Editor by setting the variable CGPARAM, such as:

在打捞工作中，装载编辑器是一个很有用的工具，可供用户实时分析，迅速完成反复试验。可通过多种方式构建设置装载编辑器。打捞人员可发现装载编辑器有个很有效图像显示功能，该图形界面与编辑工况实时更新，同步显示。用户可设置变量 CGPARAM，将感兴趣的视图命令指定给装载编辑器。如：

```
VARIABLE CGPARAM = "BODY @27F @23.1A, BODY @23.0F @30.8A, PROFILE:OUTBOARD /SYNC"
```

The string variable defined above is exactly the same as if entering Condition Graphics from GHS. Any of the Condition Graphic parameters can be used. See the Load Editor manual for other built in features of Load Editor.

如上定义的命令串和 GHS 中图形工况命令设置是完全一致的，所有图形工况的参数在本程序中一样都是可以使用的。其他功能，参考装载编辑器手册。

When there is not a built in feature, a macro or template can be defined. For a trial and error approach to finding the pull to tip the vessel, a macro to return the vessel back to the original condition is as follows:

当未在装载编辑器中定义时，可通过命令或者模板定义。为了通过反复试验得出使船倾斜的拉力，设置船回到初始工况的命令如下：

```
MACRO REHEEL "RESETTHEEL"  
  HEEL 75  
  SOLVE  
/
```

The information displayed in the pull window in Load Editor provides only the vertical component of the force. To display the heeling moment derivation and the pull force summary, another macro can be defined.

装载编辑器中拉力窗口只显示垂向力，想要显示横倾力矩和总拉力，需定义另一个宏。

```
MACRO HMMTPULL "PULL SUMM"  
  HMMT REPORT  
  PULL REPORT  
  WAIT  
/
```

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To launch Load Editor,

为了运行装载编辑器，

```
LOAD (*) EDIT /DISPLAY:OFF /CG /PULL /MACRO:REHEEL, HMMPULL
```

/DISPLAY:OFF prevents the vessel display at the bottom of the window if it is not wanted,

/CG and /PULL enable CG and PULL button in the toolbar and

/MACRO:REHEEL, HMMPULL makes the above macros available in Load Editor.

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The Pull window can be used to applied or change a pulling force. If a value is applied that "tips" the vessel, the RESETHEEL button can be used to return to the starting condition and smaller forces applied. To see the resulting heeling moment and pull forces that produces that moment, click the HMMTPULL button (may have to right click on the RESETHEEL button).

拉力显示窗口可用于施加或更改拉力。如果施加了一个拉力值翻转船舶，那么可以通过【RESETHEEL】按钮返回初始工况和施加的较小的力来实现。如需查看横倾力矩和拉力所产生的力矩，点击【HMMTPULL】按钮（可能需要右键点击【RESETHEEL】按钮）。

Starting Load Editor will bring up a window similar to Figure 4.

启动装载编辑器会弹出一个类似于图 4 的窗口。

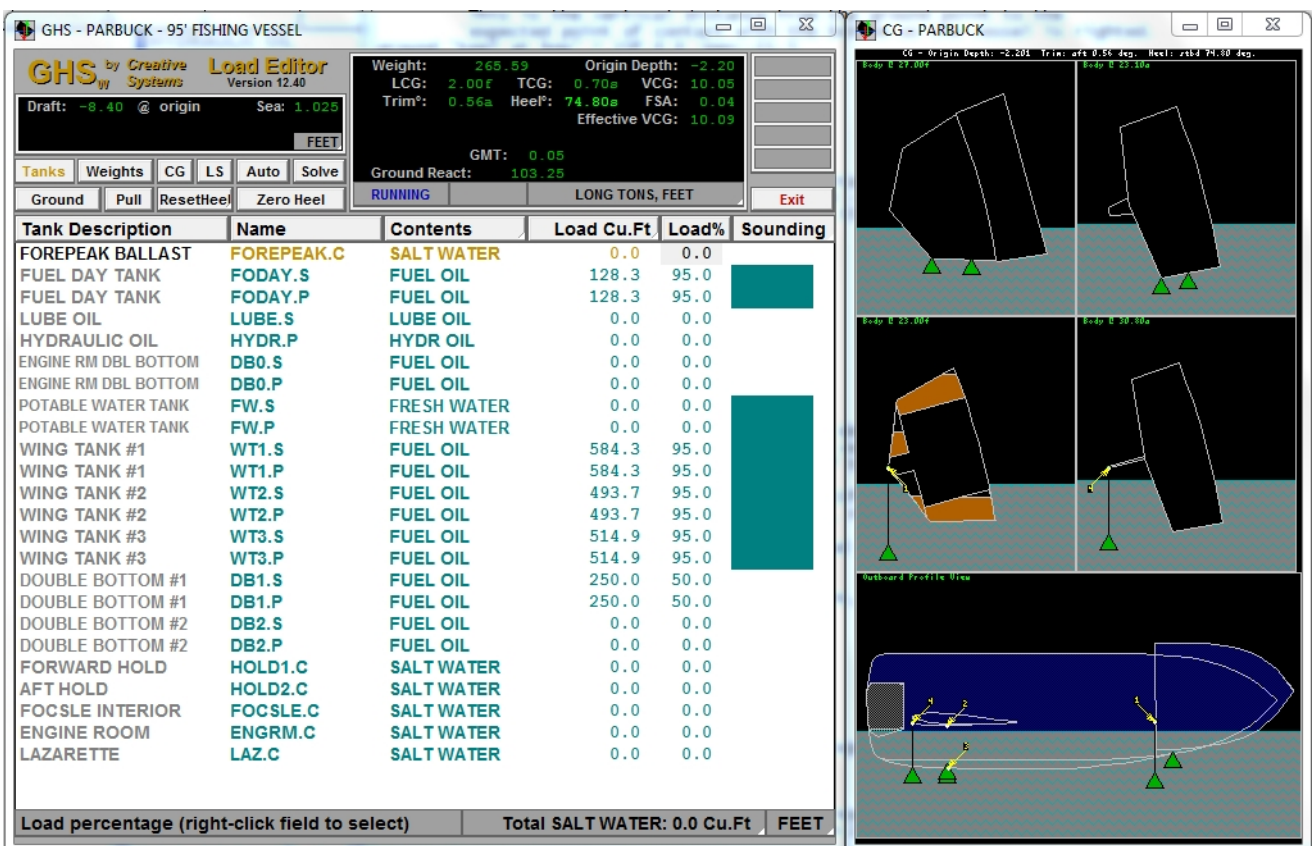


Figure 4

The "Tank", "Weights", "Ground" and "Pull" buttons will bring up their respected windows. Tank loads, weights and the pull forces can be changed and the results displayed after clicking the "Solve" button. The "Auto" button can be clicked to eliminate the need to click "Solve".

点击【Tank（舱室）】，【Weights（重量）】，【Ground（搁浅）】和【Pull（拉力）】按钮，可弹出相应的窗口。可改变舱室装载、重量装载和拉力，并通过点击【Solve（求解）】按钮显示结果。【Auto（自动）】按钮可自动求解，无需再点击【Solve（求解）】按钮。

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Once enough pull force is applied to right the vessel, the Condition Graphic window displays the vessel in nearly an upright position. Note that there is some resulting reactions at the skeg.

施加足够的拉力扶正船只，工况图象界面显示船处于正浮状态。注意，此时有反作用力作用在尾鳍。

### 4.1 GROUND REACTIONS 搁浅反作用力

Up to this point we only know what will happen up to the tipping point. During the rollover, the lost buoyancy due to the emerging topsides or superstructure may be greater than the gained buoyancy due to the submerging hull bottom. This could effect the ground reactions in unpredictable ways. To find the maximum ground reaction, a short macro can step through the rolling at small increments and the ground reactions evaluated.

到这里为止，我们只知道在翻转点会发生什么。在翻转期间，漏出水面的船体和上层建筑损失的浮力可能大于浸没船底的浮力，这影响到无法预测搁浅反作用力。找到最大的搁浅反作用力，下面的宏可以设置小范围的翻转，预估搁浅反作用力。

```
VARIABLE HE MAXHEEL MAXREACT = 0
.REHEEL
FIX HEEL

MACRO TIPOVER
  SET HE = {HEEL} MIN 1
  HEEL {HE}
  SOLVE
  IF {REACT} = 0 THEN EXIT
  IF {REACT} > {MAXREACT} THEN SET MAXREACT = {REACT} | SET MAXHEEL =
{HEEL}
  \TOTAL GROUND REACTION:{ REACT:2}, RA ={ RAH:2}, GMT = { GMT:2}, HEEL
={ HEEL}
/
```

To run the macro and see the reactions at every ground point at the maximum.

运行宏，知道每个搁浅点的最大反作用力。

```
.TIPOVER (90)
\\
HEEL {MAXHEEL}
SOLVE
\THE MAXIMUM GROUND REACTIONS OCCURRED AT {HEEL} DEGREES\
\\
STATUS DISPL
```

The above approach is a check of the total ground reaction. The reactions at the two chine locations are reported when the total reaction is at its maximum. It is possible that these individual reactions may be greater at some other heel angle that at the angle of the maximum total ground reaction.

上面方法用于检查总搁浅反作用力。报告显示当总搁浅反作用力最大时两个舭部位置的反作用力。两个位置各自的搁浅力在总搁浅力倾角下不一定最大，在某些倾角下各自的反作用力可能会更大。

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If the individual ground reactions are desired, a GROUND REPORT can be given at each tip angle and examined. When in Load Editor, the Ground button will display the ground reactions and can be checked when the pull forces are changed.

搁浅报告可以生成和检查每个倾角下各个搁浅反作用力。在装载编辑器中，【Ground（搁浅）】按钮将显示搁浅反作用力，并且当拉力改变时可以进行检查。

### 4.2 STABILITY THROUGH THE ROLLOVER 翻转过程中的稳性

To see the righting arm during the roll, return to the initial condition and change the angles to produce the curve as the vessel rolls to port.

为了观察船在倾斜翻转过程中的回复力臂，可返回到初始工况，改变横倾角（如同船倾斜翻转至左舷）产生回复力臂曲线。

```
.REHEEL  
VARY heel  
SOLVE  
ANGLES 0 -5 -10 ... -90  
RAH
```

The righting arm curve should look similar to Figure 5.

回复力臂曲线类似于图 5。

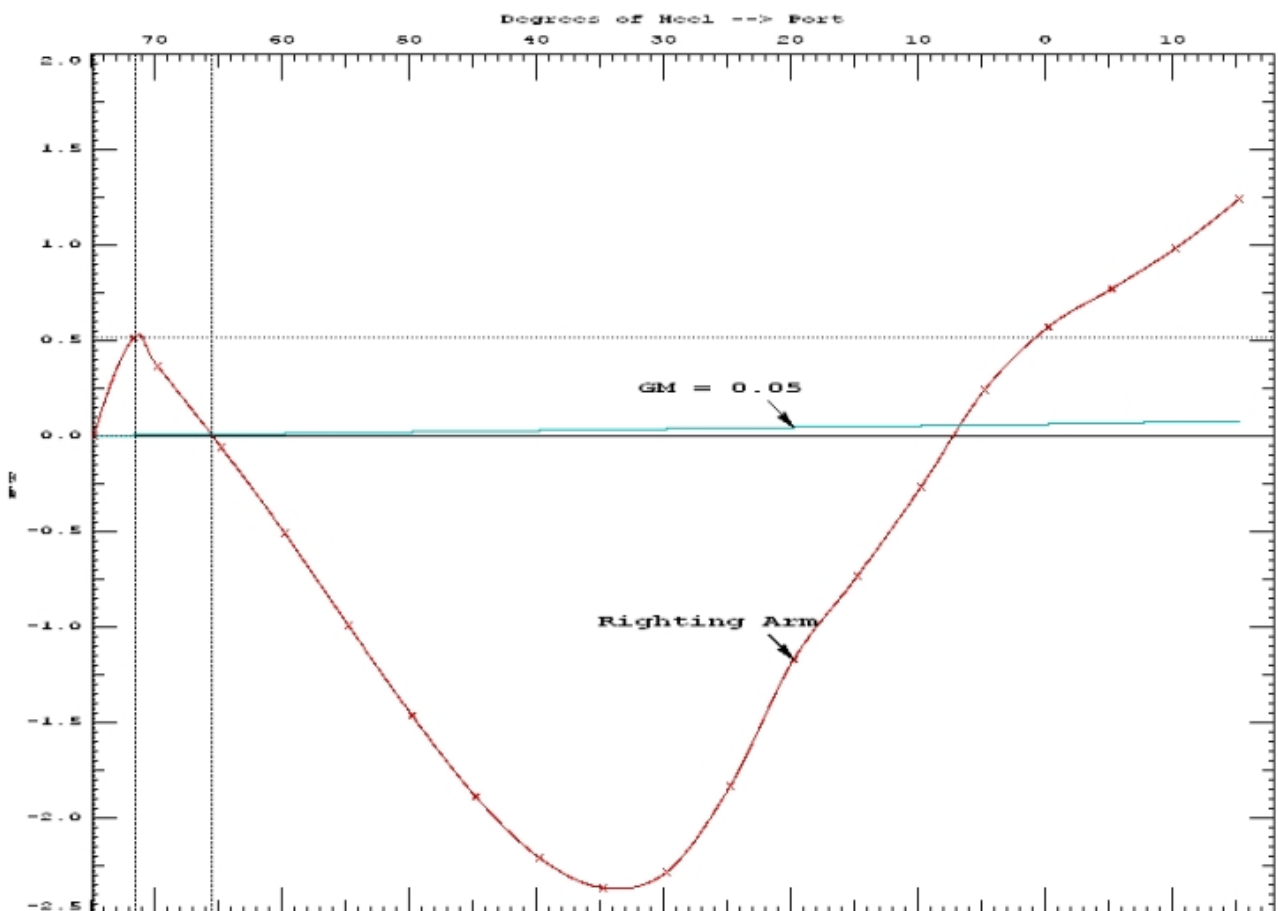


Figure 5

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A copy of the run file, PARBUCK.RF, to perform the above analysis can be found in the Appendix. From the .pdf file, the commands can be copied and pasted into a text file.

从 PDF 文件中复制命令为文本文件中，运行该文件 PARBUCK.RF，执行上面的分析。

## 5.0 CAPSIZED VESSEL 船舶倾覆

The pull command can be used to find the forces needed to right a floating capsized vessel. Since the command converts the defined pull force into a moment, the total moment needed to roll the vessel can be determined by a single pull command. In reality, bridles and cables would be arranged to pull in opposite directions at two or more locations. In the example that follows, only one location will be used.

可用【Pull（拖拉）】命令得出扶正漂浮状态的倾覆船舶所需的力。由于该命令将拉力等效成力矩，所以翻转船的所有力矩都可以用一个【Pull（拖拉）】命令来求得。通常的，索具和缆绳应在两个或两个以上位置朝相反方向布置。在下面的例子中，只布置了一个位置。

A simple initial condition of a 2000 mt displacement, an LCG located at 27 m fwd of the origin and a VCG of 5 m

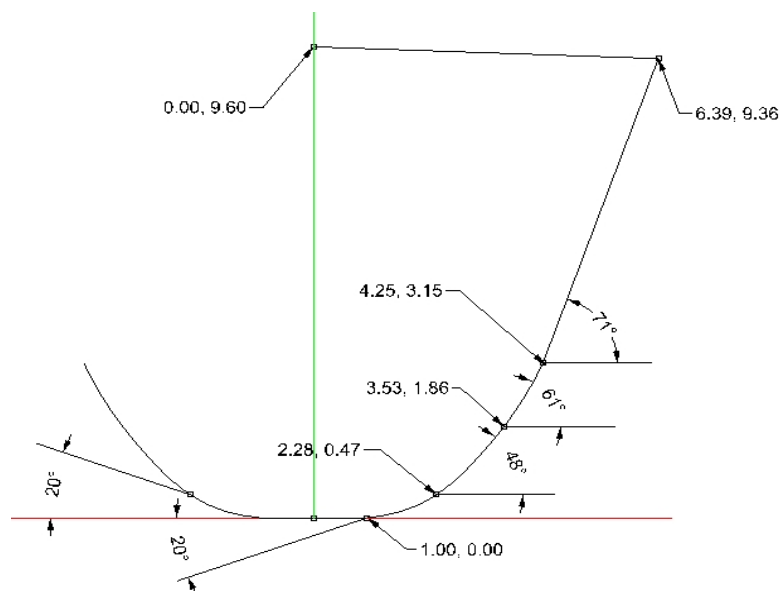
初始工况，排水量 2000mt，LCG 位于原点向前 27m，VCG 为 5m。

```
WE 2000 -27 0 5
HEEL 180
SO
```

From the geometry model SV.GF the following hull offsets are taken at station 44.87f.

从模型 SV.GF 看出，下面船体的偏移在 44.87f 处。

Figure 6



## Salvage Procedures using GHS – 7/2011

In the previous example, the pull command applied the same given force at the attach point for all angles of heel. In this case, the force applied will be a function of the heel angle. This will simulate the "unfurling" of the bridle as the vessel rolls. Assuming the pull force is directed 10 degrees downwards relative to the waterplane, and starting at a heel of 180 degrees, the force will be applied at the first point from 180 to 170 degrees. The first point being the edge of the keel flat on the port side. Turning Figure 6 upside down will help to visualize the values for the force function. Then the force is applied at the second point from 170 to 150 degrees. The opposite bridle is slung under the hull and attach to the opposite side. The elevation angle is 10° upwards. The deck camber is 2°, so as the heel passes 8°, the attachment point is taken at centerline, and so on. From the above geometry, the commands would look like this.

在前面例子提到的，【pull（拖拉）】命令同样适用于给定各个横倾角度对应的接触点的力值。在本例中，在不同横倾角下给定力，模拟索具在船翻转过程中的作用力。假设拉力水平夹角 10°，方向向下，从横倾 180° 开始。第一点作用力将从 180° 到 170°，第一点在左舷龙骨边缘，将图 6 倒转过来有助于想象力作用的方向。第二点作用力将从 170° 到 150°。相反方向的索具吊挂在船体之下，吊挂点在船舷另一边，水平夹角 10°，方向向上。甲板梁拱是 2°，所以当前横倾是 8°，吊挂点在船中等等。根据上面模型，命令定义如下：

Force function										LCF	TCF	VCF			
AZ	EL	PULL "FWD DECK STBD"	%1@180	%1@172	0@171	0@0					-45	6.39	9.36	180	10
		PULL "FWD DECK CL"	0@180	0@171	%1@170	%1@168	0@167	0@0	-45	0	9.60	180	10		
		PULL "FWD DECK PORT"	0@180	0@168	%1@167	%1@0				-45	-6.39	9.36	180	10	
		PULL "FWD AT KEEL 1"	%1@180	%1@170	0@169	0@0				-45	-1	0	0		-10
		PULL "FWD BOTT 2"	0@180	0@170	%1@169	%1@150	0@149	0@0	-45	1	0	0			-10
		PULL "FWD BOTT 3"	0@180	0@150	%1@149	%1@122	0@121	0@0	-45	2.28	0.47	0			-10
		PULL "FWD BOTT 4"	0@180	0@122	%1@121	%1@108	0@107	0@0	-45	3.53	1.86	0			-10
		PULL "FWD BOTT 5"	0@180	0@108	%1@107	%1@98	0@97	0@0	-45	4.25	3.15	0			-10
		PULL "FWD AT DECK 6"	0@180	0@98	%1@97	%1@0				-45	6.39	9.36	0		-10

Inserting the above pull commands in a macro and calling that macro with a pull force, GHS will apply that force at the proper attachment point. If the resultant heel is between angles specified in a function, linear interpolation is used to find an intermediate force.

在宏中插入以上【pull（拖拉）】命令，调用该宏时产生拉力。GHS 在相应吊挂点施加作用力。如横倾角的角度在定义角度之间，可用线性插值求力的中间值。

By adding the following lines to the macro, multiple cases with different pull magnitudes can be run.

通过添加以下语句到宏，可以运行各种工况的不同拉力。

```

SO
SET HE = {HEEL}
PULL REPORT
HMMT REPORT
DI STATUS BODY@-45
PAGE
HEEL 0
RA 0 -5 ... -180 /SIZE:1.8
HEEL = {HE}

```

Sample results for a pull of 250 mt and graphs of the righting and heeling arms for 50,

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150, 250 and 290 mt forces are shown on the following pages.

下页是拉力为 250mt 的简单报告和 50、150、250 和 290mt 拉力时的回复力臂和横倾力臂的曲线图。

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09/03/10 17:03:46  
GHS 12.32

Creative Systems, Inc.  
66 M. SUPPLY VESSEL/TUG

Page 1  
CAPSIZE

Pull for heel 147.02p	Force (MT)	LCF	TCF	VCF	Az	El
FWD DECK STBD	0.00	45.000f	6.390s	9.360	180.0a	10.0
FWD DECK CL	0.00	45.000f	0.000	9.600	180.0a	10.0
FWD DECK PORT	250.00	45.000f	6.390p	9.360	180.0a	10.0
FWD AT KEEL 1	0.00	45.000f	1.000p	0.000	0.0	-10.0
FWD BOTT 2	0.00	45.000f	1.000s	0.000	0.0	-10.0
FWD BOTT 3	250.00	45.000f	2.280s	0.470	0.0	-10.0
FWD BOTT 4	0.00	45.000f	3.530s	1.860	0.0	-10.0
FWD BOTT 5	0.00	45.000f	4.250s	3.150	0.0	-10.0
FWD BOTT AT DECK 6	0.00	45.000f	6.390s	9.360	0.0	-10.0

Distances in METERS.

HEELING MOMENT specification				
Pull for heel 147.02p	Height	Arm	Force (MT)	Moment
FWD DECK STBD	0.393	3.449	0.00	0.00
FWD DECK CL	-3.271	-0.215	0.00	0.00
FWD DECK PORT	-6.534	-3.479	-246.20	856.42
FWD AT KEEL 1	4.206	7.262	0.00	0.00
FWD BOTT 2	5.290	8.346	0.00	0.00
FWD BOTT 3	5.592	8.647	246.20	2,129.01
FWD BOTT 4	5.108	8.164	0.00	0.00
FWD BOTT 5	4.421	7.476	0.00	0.00
FWD BOTT AT DECK 6	0.393	3.449	0.00	0.00
Total pull heeling moment to starboard				2,985.43

Distances in METERS. Moment in m.-MT

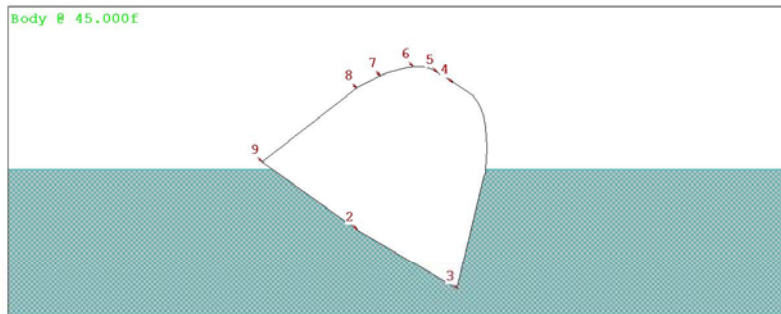
RESIDUAL RIGHTING ARMS vs HEEL ANGLE  
LCG = 27.000f TCG = 0.000 VCG = 5.000

Origin	Degrees of	Displacement	Residual Arms
Depth	Trim	Heel	Weight (MT)
-0.637	5.24a	147.02p	2,000.00
			in Trim--in Heel
			0.000 0.000

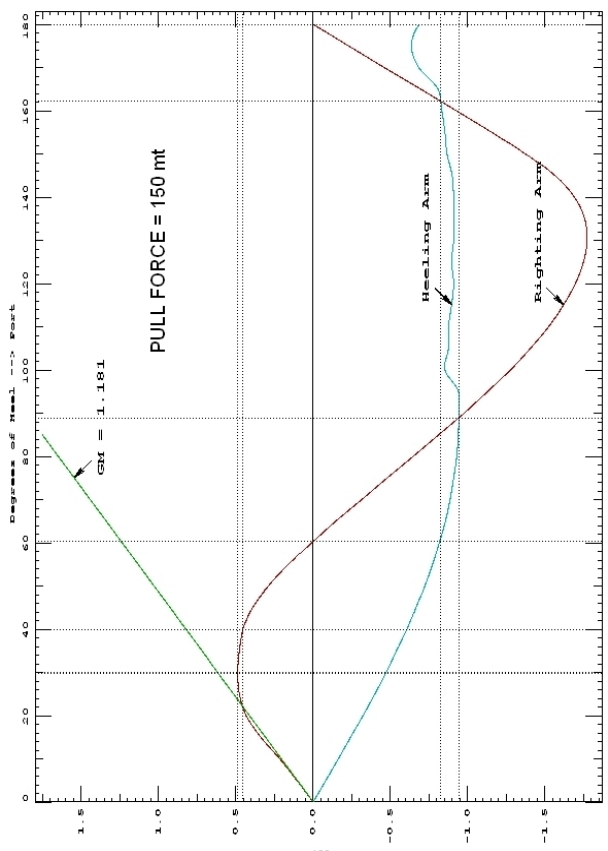
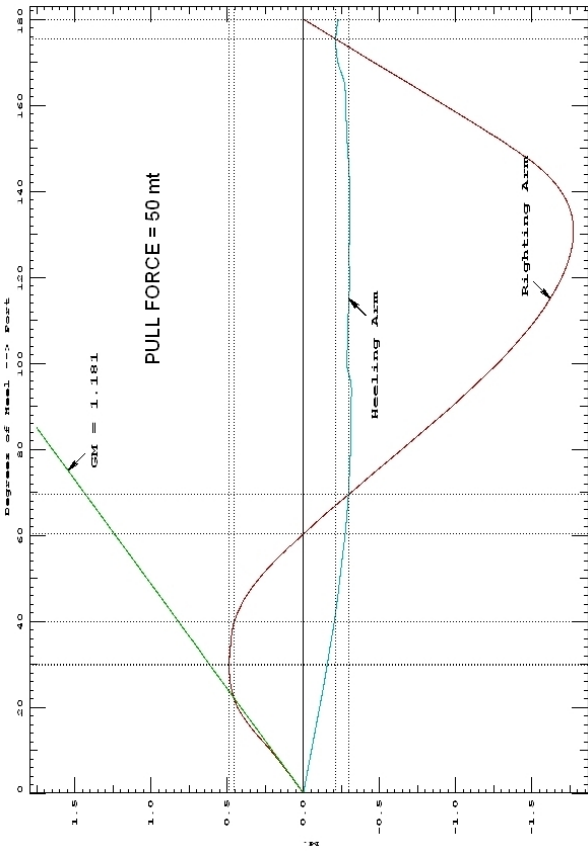
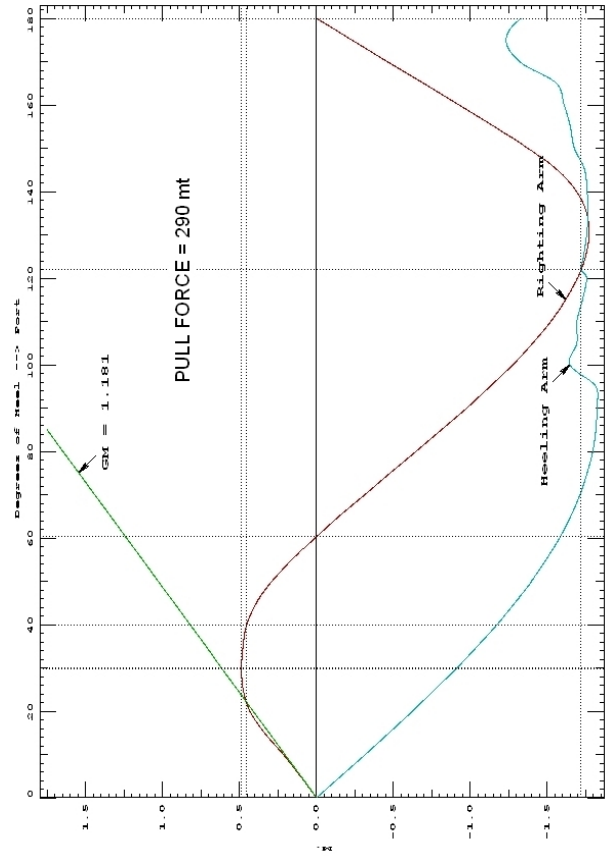
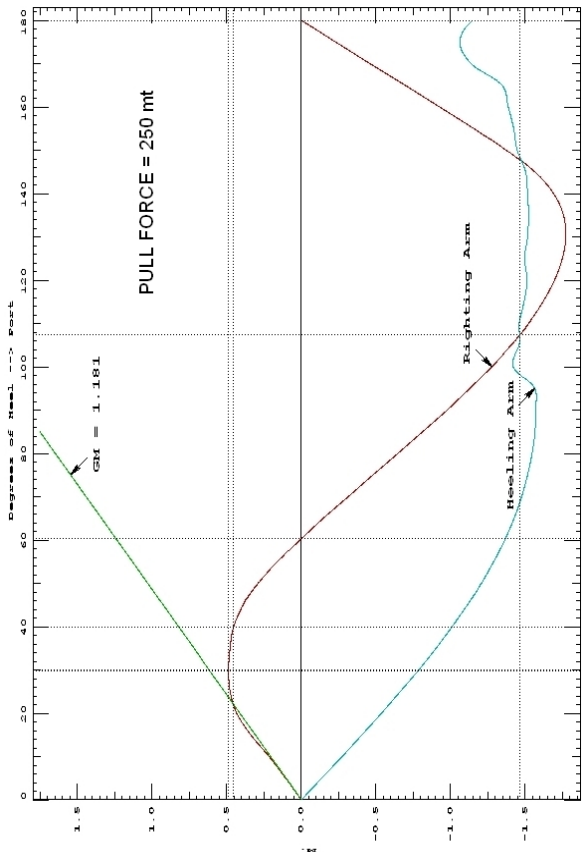
Distances in METERS. Specific Gravity = 1.025.

Note: The Residual Righting Arms shown above are in excess of the overturning arms derived from pull moments.

CG - Origin Depth: -0.637 Trim: aft 5.24 deg. Heel: port 147.02 deg.



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The maximum force needed to overcome the maximum negative righting arm is approximately 290 mt. If a force is applied that is greater than the righting moment, the righting arm and heeling arm curves do not intersect. In reality, a pull of that magnitude could never be achieved. Once the vessel is rolled beyond the angle of largest negative righting arm, the pull forces will decrease. However, the range of negative stability continues until 60 degrees, after which the vessel will continue to right itself.

回正最大负方向回复力臂需最大力约为 290mt。如果施加的力大于复原力矩，那么回复力臂曲线和倾斜力臂曲线不相交。而事实上，不会出现这么大的力。船翻转角度超过了最大负值回复力臂之后，相应拉力会减小。但由于负稳性范围角发生在  $60^\circ$  内，当横倾角超过  $60^\circ$ ，船就能自行回正。

### 6.0 SUNKEN VESSEL 沉没的船舶

Using the pull command is not appropriate for raising vessels completely submerged. However, it would be appropriate for rolling a submerged vessel that may be on its side. For instance, to access a damaged area for repairs or to orient the vessel for lifting in an upright condition.

【Pull(拖拉)】命令不适用于吊装完全沉没的船只。但适用于力作用于一侧翻转船只的工况。例如，进入破损区域进行修理，扶正将船吊至正浮状态。

When a PULL is applied to the model, GHS treats the vertical component of the force as a point load. A positive weight if the component is downwards, and a negative weight if the pull is upwards. The horizontal component, if any, is handled as a moment. The moment being equal to the magnitude of the horizontal component times the distance to the centroid of the submerged lateral plane area.

【Pull(拖拉)】命令应用到模型时，GHS 把垂向力认作为点载荷。拉力为正，方向向上；拉力为负，方向向下。水平力等效横倾力矩处理，横倾力矩等于水平力乘以力作用点至水下侧面积中心的距离。

Consider a case where the sunken vessel is submerged and resting on the ground. The total reaction of ground points will be the weight of the vessel (fix weights and tank loads) less any buoyancy. When pull forces are applied, the vertical components will reduce the ground reactions. When the total of pull forces exceeds the total of ground reactions, GHS will solve for the condition where any excess pull forces will be equal to the lost buoyancy due to the hull emerging from the water. This may be acceptable if the only purpose is to determine the lift needed to raise the vessel. If in this case, the bottom is an irregular surface and the vessel cannot be lifted straight up, some rolling will occur in the initial stages and if the ground reactions are of concern, the PULL command may not be suitable. In addition, if the lift involves more than one lifting device, as the vessel rolls and gains and/or loses ground points, the force on the lifting devices will vary.

假设如下工况，船沉没且搁浅在水底，搁浅点的反作用力等于整船重量（固定重量和舱室装载）减去浮力。当施加垂向力时，减小搁浅点反作用力。当总拉力大于搁浅反作用力时，GHS 求解当前工况，超出的拉力等于船露出水面时失去的浮力，这种情况适用于把船吊出水面。如果在这种情况下，由于船底部线性非规则面，船体无法垂直吊离水面，吊装初期船体会发生翻转，如果考虑搁浅反作用力，那么【Pull(拖拉)】命令可能不适用于此种工况。此外，当吊装涉及多台吊机、船翻转且搁浅点数量不一时，吊机上的作用力会有所不同。

Since such a procedure will be influenced by many factors, using the Multi Body module will provide more flexibility to the Naval Architect and provide more information and a better understand of the forces encountered and how they will interact.

由于打捞沉船过程受很多因素影响，所以工程师在使用多模型模块需更加灵活运用、提供更多的信息、更深层次理解力的作用以及力之间的相互影响。

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### 6.1 GETTING STARTED WITH MULTI BODY 多体的入门

If you are familiar with Multi Body or have used it in the past, you may wish to skip to the next section.

如果您熟悉多模型模块或者之前已使用过，那么可以跳过本章节，进入下一章。

Windows allows more than one session of GHS to run at the same time. The Multi Body module allows these sessions of GHS to communicate with each other. Multi Body (from here on referred to as MB) operation is initiated by a special form of the solve command. This is:

Windows 操作系统允许同一时间运行多个 GHS 程序，多模型模块允许各 GHS 程序联系起来。多模型模块（以后简称 MB）是由【Solve(求解)】命令的一种特殊形式启动操作的。这就是：

```
SOLVE PRIMARY ...parameters
```

or

```
SOLVE SECONDARY ...parameters
```

or

```
SOLVE NORMAL
```

Before discussing the parameters, understanding how the individual sessions of GHS communicate with each other is needed. Each of the sessions of GHS in use during MB operation, is considered either a primary or a secondary session. Each primary may be connected to one or more secondaries, and each secondary may be connected to one or more primaries. However, primaries may not be connected to primaries, and secondaries may not be connected to secondaries. This is accomplished through "channel files". Each primary session will have a unique channel. Secondaries can have one or more channels associated with them. Once connected, the various sessions of GHS will communicate with each other through connection points defined through critical points.

在讨论参数之前，用户有必要先了解单独的 GHS 程序如何与其他 GHS 程序建立联系。在 MB 运行过程中，GHS 程序要么是主程序，要么是次级程序。每个主程序可以连接一个或多个次级程序；每个次级程序可以连接一个或多个主程序。但是主程序不可以连接主程序，次级程序不可以连接次级程序。程序之间通过“通道文件”相联系。每个主程序只有唯一一个通道，而次级程序有一个或多个通道。建立连接之后，各 GHS 程序通过定义为关键点的连接点进行联系。

There are two types of connection between these critical points, latched and grounded. Considering the case of an integrated tug-barge, latch type connections are needed. Grounded type connections are used where one vessel is resting on another. In this case, one vessel will exert an upward force only on the other, such as a drydock raising a vessel would. If the connection points are not in contact, then no forces are exerted. These critical points are defined in the coordinate system of the geometry model used in that session. In addition, if two critical points are present, the 3 dimensional distance between them should be the same. If three or more critical points are present, the

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distance between them and their relative locations to each other should be the same, since this type of connection requires that the critical points must be coincidental at all times. The effect of the connection points not being coincidental will be discussed later.

有两种关键点连接方式，拖带式和搁坐式。当拖船拖带时，这种情况就是拖带式。当一艘船搁在另一艘船上，这种情况就是搁坐式。在这种情况下，一艘船对另一艘船施加一个向上的力，就像干船坞举升一艘船。如果连接点没有接触，那么不会有力的作用。关键点设置在程序模型的坐标系中。此外，如果有两个关键点，那么他们在三维空间的距离是不变的；如果有三个或以上的点，由于搁坐式要求所有连接点在任何情况下同时起作用，所有连接点之间的距离及相对位置不变。连接点不同时起作用的情况将在以后讨论。

Only vertical forces are considered in the interactions between the vessel, so it is best to think of the connections as ball and socket joints as opposed to pinned joints.

由于船之间只有垂向作用力，因此，把连接点考虑成球窝接头连接，而不是销连接。

For the sake of simplicity, let's use a barge train consisting of two identical barges connected at the corners. The geometry file CSI100.gf is a 100' x 40' x 10' rectangular barge with 4 equal port and starboard tank pairs. As each session uses a single geometry file, however the same geometry file can be used. Figure 7 shows the arrangement and connection details of the barge train.

为简化起见，让两个一模一样的驳船在边角处连接。模型文件 CSI100.gf 是 100 英尺 × 40 英尺 × 10 英尺的矩形驳船，该驳船等分为四组舱室且左右对称。每个程序只使用单个独立的模型，但可以使用一样的模型。图 7 详细显示了驳船的布置和连接方式。

The run file MBBARGE.RF can be created by copy and pasting the commands in the Appendix.

复制和粘贴附录中的命令创建运行文件 MBBARGE.RF。

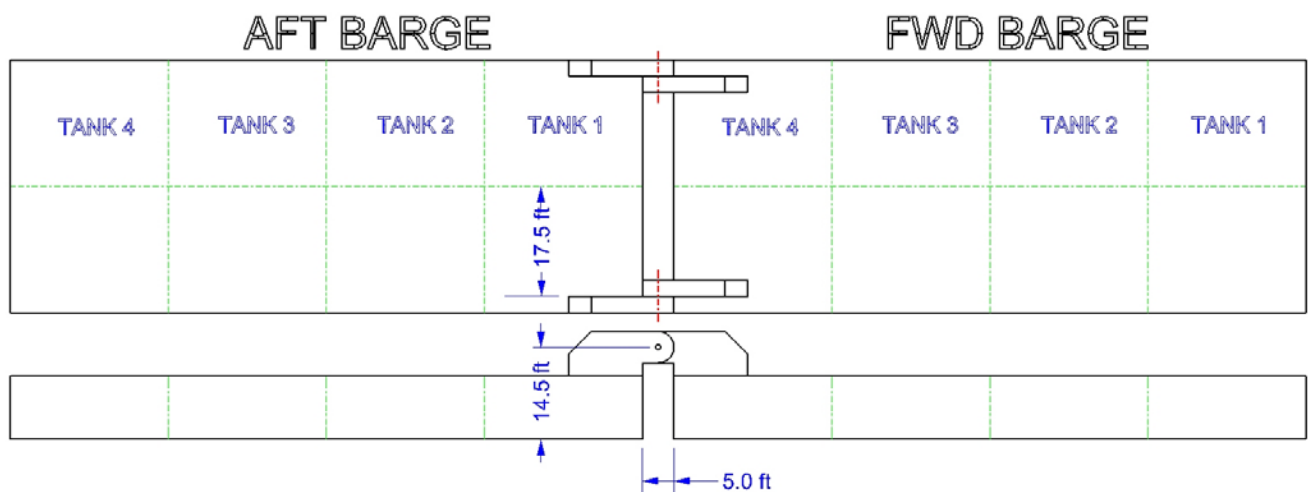


Figure 7

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The critical points for the forward barge would be:

前面驳船的关键点是:

```
CRTPT (1) "STBD PIN" 102.5 17.5 14.5 /NOFLOOD  
CRTPT (2) "PORT PIN" 102.5 -17.5 14.5 /NOFLOOD
```

and for the aft barge:

后面驳船的是:

```
CRTPT (1) "STBD PIN" -2.5 17.5 14.5 /NOFLOOD  
CRTPT (2) "PORT PIN" -2.5 -17.5 14.5 /NOFLOOD
```

The transverse location of 17.5 feet off centerline is the location where the reaction forces are balanced. The location of the actual reactions should not be used. For example, 16.25 feet of centerline for the forward barge and 18.75 feet for the aft barge. We will see why at the end of the exercise.

反作用力的平衡位置距中心线横向距离 17.5 英尺，此距离一般不按照实际距离选取，例如，前面驳船距中心线的距离是 16.25 英尺，后面驳船距中心线的距离是 18.75 英尺。这么做的原因见本练习的结尾。

Once defined, setting the channel of communication and connecting point interactions would be done with the following commands.

定义完成，按照如下命令设置联系和连接点。

```
SOLVE PRIMARY:TRAIN.MB /WAIT
```

and

和

```
SOLVE SECONDARY:TRAIN.MB,1,1; *,2,2 /WAIT
```

In the first statement above, TRAIN.MB is the name given to the communication channel to be used. If more than one primary session is to be used, a different channel name must be used in the statement for that session. The parameter /WAIT tells this session of GHS to wait until communication is established with the secondary session.

上述第一条语句中，TRAIN.MB 是联系通道的名称。如有多个主程序，那么需使用不同的通道名称。参数/WAIT 表示暂停本程序，直至确保与次级程序完成连接。

In the second statement, the critical points are connected by reference to their number, thus 1 to 1 and 2 to 2. The first in the pair refers to the critical point on the primary vessel, the second in the pair to the secondary vessel. Since both critical point numbers are positive in each pair, this becomes a latched connection. If one was negative, then it would be a grounded connection with that point being one that would not bear weight or not exert an upward reaction on the other vessel. The \* before the second pair indicates that the same communication channel is to be used. If this secondary vessel was also connection to a different primary vessel, then the different communication channel would be stated.

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第二条语句中，通过数组连接关键点，如 1 对 1, 2 对 2。数组中第一个数指主程序的关键点，第二个指次级程序的关键点。两个关键点都是正值，那么这种连接为拖带式连接，如果有一个点是负值，这个点不负重或者不对另一艘船施加反作用力，那么这种连接是搁坐式连接。第二组数组前的\*表示使用相同的通道。如果次级船还连接了另外一艘主船体，则需建立不同的通道。

So, in order to initiate the MB process, the following commands for the forward (primary) vessel would be:

因此，为了运行 MB 程序，用于前面（主）船体的命令如下：

```
CLEAR
READ CSI100.GF

DR 3
SO WE LCG
VCG 6

CRTPT (1) "STBD PIN" 100 20 10 /NOFLOOD
CRTPT (2) "PORT PIN" 100 -20 10 /NOFLOOD

SOLVE PRIMARY:TRAIN.MB /WAIT

ST GHS
ST CRT

LOAD (*) EDIT /DISPLAY:TRUE
```

the commands for the aft (secondary) vessel would be the same with the CRTPT and SOLVE commands as given on the previous page. The LOAD (\*) EDIT command enters a load editor window for each session with MB running under load editor. Any change in loads made in one load editor window will be reflected in the other.

后面（次级）船体的运行命令与前面页上的【CRTPT】，【Solve（求解）】是一样的。【LOAD (\*) EDIT】命令进入装载编辑窗口，在装载编辑器窗口运行 MB 模块。在任何一个转载编辑器中改变装载，都将影响另外一个。

### 7.0 EXERCISE 练习:

Write two run files using the above commands. Start two sessions of GHS and execute each run file.

根据如上运行命令编写运行文件，开始两个 GHS 程序，运行文件。

What would happen if the connection point of one barge was 20 feet off centerline and for the other barge, 15 feet off centerline? This is an exaggeration of using the location of the actual hinges on each barge. The reactions computed by GHS are equal in magnitude but because the location, and thus the lever arms are different, the barges will result in different heels.

按照两船连接点实际位置，夸张点设置，两船的连接点一个距中心线 20 英尺，另一个距中心线 15 英尺，会发生什么状况呢？根据 GHS 计算，力的大小是一样的，但是由于距离不一样，力臂长度不一样，导致驳船的横倾不一致。

What would happen if the connection points were defined as being at the fwd end of each barge? Since we visualize the forward direction of model towards the right, we might visualize this arrangement as one barge on top of, or superimposed on the other. GHS would find equilibrium but does not recognize any interference between the two hulls. So if the Multi body sessions were set up in this way, loading Tank1 of either or both barges would result in both barges being trimmed by the bow.

如果将连接点都定义在每个驳船的首部会发生什么？我们设船右舷为正，并且假设该船在顶部或者叠加在别的船上。GHS 可以找到平衡，但不能识别两个船体之间的任何冲突。因此，如果通过此种方式建立了多体模式，在任一或者所有驳船的舱室 1 中装载都会导致所有驳船在船首纵倾。

如果将连接点都定义在每个驳船的首部会发生什么？我们设定右舷为正且一船在另一船顶部或者叠加在另一艘船上。GHS 可以求解平衡，但不能识别两个船体之间的联系。所以按照如此方式设定 MB 程序，装载任一或两个驳船都在舱室 1 装载，那么两艘驳船都会产生首倾。

Note also, since GHS does not recognize any interference between the two hulls, a condition with excessive trim could result in the hulls making contact. This is true regardless of the arrangement. To prevent this, a combined trim (aft barge trim minus fwd barge trim) of

$$2 \times \arctan (2.5/14.5) = 19.56 \text{ degrees}$$

还需注意，由于 GHS 不能识别两船之间的联系，过大的横倾的情况可能会导致船体相互接触。无论怎样安排都是无法避免的。为了防止这种情况的发生，有必要进行修正纵倾（后面船纵倾减去前面船纵倾）

$$2 \times \arctan (2.5/14.5) = 19.56 \text{ degrees}$$

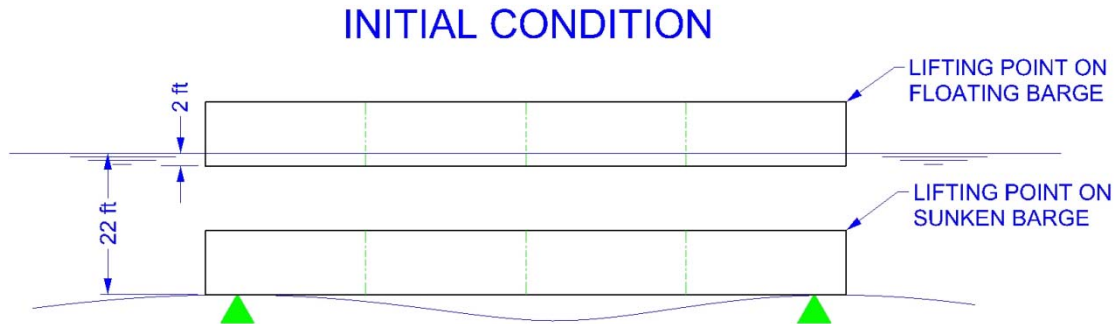
in this case would have to be an operational limit.

在这种情况下，必须有操作限定。

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Now let's explore connection points as ground point types. A simple scenario of a floating barge lifting a sunken barge in 22 feet of water will demonstrate the use of this type of connection.

现在，让我们探讨搁坐式的连接点。设定某一搁坐式连接的简单工况，一艘驳船浮在水中提举一艘沉没的驳船，该驳船位于水下 22 英尺处。



If the sunken barge was on a level bottom with its deck 12 feet below the surface, the commands to set up the condition and initiate a Multi Body session would be

如果沉没驳船甲板位于水下 12 英尺，设置工况和 MB 程序的命令如下：

```
CLEAR
PROJECT SINKER                `this displays in the title bar, helps to keep
READ CSI100.GF                `track of which session is which

WEIGHT 300 50 0 6             `weight = 300 Ltons at 50 ft aft,
                               `centerline, 6 ft above the bottom

DR 0                           The draft needs to be defined before groundpoints.
                               The negative penetration then locates the ground points below the waterline.

CRTPT (1) "FWD CONNECTION" 0 20 10 `connection at fwd stbd corner
CRTPT (2) "AFT CONNECTION" 100 20 10 `connection at aft stbd corner

GROUND "FWD STBD" * 5 20 0 /PEN:-22 `at zero draft, 22 ft to the
GROUND "FWD PORT" * 5 -20 0 /PEN:-22 `bottom will put the deck at
GROUND "AFT STBD" * 95 20 0 /PEN:-22 `12 feet below the surface
GROUND "AFT PORT" * 95 -20 0 /PEN:-22

LOAD (*) .95                   `to make sure it sinks
SOLVE SECONDARY LIFT.MB 1,1; *,2,2 /WAIT
```

With the lifting barge directly above the sunken barge at a draft of 2 feet, the commands are

起重驳船在沉没驳船正上方，吃水为 2 英尺，命令语句如下：

```
CLEAR
PROJECT FLOATER
READ CSI100.GF

DRAFT 2
SOLVE WE LCG TCG
VCG 6
```

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```
CRTPT (1) "FWD LIFT POINT" 0 20 10          `lifting at the fwd stbd  
corner  
CRTPT (2) "AFT LIFT POINT" 100 20 10      `lifting at the aft stbd corner  
  
SOLVE PRIMARY LIFT.MB /WAIT
```

It is suggested that you type or paste these commands into two run files, for example, SINKER.RF for the sunken barge and FLOATER.RF for the floating barge.

建议打字或者粘贴这些命令语句到两个运行文件。例如，沉没驳船的 SINKER.RF 文件和漂浮驳船的 FLOATER.RF 文件。

It does not matter in this case, which is the primary and which is the secondary as the critical point numbers match and both are positive. But that defines the connections as the latched type. If chains or cables are to be used, so the lifting barge can only lift up and not push down, a grounding type connection is needed. To do this, the command for the sunken secondary vessel would be

在本例中，关键点相匹配且数值为正，哪个是主程序的点，哪个是次级程序的点，这并不重要。但如果定义为拖带形式，那么就会很重要。如果使用了锁链或钢索，起重驳船只能提供提升的力，不能提供向下的推力，那么需设置成搁坐式的连接。次级船为沉没船的命令语句如下：

```
SOLVE SECONDARY LIFT.MB 1,-1; *,2,-2 /WAIT
```

The second number in each pair corresponds to the secondary vessel. The negative sign sets that point as a grounding point. As such, it can be pushed up (or in this arrangement, pulled up), but it can't be pushed down (or bear weight).

每组数的第二个数字对应次级船的关键点。负号的点设为搁坐点。那么，此点可以力可以向上推（在此布置中，往上拉），但不可能向下推（或者负重）。

To use load editor and view the Condition Graphic window, add to each run file

为了使用装载编辑器和查看图形窗口，增加下面语句到运行文件

```
VARIABLE CGPARAM="BODY @5 @95,PROFILE"  
LOAD (*) EDIT
```

To initiate a MB session from a single run file, a third run file, such as LIFTBARG.RF, the commands

用单独的第三文件用于启动 MB 程序，如 LIFTBARG.RF，

```
SHELL GHS FLOATER.RF /SPAWN  
RUN SINKER.RF
```

will shell out to another spawned GHS session which will run FLOATER.RF then will run SINKER.RF. Once equilibrium is reached, the Condition Graphic window can be viewed by clicking the CG button in Load Editor.

这个命令语句打开新的成型的 GHS 程序，运行 FLOATER.RF，然后运行 SINKER.RF。求解平衡后，可点击装载编辑器中【CG】按钮，查看图形窗口。

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Condition Graphics button

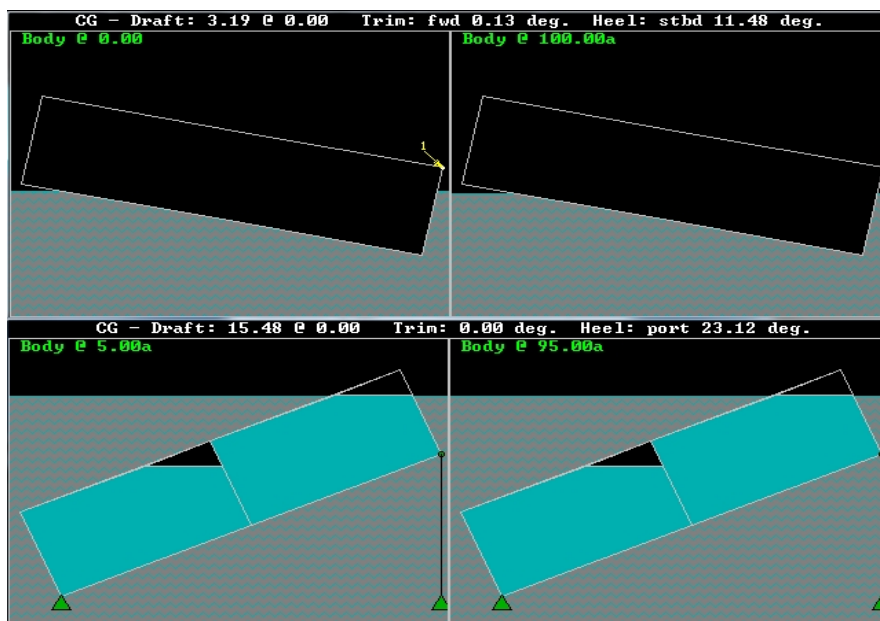
Height of connection point

MB flag, green if in Equilibrium, magenta if not

Weight Description	LONG TONS	LCG	TCG	VCG	Load%
Interaction @ 1 (-12.06)	0.76	0.00	20.00s	-10.00	
Interaction @ 2 (-12.07)	0.96	100.00a	20.00s	-10.00	

The graphic will demonstrate two issues. First, since the connection points were defined at the deck of both barges, GHS immediately solved as if the barges were connected at those points, pulling the floating barge down while trying to lift the sunken barge. To make this a useful MB session, the connection points on the floating barge should be located near their respective connection points on the sunken barge. The deck of the sunken barge we know is initially 12 feet below the surface, the deck of the floating barge is 8 feet above the surface. The height of the points on the floating barge need to be decreased 20 feet.

该图形演示了两个问题。首先，由于两个驳船都在甲板定义了连接点，GHS 根据驳船连接点立即计算，当漂浮驳船设法提举沉没驳船时，漂浮驳船会被向下拉。漂浮驳船上的连接点应与沉没驳船上各自对应的连接点连接，这样 MB 程序才会起作用。我们知道沉没驳船的甲板初始位置在水面以下 12 英尺，漂浮驳船的甲板距水面以上 8 英尺。漂浮驳船上点的高度需减去 20 英尺。



Secondly, there would be interference between the two hulls making the above situation impossible. One could attempt to add addition points assigned to act as constraints. In this case, adding points to the bottom of the floating barge and connecting them to the point on the deck of the sunken barge with the deck of the sunken barge acting as

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ground points. To prevent any interference between the hulls, we can add two additional critical points to each. Two at the bottom corners of the floating barge, and two at the top corners of the sunken barge. FLOATER.RF should be revised with:

其次，两船壳相碰冲突，使得上诉情况不可能发生。可尝试添加额外的点当做系统参数。在这种情况下，在漂浮驳船底部增加点，与沉没驳船甲板相连，设置成搁坐点。为了避免出现两船体之间相互碰撞冲突，我们可以在每船各自增加两组额外的关键点，两个在漂浮船体底部边角处，两个在沉没船体顶部边角处。FLOATER.RF 应修订为：

```
CRTPT (1) "FWD LIFT POINT" 0 20 -10          `10 - 20 = -10
CRTPT (2) "AFT LIFT POINT" 100 20 -10
CRTPT (3) "FWD BOTTOM CORNER" 0 20 0
CRTPT (4) "AFT BOTTOM CORNER" 100 20 0
```

And to SINKER.RF, add

对于 SINKER.RF, 增加

```
CRTPT (3) "FWD TOP CORNER" 0 20 10
CRTPT (4) "AFT TOP CORNER" 100 20 10
```

Finally, the MB command for the sunken vessel needs to be revised. If the sunken barge is the secondary vessel, the revision would look like..

最后，沉没驳船的【MB】命令需修正。如果沉没驳船是次级船体，修正如下：

```
SOLVE SECONDARY LIFT.MB 1,-1; *,2,-2; *,-3,3; *,-4,4 /WAIT
```

The two additional pairs for points 3 and 4 defines the relationship between the new critical points. The first point in each pair corresponds to the primary vessel and the negative sign sets that point on the floating vessel as a grounding point.

两组附加关键点 3 和 4 定义了新的关联关键点。每组第一个数对应主船体的点，漂浮船舶上搁浅点设置为负号。

Rerunning MB should result in little or no reaction forces at the initial connecting points. The sunken barge is grounded on all four points. The floating barge at at zero or very small heel and trim. To simulate lifting the sunken vessel, the height of the critical points of the floating vessel can be increased.

重新运行 MB 程序，结果显示在初始连接点处有很少量或根本没有反作用力。沉没驳船四个点都搁浅在水底。漂浮驳船正浮或者有少量横倾纵倾。为了模拟提举沉没驳船的情况，可在漂浮驳船不同高度增加关键点。

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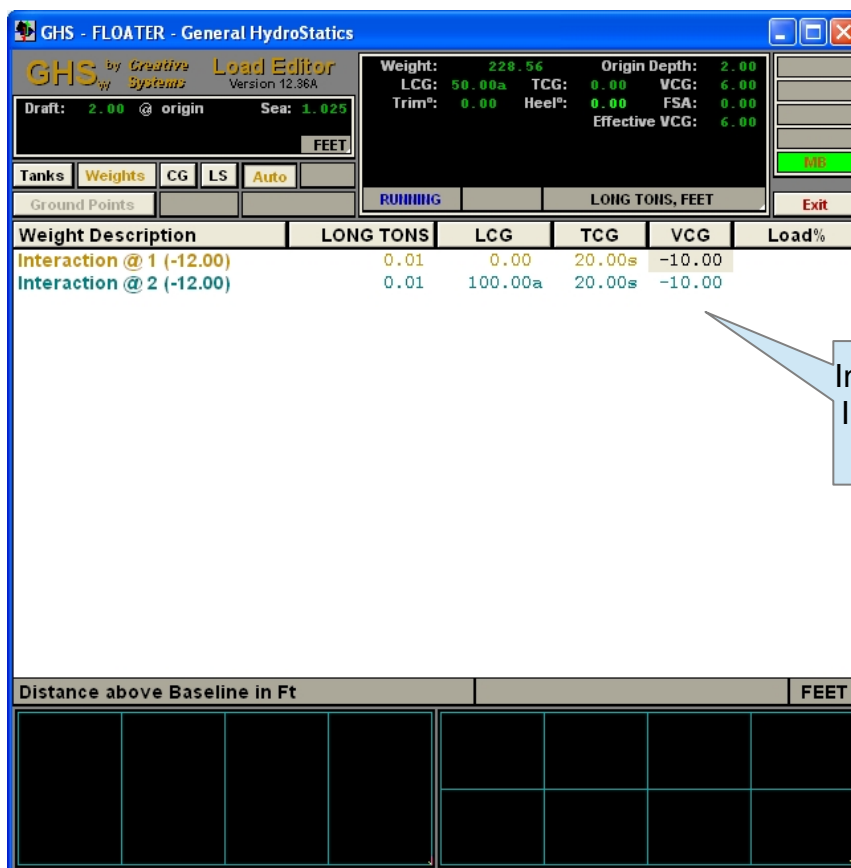


Figure 7

As the critical points heights are raised, the floating vessel will change its trim and heel while the sunken vessel may remain on the bottom. As this happens, the connection points will no longer be coincidental. Recalling from the previous exercise with the barge train, when the connection points are not coincidental, discrepancies occur. The user should be aware of this and attempt to keep the differences small when raising the critical points. Another problem is that when changing the heights by a large amount, when the second pair of critical points we added result in a large penetration (remember how the penetration and stiffness effect the reaction of a ground point) a solution can't be found.

当关键点提高时，漂浮驳船改变纵倾横倾，然而沉没驳船可能还在水底。如发生这种情况，连接点将不再同时改变。重新回到之前驳船的练习，当连接点不同时改变，产生差异。用户需注意，在提举时，需保持连接点较小的差异。另外一个问题是，当高度改变较大时，关键点数组的第二个数在水底发生穿透（注意搁坐点由于穿透和弹性变形影响反作用力），这种情况不易被发现。

Whether running Multi Body from run files or Load Editor, changes in critical point heights should be kept small. Due to the solving process used by GHS and Multi Body, making a change and then changing back to the initial value will not always return to the prior results. It is important that the difference between the heights of the connection point pairs and the magnitude of the reaction forces remain small. Large differences are an indication that the connection points are becoming unaligned.

无论是使用运行文件还是装载编辑器运行 MB 程序，每次关键点高度的改变量保持在一个较小的范围。由于通过 GHS 和 MB 模块求解，改变某些值，然后再改回原来的值，不一定能得出之前一样的结果，所以，保持较小范围内改变连接点的高度和反作用力的大小是十分重要的。如产生了较大的差异，那意味着连接点不在同一直线上。

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It should be noted that there are times when using a simple approach or applying an appropriate restriction may yield better results. Taking the above as an example, the realistic approach of two connection points resulted in possible errors. If the sunken barge is actually on a flat bottom, one connection point could be used. Then alignment of the critical point is guaranteed. Or fixing the trim of the floating barge if it can be assured that the trim can be kept to a minimum.

应注意的是，使用一个简单的方法或施加适当的限制可能会产生更好的结果。采取上述作为一个例子，只使用两个连接点的方法得出的结果可能是错误的。但如果沉没驳船搁坐在平整的水底，可以使用一个连接点。可设置关键点排成直线或者在倾角较小的情况下锁定其纵倾。

Another issue to be aware of is that using the Load Editor to raise the critical points, only the vertical distance relative to the vessel's baseplane was changed. As it is expected that the attaching cables or chain remain perpendicular to the waterplane, the results are reasonable only for small angles of heel and trim. In the next example, a special form of the CRTPT command is used to make adjustments to the connecting point heights perpendicular to the waterplane. Unfortunately, this is not possible in Load Editor.

还有一个问题要注意的是，在使用装载编辑器提升关键点的时候，只有船基准面之间相对垂向距离在改变。假定绳索和锁链与水面保持垂直，得出的结果只适用于小角度横倾和纵倾情况。在下例中，一个特殊形式的【CRTPT】命令用于调整连接点垂直于水面。遗憾的是，装载编辑器无法实现这个功能。

### **7.1 PREPARING TO RAISE THE SUNKEN FISHING VESSEL 准备打捞沉没的渔船**

The use of ground points has already been discussed and will not be repeated here. The number and locations will need to be determined by the situation and experience. The use of the PULL command may or may not be appropriate. This section will discuss the use of Multi Body to roll and raise a sunken vessel with two floating barges.

搁浅点的运用已经讨论过了，此处不再重述。点的数量和位置需根据现场情况和经验判断。【Pull（拖拉）】命令可能适用也可能不适用。本节将讨论，使用两条漂浮船运用MB模块翻转和提举一艘沉船。

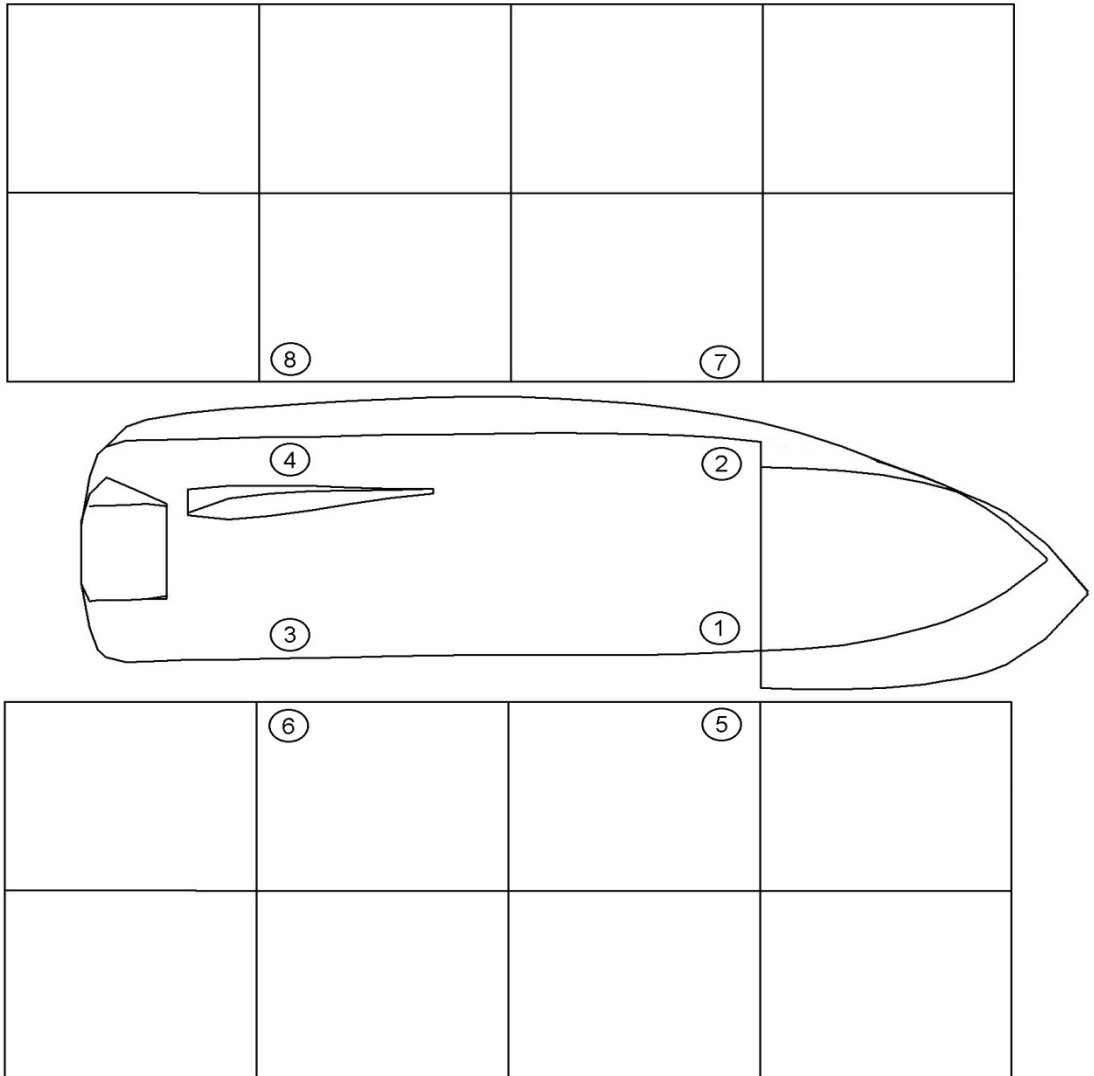
The fishing vessel has sunk and is in 30 feet of water and heeled at 25 degrees to starboard. Our two 100 foot barges are position on each side and will winch the vessel up by cables over the side. Figures 8 and 9 show the arrangement of vessels.

渔船已经沉没，并在 30 英尺深的水中，右舷横倾 25°。两条 100 英尺的驳船在该渔船的两边，通过缆绳从两侧对其进行打捞。图 8 和图 9 示出了船舶的布置。

一艘渔船沉没在 30 英尺的水中，右倾 25°。两条 100 英尺的驳船在该渔船两侧，用绞车绳索向上提升该渔船。图 8 和图 9 显示船只布置。

# Salvage Procedures using GHS – 7/2011

Figure 8



## Salvage Procedures using GHS – 7/2011

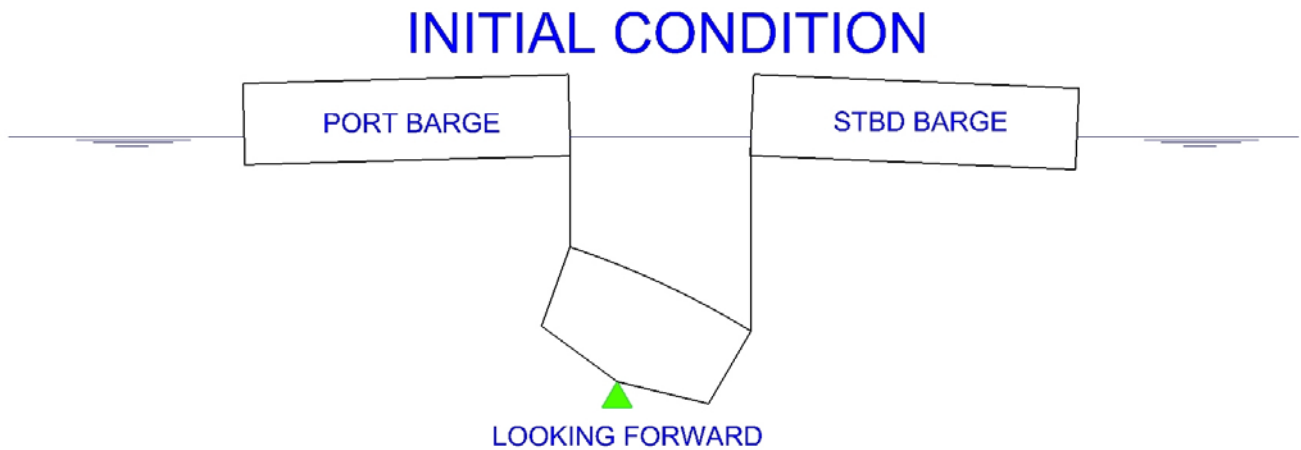


Figure 9

The following commands will define the initial condition for this example. The fishing vessel will be the secondary vessel as the connections will be grounding type connections and is the preferred method. The weight and center of gravity of the fishing vessel is determined by assuming a 10.5 foot initial draft and 1 foot of aft trim. The VCG is set at 10 feet. The vessel is resting on the bottom with a heel of 25 degrees. The pilothouse top is set at 5 feet below the waterplane. The ground points used are 3 along the keel and two on the chine. Or some reason, all the hatches and doorways were open so the lazarette, holds, engine room and foc'sle are flooded. These commands should be entered into a run file, FVLIFT.RF

通过下面命令语句定义本例初始工况。首选方法，设定渔船为次级船体，通过搁坐式相连接。渔船重量重心通过假设一个 10.5 英尺的初始吃水和 1 英尺的尾倾工况确定，VCG 设定为 10 英尺。船搁浅在水底，呈 25°。操作室顶部设定在水下 5 英尺处。沿着龙骨设置 3 个搁浅点，设置 2 个搁浅点在舳部。由于某些原因，所有舱口和门道都是打开的，所以安全空间、房间、机舱和首部甲板室都进水淹没。输入这些命令至运行文件 FVLIFT.RF。

```
CLEAR
PROJECT FVLIFT
READ FV.GF

TRIM 1/100
DRAFT 10.5
SOLVE WE LCG TCG
VCG 10

HEEL 25
CRTPT (1) "PILOTHOUSE TOP" -24 0 28
HEIGHT (1) -5

GROUND "FWD KEEL" * -27 0 0.157
GROUND "MID KEEL" * -4 0 0
GROUND "AFT KEEL" * 23 0 0
GROUND "FWD CHINE" * -15 10 3
GROUND "AFT CHINE" * 12 12 3

TYPE (LAZ.C, FOC'SLE.C, ENGRM.C, HOLD*) FL
SOLVE
STATUS CRT GHS
```

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For lifting points the following critical points will be used.

下面的关键点将作为吊点。

```
CRTPT (1) "FWD STBD CONNECTION" -19.25 12 12.90 /NOFLOOD
CRTPT (2) "FWD PORT CONNECTION" -19.25 -12 12.90 /NOFLOOD
CRTPT (3) "AFT STBD CONNECTION" 19.25 12 13.36 /NOFLOOD
CRTPT (4) "AFT PORT CONNECTION" 19.25 -12 13.36 /NOFLOOD
```

The locations were taken from the geometry file but they do not have to be on the hull. An example of locating them at other locations will be shown below. Two lifting barges will be used. One on each side of the sunken vessel. The one on the starboard side of the sunken vessel, STBDLIFT.RF will be lifting from its port side. Two starboard tanks will be used for counter ballast. Its initial condition and connection points are as follows:

这些点的位置取自模型文件，但它们不必一定要在船体上。下面将展示点不在船体上的例子。将用到两艘起重驳船，分别位于沉船的两侧。在沉船右舷的起重驳船，运行 STBDLIFT.RF，在其左舷提升沉船，两个右边舱室用于配重压载，其初始工况和连接点如下：

```
CLEAR
PROJECT STBDLIFT.RF
READ CSI100.GF
WEIGHT 300 50 0 6
LOAD (TANK2.S,TANK3.S) 0.2

CRTPT (5) "FWD PORT WINCH" 30.75, -20, 11
CRTPT (6) "AFT PORT WINCH" 69.25, -20, 11
SOLVE
ST CRT
```

The location of the connection points are centered on the barge's length at the same distance apart as the points on the sunken vessel, on the barges side and 1 foot above the deck. If the critical point numbers were not specified, they would have been assign 1 and 2 by GHS. This could lead to confusion in the reports, so 5 and 6 was given.

连接点的位置在起重驳船船长方向居中，其位置在沉船上是一样的，位于船舷一侧，高于甲板 1 英尺。如果没有定义关键点序号，那么 GHS 将自动定义序号 1 和 2，但是这样做会混淆报告，所以需定义序号 5 和 6。

For the other barge positioned on the port side of the fishing vessel, PORTLIFT.RF, a counter weight of 25 tons is used located on its port side to give an initial starboard heel.

对于渔船左舷位置的另一艘驳船，PORTLIFT.RF 文件在其左舷给定 25t 的配重使其初始右倾。

```
CLEAR
PROJECT PORTLIFT
READ CSI100.GF
WEIGHT 300 50 0 6
ADD "COUNTER WEIGHT" 25 50 -15 12

CRTPT (7) "FWD STBD WINCH" 30.75, 20, 11
CRTPT (8) "AFT STBD WINCH" 69.25, 20, 11
SOLVE
STATUS CRT
```

## Salvage Procedures using GHS – 7/2011

At this step, run each file and note the heights of the critical points. The points on the barges are about 9 feet above the water and the deepest point on the ship is about 24 feet below the surface for a total of 33 feet. The points on the barges will need to be changed to create a connection. That could be done by changing the heights in the above statements, but doing so would lower them perpendicular to the barge's baseplane as explained earlier. A better method would be to change them using special form of the critical point command, `CRTPT (n) *-d` will lower the *n*th critical point *d* feet. The same statement can be used to raise the critical point by replacing the minus sign with a plus sign. The amount each is lowered depends on how the vessel is to be lifted. One option would be to lift it straight upwards with its current heel of 25 degrees, or to rolled it upright then lift. Here we will roll the vessel first. If it is lifted on the stbd side too far, it may tip to port. To prevent this, we set all the barge's critical points to 33 feet below their present position. Then we will raise each the same amount so the port side connection will support the vessel when it is near upright.

在此步骤中，运行每个文件并注意的临界点的高度。在起重驳船的点是大约在水线以上 9 英尺处和船上的最深点在水线以下约 24 英尺，共计 33 英尺。我们需要改变起重驳船上的点来创建连接。在上述语句中这可以通过改变高度来完成，但这样做会降低他们垂直到沉没驳船的底平面的距离。更好的方法是使用临界点命令的特殊形式来改变他们，**【CRTPT (n) \* -d】**命令将降低第 *n* 个关键点 *d* 英尺距离。同样的语句可用于通过用加号代替减号提高临界点高度。每次降低的数额取决于该船只被打捞的方式。一种选择是将其目前的 25° 横倾直接垂直向上拉，或将转正然后载向上拉。在这里，我们将首先翻转船舶。如果起吊点距右舷太远，它可能会向左舷翻转。为了防止这种情况，我们将所有的驳船的临界点降到其当前位置的 33 英尺以下。然后，我们在所有点上施加同样的力，这样当船接近正常状态时，左舷的连接点可以支撑整条船。

在此步骤中，运行每个文件，标记关键点高度。在起重驳船上关键点的高度从水面以上 9 英尺到水面以下 24 英尺，总共 33 英尺。我们需改变起重驳船上的点用于创建连接。如上情形，我们可以通过改变关键点高度来实现，但是如之前已经说明的，这么做会减少它们到驳船基准面的垂直距离。一个更好的办法就是采用**【CRTPT (n) \* -d】**命令减小第 *n* 个关键点 *d* 英尺的距离。这同样适用于提升关键点高度，只需把减号改成加号。每次降低的数值取决于如何提升沉船。有一个可选项，直线提升沉船，保持沉船当前右倾 25°。或者扶正沉船，再进行提升。这里我们首先扶正沉船。如果右舷提升过大，那么沉船左倾。为了避免这种情况，我们设置所有驳船上的关键点都为当前位置以下 33 英尺。然后左右舷提升同样高度，这样当船接近正浮时，左边连接点可以支撑沉船。

To move the critical points, set up the communication channels for Multi body and enter Load Editor, add the following commands

移动关键点，为 MB 模块建了连接通道，进入装载编辑器，添加如下命令语句：

### FVLIFT.RF

```
SHELL GHS STBDLIFT.RF /SPAWN
SHELL GHS PORTLIFT.RF /SPAWN
SOLVE SECONDARY: LIFT1.MB,5,-1; *,6,-3; LIFT2.MB,7,-2; *,8,-4
LOAD (*) EDIT
```

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### STBDLIFT.RF

```
CRTPT (5) *-33
CRTPT (6) *-33
SOLVE PRIMARY:LIFT1.MB
LOAD (*) EDIT
```

### PORTLIFT.RF

```
CRTPT (3) *-33
CRTPT (4) *-33
SOLVE PRIMARY:LIFT2.MB
LOAD (*) EDIT
```

Now executing FVLIFT.RF in GHS will start two additional sessions of GHS/Load Editor. The results can be viewed in the appropriate Weight and Ground Point windows. The heights of the connection points can be changed in Load Editor as in the previous example. But by using run files, we can use the CRTPT (n) \*-d form of the critical point command. To do this, the three sessions of GHS will need to communicate with each other each time the values are changed. If we step the connection point heights, say one foot at a time, it is necessary that all three sessions of GHS reach equilibrium before continuing to the next step. Since we expect the port side barge to not make a connection in the first condition and possibly subsequent conditions, that session will need to wait until the others reach equilibrium. That can be done by looping macros that exit when the condition that the other session are ready to continue.

现在，在 GHS 中运行 FVLIFT.RF，启动两个额外的 GHS/装载编辑器程序。结果可以在【Weight】和【Ground Point】窗口中查看。如前面例子，在装载编辑器中可以改变连接点高度。通过使用运行文件，则需使用【CRTPT (n) \*-d】形式的关键点命令。三个 GHS 程序互相联系且实时同步变化。如果我们设置了连接点的高度，每次移动一英尺，三个 GHS 程序全部求解平衡后才会继续下一步。由于我们预计左边的驳船在第一次工况不建立连接，而在之后的工况中建立连接，这个程序需等其他程序达到平衡后在运行。当其他程序准备继续时，可通过推出循环宏的方式实现上面情况。

As stated at the beginning of this manual. It is assumed the user is familiar with macros, user variables and passing parameters. These features of GHS will now be implemented. For every user variable created, they will need to be declared in each run in which they are used.

正如本手册开始描述的，用户需熟知宏、用户变量和临时参数。GHS 这些功能将在这里执行。对于每一个用户创建的变量，在每个运行文件中使用变量时都需要提前声明。

Above we defined the two barges each as primary sessions and the sunken vessel as a secondary session. The looping macros will be in the run files associated with the barges. Then neither one will continue until the fishing vessel reaches equilibrium. The looping macro is written as

上面我们分别定义两条起重驳船为主程序，定义沉船为次级程序。运行文件中的循环宏用于驳船之间的联系。任何一个运行文件都不会运行，直至沉没渔船达到平衡。循环宏编写如下：

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```
MACRO IFREADY                                `creates a looping macro
  WAIT 0.1                                    `waits for 0.1 second
  IF {READY}=0 THEN EXIT IFREADY `loop if second session not ready
/
```

In the run files for each of the primary vessels, the following macros are needed

在每个主船体的运行文件中，需如下宏：

```
MACRO HOIST          `to adjust the height of each connection point
  CRTPT (7) *+%1 `note that the critical point numbers must
  CRTPT (8) *+%2 `correspond to those in the run file
/

MACRO STEP          `macro to change point heights
  .HOIST %1 %2          `passes new values to macro hoist
  SOLVE SEND SET NEWLOADP=1 `note, use NEWLOADS=1 for the stbd side
  .IFREADY          `starts looping until READY=1 is
                   `received from secondary session

  CLS
  IF {STARTED}=0 THE SET STARTED=1 ELSE PAGE          `for output control
  STATUS CRT GHS
  DI STATUS PROFILE:OUTBOARD, BODY @30.75 @69.25
  SET READY = 0
  WAIT 0.1
/
```

Variables **READY** and **STARTED** need to be declared. Variables **NEWLOADP** and **NEWLOADS** do not need to be declared in this run file. The **SOLVE SEND** sends what follows to the session with which it is communicating. The command **SET NEWLOADP=1** in this case, is only recognized as a GHS command in the receiving session. Therefore, that variable needs to be declared in that run file.

需声明变量【**READY**】和【**STARTED**】。在这个运行文件中，变量【**NEWLOAD**】和【**NEWLOADS**】无需声明。【**SOLVE SEND**】命令把命令之后跟随的参数传送给相联系的程序。此时，在 GHS 接受程序里只接收了【**SET NEWLOADP=1**】命令。因此，**NEWLOADP** 需在接收程序里面声明。

To open a report, raise the connection points 8 feet in 1 foot increments and view the results, include the following:

为了生成总共提升连接点 8 英尺，每次 1 英尺的报告，并且查看结果，需添加如下命令语句：

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```
REPORT PT_BARGE.PF
.STEP 1 1
.STEP 1 1
.STEP 1 1
.STEP 1 1
.STEP 1 1
.STEP 1 1
.STEP 1 1
.STEP 1 1
.STEP 1 1
.STEP 1 1

WAIT 0.5                                `to avoid conflicts with stbd printout
SOLVE SEND SET NEWLOADP=-1             `send to second session to stop macro
                                         `NEWLOADS=-1 for stbd side
REPORT CLOSE /PREVIEW /SPAWN`preview report
END
```

For the secondary vessel, the following macros are needed

对于次级船，须写入以下的宏

```
MACRO STEP          `macro to start solving for secondary vessel
  WAIT 0.1
  IF {NEWLOADP}<0 THEN IF {NEWLOADS}<0 THEN EXIT
  IF {NEWLOADP}=0 THEN EXIT STEP `if port side not ready, loop
  IF {NEWLOADS}=0 THEN EXIT STEP `if stbd side not ready, loop
  WAIT 0.1              `allow time to detect now unsolved
  SOLVE WAIT:60         `wait until fully solved
  CLS
  IF {STARTED}=0 THEN SET {STARTED}=1 ELSE PAGE
  ST CRT GHS
  DI (*) STATUS BODY @-19.25 @19.25
  SET NEWLOADP=0, NEWLOADS=0
  SOLVE SEND SET READY=1          `broadcasts ready to both port and stbd
  EXIT STEP                       `exits macro and reruns macro step
/

REPORT FV_LIFT.PF
.STEP
SOLVE NORMAL                    `ends Multi Body communications
WAIT 0.5                        `avoid conflicts with other printouts
REPORT CLOSE /PREVIEW /SPAWN
END
```

Variables **NEWLOADP**, **NEWLOADS** and **STARTED** need to be declared. Due to different processor speeds, memory and possibly other issues, the time GHS takes to solve a particular condition may vary. The procedures utilized during Multi Body solving with multiple sessions may have timing issues in complicated arrangements. The **WAIT n** commands causes timed pauses that help to keep the sessions in sequence. The length of time of the pauses or the need for them may vary for different computers or networks if using one.

需声明变量【**NEWLOADP**】，【**NEWLOADS**】和【**STARTED**】。由于不同的运算速度、内存和其他可能的问题，GHS 计算某一特定工况的时间可能会有所不同。程序利用 MB 模块求解多级程序时由于复杂的布置可能会产生时间上的问题。【**Wait N**】命令可以暂停进程，使程序按顺序依次运行。由于不同的电脑和不同的网络，是否使用停顿和停顿时间的长短都是不一样的。

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After successfully running the above run files by running FVLIFT.RF, three report files will be opened in a preview window. Each report should have 9 pages corresponding to the 9 steps as the connection points were changed. Note that there was no reactions at the connection points on the port barge for the first 6 steps. This is due to the initial condition defined with the critical points on the barge positioned below the critical points on the fishing vessel. All four of the lifting points were raised 1 foot in each step. The increments for each step could have different. For example, the lift points for the port barge could have be located at the contact points on the fishing vessel. This would simulate the lines on the port side being snugged up as the starboard barge started to lift to prevent an increase of the ground reactions as the vessel rolls. In this case, initial height of the port barge points would be set by

成功运行文件 FVLIFT.RF 之后，预览窗口中会打开三个报告文件。每个报告有 9 页分别对应连接点变化的 9 个步骤。注意到左舷驳船的前 6 个步骤的连接点没有反作用力作用。这是由于初始工况时，起重驳船上的关键点低于沉没渔船的关键点。四个吊点每次上升 1 英尺。每个步骤中的增量可以有不同。例如：左边驳船的吊点设在沉没渔船上，可模拟如下工况：当船翻转时，为了防止搁浅反作用力增加，起吊右边驳船，而左舷绳索可以自由上升。在这种情况下，左舷驳船的初始点通过以下方式设置

```
CRTPT (7) *- 23 `25 degrees of heel puts the port side about  
CRTPT (8) *- 23 `10 feet above the stbd side
```

The steps would then be

```
.STEP 0 0  
.STEP 0 0  
.STEP 0 0  
.STEP 0 0  
.STEP 0 0  
.STEP 0 0  
.STEP 1 1  
.STEP 1 1
```

Likewise, the steps could be such that only the forward or aft points were raised in a step.

同样的，这些步骤适用于前后提升的情况。

If the operation is carried out as illustrated above, it is apparent that the fishing vessel cannot be brought to the surface. In reality, the barges may have sheaves mounted outboard of the hull sides, the lifting is done by a crane or the barges are restrained so they are not directly over the sunken vessel. To do this, the connection points can be located outboard of the hull sides. See Figure 10.

如果操作按上图所示执行，很明显，渔船不能成功被打捞。在现实中，驳船可能在船体两侧的外侧安装滑轮，通过起重机或者驳船提升，由于船体位置的限制，起重驳船不直接在沉船的正上方。这样的话，连接点可设置在船体外侧。参见图 10。

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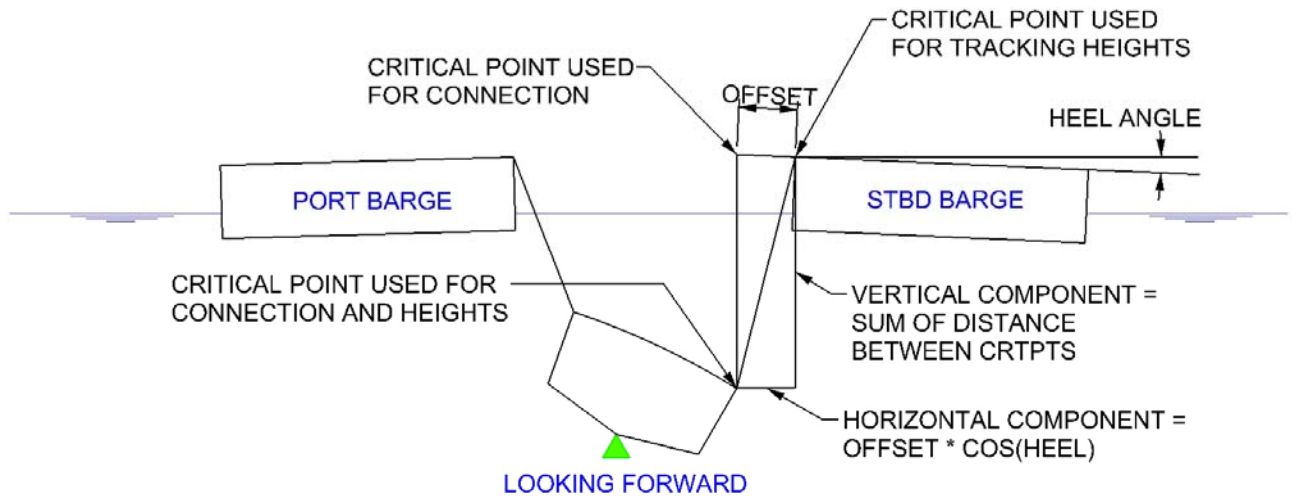


Figure 10

By setting up the Multi Body sessions as shown above, the reaction forces given will be proportional to the vertical component. The ratio of the vertical to horizontal components is equal to the ratio of vertical to horizontal reactions. From this, the forces needed to restrain the barges and the tension in the chain or cable can be determined.

通过设置如上所示的 MB 程序，反作用力将按一定比例作用在垂直方向。垂直和水平分量的比值等于垂直和水平反作用力的比值。由此，可确定用于约束驳船的力和铁链或者索具的拉力。

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### 7.2 DEBALLASTING THE SUBMERGERED FISHING VESSEL 排放沉没 渔船的压载水

In some cases, raising a sunken vessel by lifting as above, the vessel cannot always be raised to a position where enough waterplane area to maintain positive GM while pumping out flooded compartments. In this example, we will assume the fishing vessel has been raised to a level that the pilothouse is exposed and the hull is somewhat accessible. To empty the flooded compartments, we will make use of several of the types of tanks available in GHS. To begin, the initial condition is set using the weight, centers of gravity and lift points as in the example above. Using part of the FVLIFT.RF run file, we can quickly start a new run file. Copy FVLIFT.RF to FVDEBALL.RF and make the revisions shown below. Delete what is crossed out, add what highlighted.

在某些情况下，沉船不一定用上述吊装的方式打捞沉船，在本例中，我们假定一艘渔船已被打捞提升至驾驶室露出水面，且渔船船体受损不严重。要抽空浸水舱室，在 GHS 中我们需利用这几个浸水舱室。首先，和上面的例子一样，先利用重量，重心，起吊点来确认初始工况。利用部分 FVLIFT.RF 运行文件，我们可以快速编写一个新的运行文件。复制 FVLIFT.RF 到 FVDEBALL.RF 文件并作出如下所示的修改，删除划掉的，加入标示的。

```
CLEAR
PROJECT FVLIFT FVDEBALL
READ FV.GF

TRIM 1/100
DRAFT 10.5
SOLVE WE LCG TCG
VCG 10

HEEL 25
CRTPT (1) "PILOTHOUSE TOP" -24 0 28
HEIGHT (1) -5 7

GROUND "FWD KEEL" * 27 0 0 .157
GROUND "MID KEEL" * 4 0 0
GROUND "AFT KEEL" * 23 0 0
GROUND "FWD CHINE" * 15 10 3
GROUND "AFT CHINE" * 12 12 3

TYPE (LAZ.C, FOCLE.C, ENGRM.C, HOLD*) FL
SOLVE
STATUS CRT GHS

CRTPT (1) GROUND "FWD STBD CONNECTION" * -19.25 12 12.90 /NOFLOOD
CRTPT (2) GROUND "FWD PORT CONNECTION" * -19.25 -12 12.90 /NOFLOOD
CRTPT (3) GROUND "AFT STBD CONNECTION" * 19.25 12 13.36 /NOFLOOD
CRTPT (4) GROUND "AFT PORT CONNECTION" * 19.25 -12 13.36 /NOFLOOD

MACRO OUTPUT
SO
STATUS WEIGHT, DISPL, WPL:TOTAL
DI (*) STATUS PROFILE
/

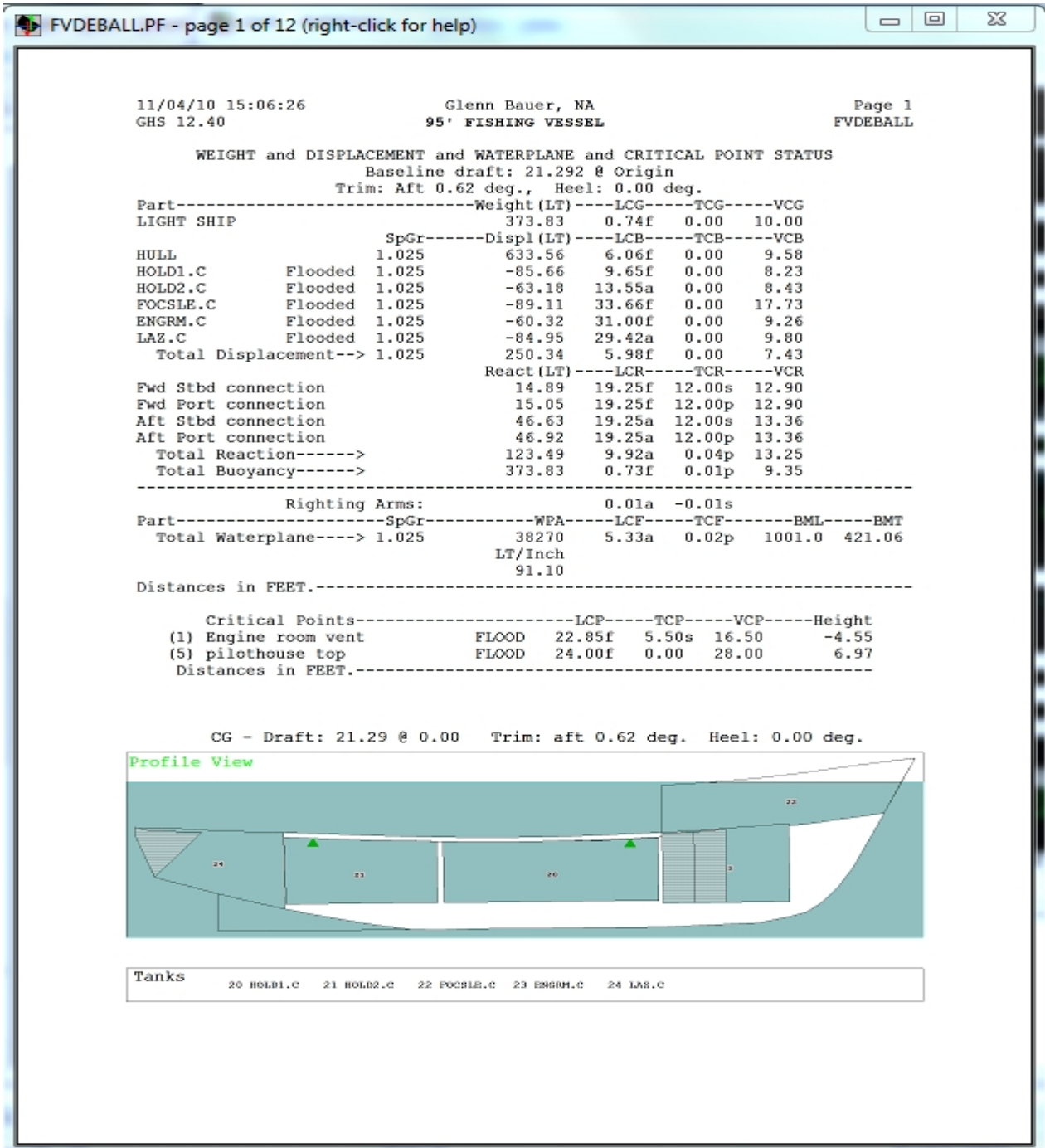
REPORT FVDEBALL.PF
.OUTPUT
```

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REPORT /PREVIEW  
REPORT OFF

Running the above will produce the follow page

运行上面的文件生成下一页的内容



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Now that the focsle is exposed, it will be the first to be emptied. Various methods may be employed to do this, for a demonstration of the pressure tank type, we will assume the entry is sealed and an opening cut into the aft bulkhead above the main deck. A connection is made to the focsle deck so the compartment can be pressurized. The pressure tank type using the tank's reference point as the opening or breach in the hull. Add the following to the run file

现在，艏楼甲板已露出水面，将首先清空艏楼舱室。清空舱室可以有很多种方法，演示一个用压力法清空舱室，我们假定入口密封，在主甲板以上的艏楼甲板室后舱壁开口。艏楼甲板室形成联通，这样就可以加压了。加压舱室把开口或裂口当作参考点。添加如下命令语句到运行文件

```
REPORT FVDEBALL.PF
.OUTPUT
```

```
REFPT (FOCSLE.C) -23.1 0 14
CRTPT "FOCLSE OPENING" -23.1 0 14 /NOFLOOD
TYPE (FOCSLE.C) PRESSURE /HEAD:2
.OUTPUT
```

```
REPORT /PREVIEW
REPORT OFF
```

The reference point is set to a meaningful location. When the PRESSURE tank type is given the slash parameter must also be given. The head given in this case is 2 feet. GHS will lower the level in the compartment to a level 2 feet below the external waterplane. If the reference point is above the external waterplane, the level will only be lowered to the reference point. Viewing the results shows that the compartment is not complete empty. Increasing the head to 5 feet will lower the level to the reference point.

上述控制点被设定在一个有意义的位置。当压力舱室被赋予必须的斜线参数时，在这种情况下，最高点定义为 2 英尺。GHS 将降低外部水线以下的隔间的控制点到 2 英尺。如果控制点在外部水线以上，只需要下降到控制点。观察结果表明，该舱室不是完全空的。增加最高点到 5 英尺会降低控制点的水平。

上述参考点被设置在有意义的位置。当设置压力类型的舱室时，需给定降低参数。在本例中，压头设置为 2 英尺，GHS 将降低舱室水位高度，直至低于外部水线 2 英尺。如果参考点高于外部水线，那么水位高度指低于参考点高度。通过观察表明，该舱室还没有完全排空。增加压头到 5 英尺。

Now that the engine room vent is almost above the waterplane, cutting an opening in the hull side and pressurizing this compartment will empty most of its contents. Since the location of the engine room floor and day tanks are not visible from outside the hull the opening is made above and forward of these boundaries. This and the following additions to the run file should be place before the REPORT /PREVIEW command.

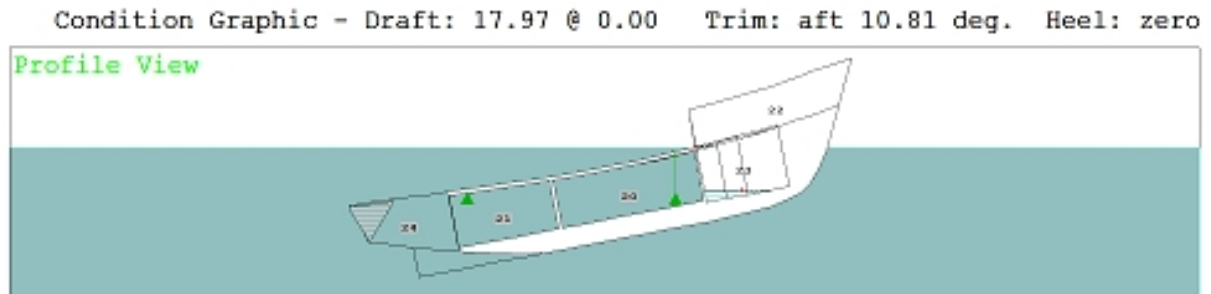
现在机舱通风口快要露出水面了，在船体舷侧设置开口，加压清空机舱绝大部分水。由于开口在机舱甲板和日用油舱舱壁位置的上面和前面，在船体外面看不到，所以在【REPORT】 【PREVIEW】命令之前运行文件应增加以下命令语句

## Salvage Procedures using GHS – 7/2011

```
REFPT (ENGRM.C) -31.0 6.5 4.5  
CRTPT "ENGINE ROOM OPENING" -31.0 6.5 4.5 /NOFLOOD  
TYPE (ENGRM.C) PR /HEAD:15  
.OUTPUT
```

The vessel's condition should look like this.

船的情况应该是这样的。



From the above results, it is seen that the opening in the hull side to the engine room is 7.6 feet below the surface. Closing or sealing of the vent opening will trap the air in the compartment. 7.6 feet of seawater is about  $7.6/33 = 0.23$  atmospheres. To make this a bubble tank type with that pressure, the type and load commands are used.

从上述结果可以看出，船体舷侧的机舱开口在水面以下 7.6 英尺处。关闭通风口，船舱里面充满空气，形成气密。7.6 英尺的海水相当于  $7.6/33=0.23$  个大气压。可以用【type】和【load】命令将这个舱室设置成气压式舱室并设置气压。

```
TYPE (ENGRM.C) BUBBLE  
LOAD (ENGRM.C) /PR:1.23
```

The above will increase the tank load if the reference point depth increases by balancing the pressures at the reference point. If the reference point depth decreases, the load won't change. In reality, air will escape decreasing the pressure, however GHS does not determine this pressure drop. So if the depth increases again, GHS will load the compartment as if the 1.23 atmospheres of pressure remains.

如上命令语句，由于在参考点调平压力，如果参考点深度增加，将增加舱室装载；如果参考点深度减小，舱室装载不改变。事实上，空气减少气压会下降，但 GHS 不会考虑气压减少，所以，如果深度再次增加，GHS 还是会按照 1.23 个大气压对船舱进行装载。

At this point, the focsle could be sealed. To do this while maintaining the amount of residual contents trapped in the compartment, add the following

此时，艏楼密封。要保持内部装载不变，添加以下语句：

```
TYPE (FOCSLE.C) DAMAGE  
TYPE (FOCSLE.C) INTACT /HBL
```

By setting the tank type to damage first, the /HBL parameter will keep the trapped contents when the tank type is set to intact. This option is available for damage and flooded tanks.

首先，设置舱室破损。如果舱室被设定成完整的，/HBL 参数将保持装载不变。此选项可用于舱室破损及淹没。

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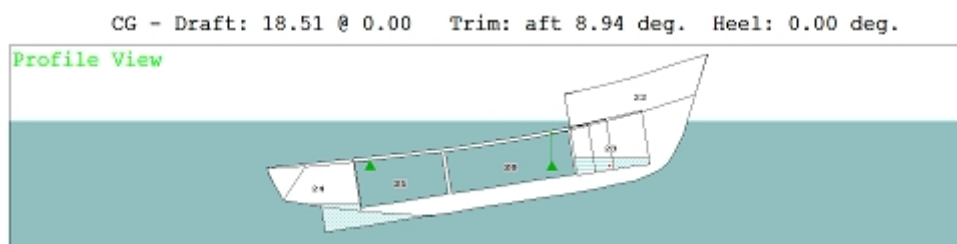
The next obvious step is to pump out the **lazarette**. Using a modified hatch cover with a vent and pickup tube, the compartment will be emptied to a point near the hull bottom. It would be good practice to decrease the load in steps to observe the effect of the introduced free surface. Setting the tank type as intact, reduce the load in 25 % increments.

下一步是抽空安全舱室。改进舱口盖，增加通风口及观察管道，清空船舱至船体底部某一点。一边按步骤排空舱室，一边观察自由液面的影响是一个良好的习惯。当舱室装载减小至 25%时，设置舱室完整不破损。

```
TYPE (LAZ.C) INTACT
LOAD (LAZ.C) 0.75
.OUTPUT
LOAD (LAZ.C) 0.50
.OUTPUT
LOAD (LAZ.C) 0.25
.OUTPUT
LOAD (LAZ.C) 0.05
.OUTPUT
```

The result is

结果是：



It is expected (and hoped) that the forward hold will emerge and begin to spill its contents. However, the **SPILL** tank type should not be use here. A spilling tank maintains the contents level at the reference point. But a spilling tank does so even if the reference point is below the external waterplane. For this situation, the damage tank type is appropriate. A damaged tank with a nominal load of 100% will act as a spilling tank if the reference point is above the external waterplane and a flooding tank if the reference point is below the waterplane. To set the forward starboard corner of the hatch opening as the reference point and the tank as damaged, add the following

如预计的（并希望），首部舱室将露出水面，排出其装载。然而，溢出类型舱室不应用于此处。溢出型舱室将根据参考点高度保留一定得装载，但是溢出型舱室即使参考点低于外部水线还是会溢出水，不符合实际。此时破损舱室类型适用于本例情况。如果当参考点高度在外部水线之上，设置装有 100%装载的破损舱室作为溢出舱；当参考点在水线面高度之下，设置为浸没舱。设定舱口的右前角为参考点，设定舱室破损，语句如下：

```
REFPT (HOLD1.C) -15.5 3 12.5
TYPE (HOLD1.C) DAMAGE
LOAD (HOLD1.C) 1.0
```

Next, the aft hold is pumped out in increments.

接下来，抽空尾部舱室

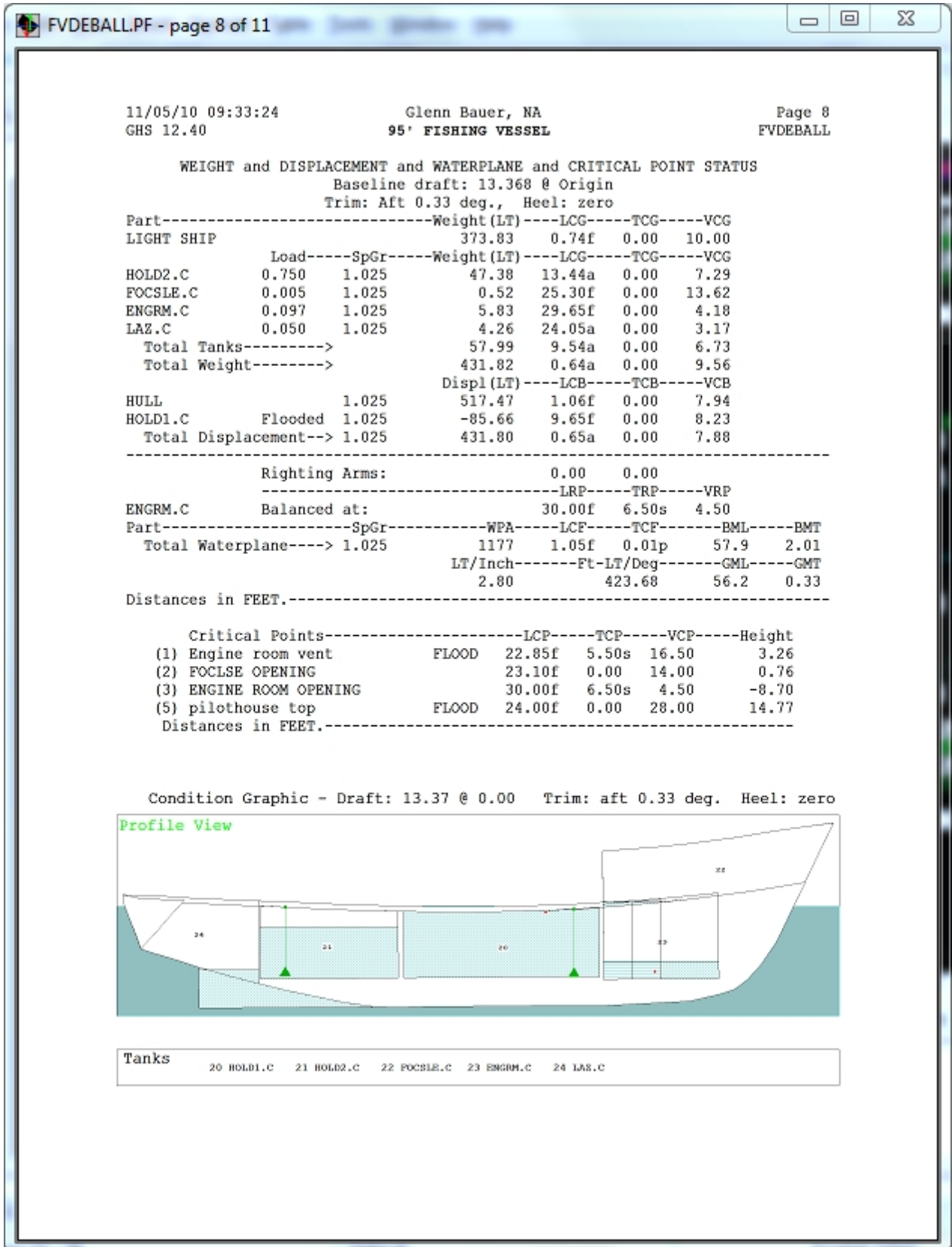
## Salvage Procedures using GHS – 7/2011

```
TYPE (HOLD2.C) INTACT
LOAD (HOLD2.C) 0.75
.OUTPUT
LOAD (HOLD2.C) 0.50
.OUTPUT
LOAD (HOLD2.C) 0.25
.OUTPUT
LOAD (HOLD2.C) 0.05
.OUTPUT
```

We find that the vessel will be freely floating with the hold pumped out to 75%. It is left as an exercise to determine if the vessel maintains positive stability between full and 75% load.

我们发现，舱室抽空到 75%时，船可保持自行漂浮。把船在 75%装载和满载情况下能否保持正稳性的工况，留作练习。

# Salvage Procedures using GHS – 7/2011



# Salvage Procedures using GHS – 7/2011

## 8.0 APPENDIX – RUN FILES FOR EXAMPLES IN THIS MANUAL

### 8.1 GRNDHEEL.RF

```
CLEAR
PROJECT GRNDHEEL
READ FV.GF

MACRO SHOW
DISP (*) STATUS BODY @ 27F @23.1A @30.8A, PROFILE:OUTBOARD
/

    `Define necessary critical points,
    `features on the hull that are useful for setting the waterplane.
    `Certain ground points and anticipated ground points can also be set.
CRTPT (1) "KEEL AT BOW" 23F 0 0 /NOFLOOD
CRTPT (2) "SKEG AT 23A" 23A 0.6 0 /NOFLOOD
CRTPT (3) "AFT CHINE AT 23A" 23A 11.63 4.78 /NOFLOOD
CRTPT (4) "END OF SKEG" 30.8A 0 0 /NOFLOOD

    `Enter a known or estimated lightship weight.
WEIGHT 150 3F 0 11
    `Enter added weights, some may have shifted.
ADD "DECK LOAD AGAINST TO BWK" 15 25 10 13
ADD "FISHING GEAR" 5 5 0 20

    `Enter any tank loads, weight shifts are calculated by GHS.
LOAD (WT*) .95
LOAD (FODAY*) .95
LOAD (DBL*) .5

    `Trim is the perpendicular distance between the waterline
    `at two locations. The keel if exposed, parallel deck edges or
    `other features may be used.
    `If the keel is 0.5 feet higher at 25.0f than at 25.0a,
    `then the trim is arctan (0.5/50) = 0.57 degrees aft
TRIM 0.57
    `The heel can be estimated from observations.
HEEL 75
    `Use the height of a critical point to set the depth.
HEIGHT (4) 2

    `Define the ground points already in contact.
    `The default penetration is 0, so it does not need to be given.
GROUND "FWD CHINE" * 27F 8.42 4.36
GROUND "FWD HULL SIDE" * 27F 10 10
GROUND "AFT CHINE" * 23.1A 11.63 4.78
GROUND "AFT HULL SIDE" * 23.1A 11.93 8.89

    `For anticipated ground points as the vessel is righted,
    `assign ground points on hull with negative penetrations.
    `This is the vertical distance from the ground point to the
    `expected point of contact with the bottom as the vessel is righted.
GROUND "KEEL AT BOW" * 23F 0 0 /PEN:-11.5
GROUND "END OF SKEG" * 30.8A 0 0 /PEN:-10

SO
ST GHS
ST CRT

    `Define locations where cables are attached.
PULL "WINCH LINE AT BOW" 0 30.8F 12P 21.2 180 -5
PULL "WINCH LINE AT STERN" 0 23.1A 12.25P 13.55 180 -5

MACRO REHEEL "RESETHEEL"
HEEL 75
SO
/
```

## Salvage Procedures using GHS – 7/2011

```
MACRO HMMTPULL "PULLSUMM"
HMMT REPORT
PULL REPORT
WAIT
/

    `Enter load editor with CG parameter defined. Determine the amount
    `of pull force required to right the vessel in the Pull window.
    `Macro reheel is to reset the heel if too much pull force is applied.

VARIABLE CGPARAM = "BODY @ 27F @23.1A,BODY @23F @30.8A, PROFILE:OUTBOARD /SYNC"
LOAD (*) EDIT /DISPLAY:OFF /CG /PULL:WINCH LOADS /MACRO:REHEEL, HMMTPULL

    `Knowing about how much pull is needed to "tip" the vessel, about 7 tons
    `in this case.

    `To determine maximum ground reactions, solve for them over a range of heel.

VARIABLE HE MAXHEEL MAXREACT = 0
.REHEEL
FIX HEEL

REPORT GRNDHEEL

MACRO TIPOVER
SET HE = {HEEL} MIN 2
HEEL {HE}
SO
IF {REACT} = 0 THEN EXIT
IF {REACT} > {MAXREACT} THEN SET MAXREACT= {REACT} | SET MAXHEEL = {HEEL}
\TOTAL GROUND REACTION:{ REACT:2}, RA ={ RAH:2}, GMT = { GMT:2}, HEEL ={ HEEL}
/

.TIPOVER (90)

\\
HEEL {MAXHEEL}
SO
\THE MAXIMUM GROUND REACTIONS OCCUR AT {HEEL} DEGREES\
\

ST DISPL

`to see the righting arm curve
.REHEEL
VARY HEEL
SOLVE
ANGLES 0 -5 -10 ... -90
RAH
REPORT /PREVIEW
REPORT OFF
```

## 8.2 CAPSIZE.RF

```
CLEAR
PROJ CAPSIZE
READ SV.GF

VARIABLE CGPARAM = "BODY @-45 @-10, PROFILE /SYNC", HE

    `Identify attach points with critical points
CRTP OFF
CRTP (1) "FWD DECK STBD" -45 6.39 9.36 /NOFLOOD
CRTP (2) "FWD DECK CL " -45 0 9.60 /NOFLOOD
CRTP (3) "FWD DECK PORT" -45 -6.39 9.36 /NOFLOOD
CRTP (4) "FWD BOT BRIDLE 1" -45 0 0 /NOFLOOD
CRTP (5) "FWD BOT BRIDLE 2" -45 1 0 /NOFLOOD
CRTP (6) "FWD BOT BRIDLE 3" -45 2.28 0.47 /NOFLOOD
CRTP (7) "FWD BOT BRIDLE 4" -45 3.53 1.86 /NOFLOOD
CRTP (8) "FWD BOT BRIDLE 5" -45 4.25 3.15 /NOFLOOD
CRTP (9) "FWD BOT BRIDLE 6" -45 6.39 9.36 /NOFLOOD

    `Set weight, center of gravity and capsize the vessel
WE 2000 -27 0 5
```

## Salvage Procedures using GHS – 7/2011

HEEL 180  
SO

```
`define the pull force as a function of heel and location
`the actual force will be passed from the call to the macro
MACRO YANK
PULL "FWD DECK STBD" %1@180 %1@172 0@171 0@0 -45 6.39 9.36 180 10
PULL "FWD DECK CL" 0@180 0@171 %1@170 %1@168 0@167 0@0 -45 0 9.60 180 10
PULL "FWD DECK PORT" 0@180 0@168 %1@167 %1@0 -45 -6.39 9.36 180 10

PULL "FWD AT KEEL 1" %1@180 %1@170 0@169 0@0 -45 -1 0 0 -10
PULL "FWD BOTT 2" 0@180 0@170 %1@169 %1@150 0@149 0@0 -45 1 0 0 -10
PULL "FWD BOTT 3" 0@180 0@150 %1@149 %1@122 0@121 0@0 -45 2.28 0.47 0 -10
PULL "FWD BOTT 4" 0@180 0@122 %1@121 %1@108 0@107 0@0 -45 3.53 1.86 0 -10
PULL "FWD BOTT 5" 0@180 0@108 %1@107 %1@98 0@97 0@0 -45 4.25 3.15 0 -10
PULL "FWD BOTT AT DECK 6" 0@180 0@98 %1@97 %1@0 -45 6.39 9.36 0 -10

`solves and produce a three page report for each step
SO
SET HE = {HEEL}
PULL REPORT
HMMT REPORT
DI STATUS BODY@-45
PAGE
HEEL 0
RA 0 -5 ... -180 /SIZE:1.8
HEEL = {HE}
/

`start a report, run 7 cases with pull forces from 0 to 300 Ltons
REPORT /NOFOOT
.YANK (7,50) 0
REPORT /PREV
REPORT OFF
```

### 8.3 MBBARGE.RF

```
CLEAR

MACRO T
CREATE TANK%1%2
SHAPE T.S
VECTOR %3,%4,0
//
/

ENTER PM

CREATE HULL
ENDS 0 100
OUT 20
TOP 10
BOT 0
/

CREATE T.S
ENDS 0 25
OUT 20
TOP 10
FIT HULL
/

.T 1 .S 0, 0
.T 1 .P 0, 0
.T 2 .S 25, 0
.T 2 .P 25, 0
.T 3 .S 50, 0
.T 3 .P 50, 0
.T 4 .S 75, 0
.T 4 .P 75, 0

DELETE T.S

WRITE CSI100.GF
QUIT PM
```

# Salvage Procedures using GHS – 7/2011

## 8.4 FWDBARGE.RF

```
CLEAR
READ CSI100.GF

DR 3
SO WE LCG
VCG 6

CRTPT (1) "STBD PIN" 100 17.5 10 /NOFLOOD
CRTPT (2) "PORT PIN" 100 -17.5 10 /NOFLOOD

SOLVE PRIMARY:TRAIN.MB /WAIT

ST GHS
ST CRT

LOAD (*) EDIT /DENFMT:1 /DISPLAY:TRUE
```

## 8.5 AFTBARGE.RF

```
CLEAR
READ CSI100.GF

DR 3
SO WE LCG
VCG 6

CRTPT (1) "STBD PIN" 0 17.5 10 /NOFLOOD
CRTPT (2) "PORT PIN" 0 -17.5 10 /NOFLOOD

SOLVE SECONDARY:TRAIN.MB,1,1; *,2,2 /WAIT

ST GHS
ST CRT

LOAD (*) EDIT /DENFMT:1 /DISPLAY:TRUE
```

## 8.6 BARGLIFT.RF

```
SHELL GHS FLOATER.RF /SPAWN
RUN SINKER.RF
```

## 8.7 FLOATER.RF

```
CLEAR
PROJECT FLOATER
READ CSI100.GF

DRAFT 2
SOLVE WE LCG TCG
VCG 6
FIX TR

CRTPT (1) "FWD LIFT POINT" 0 20 -10           `lifting at the fwd stbd corner
CRTPT (2) "AFT LIFT POINT" 100 20 -10        `lifting at the aft stbd corner
CRTPT (3) "FWD BOTTOM CORNER" 0 20 0
```

## Salvage Procedures using GHS – 7/2011

```
CRTPT (4) "AFT BOTTOM CORNER" 100 20 0
SOLVE
SOLVE PRIMARY LIFT.MB /WAIT
VARIABLE CGPARAM="BODY @5 @95,PROFILE"
LOAD (*) EDIT
```

### 8.8 SINKER.RF

```
CLEAR
PROJECT SINKER
READ CSI100.GF

WEIGHT 300 50 0 6 `weight of 300 Ltons at 50ft aft, on
                    `centerline, 6 ft abv the bottom
DR 0                `draft needs to be defined before the ground
                    `points are
CRTPT (1) "FWD CONNECTION" 0 20 10        `connection at fwd stbd corner
CRTPT (2) "AFT CONNECTION" 100 20 10     `connection at aft stbd corner
CRTPT (3) "FWD TOP CORNER" 0 20 10
CRTPT (4) "AFT TOP CORNER" 100 20 10

GROUND "FWD STBD" * 5 20 0 /PEN:-22 `at zero draft, 22 ft to the
GROUND "FWD PORT" * 5 -20 0 /PEN:-22 `bottom will put the deck at
GROUND "AFT STBD" * 95 20 0 /PEN:-22 `12 feet below the surface
GROUND "AFT PORT" * 95 -20 0 /PEN:-22

LOAD (*) .95        `to make sure it sinks
SOLVE

SOLVE SECONDARY LIFT.MB 1,-1; *,2,-2;*, -3,3; *, -4,4 /WAIT

VARIABLE CGPARAM="BODY @5 @95,PROFILE"
LOAD (*) EDIT
```

### 8.9 FVLIFT.RF

```
CLEAR
READ FV.GF
VARIABLE NEWLOADP=0, NEWLOADS=0, STARTED=0

`sets up a sunken grounded vessel
TR 1/100
DR 10.5
SO WE LCG TCG
VCG 10

HE 25
CRTPT (5) "PILOTHOUSE TOP" -24 0 28
HEIGHT (5) -5

`crtpt for multi body connections
CRTPT (1) "FWD STBD CONNECTION" -19.25 12 12.90 /NOFLOOD
CRTPT (2) "FWD PORT CONNECTION" -19.25 -12 12.90 /NOFLOOD
CRTPT (3) "AFT STBD CONNECTION" 19.25 12 13.36 /NOFLOOD
CRTPT (4) "AFT PORT CONNECTION" 19.25 -12 13.36 /NOFLOOD

`ground points
GROUND "FWD KEEL" * -27 0 0.157
GROUND "MID KEEL" * -4 0 0
GROUND "AFT KEEL" * 23 0 0
GROUND "FWD CHINE" * -15 10 3
GROUND "AFT CHINE" * 12 12 3

TYPE (LAZ.C, FOCSE.C, ENGRM.C, HOLD*) FL
SO

SHELL GHS STBDLIFT.RF /SPAWN
SHELL GHS PORTLIFT.RF /SPAWN
```

## Salvage Procedures using GHS – 7/2011

```
SOLVE SECONDARY: LIFT1.MB,5,-1; *,6,-3; LIFT2.MB,7,-2; *,8,-4
    `sets fv as the secondary vessel
    `establishes a channel for communication with other ghs sessions
    `1,-5 associates crt 1 from pri with crt 5 from sec, sec vessel
grounded
    `*,2,-7 same as above, * causes same channel, lift.mb, to be used
    `/wait causes execution to pause until a connection is made with at
least 4 interaction points

MACRO STEP                `macro to start solving for secondary vessel
WAIT 0.1
IF {NEWLOADP}<0 THEN IF {NEWLOADS}<0 THEN EXIT    `exit if both sides done
IF {NEWLOADP}=0 THEN EXIT STEP                  `if portside not ready, loop to top
IF {NEWLOADS}=0 THEN EXIT STEP                  `if stbdside not ready, loop to top
WAIT 0.1                                        `allow time to detect now unsolved
SOLVE WAIT:60                                   `wait until fully solved
CLS
IF {STARTED}=0 THEN SET STARTED=1 ELSE PAGE
ST CRT GHS
DI (*) STATUS BODY @-19.25 @19.25
SET NEWLOADP=0, NEWLOADS=0
SOLVE SEND SET READY=1                        `broadcast ready to both port & stbd
EXIT STEP                                     `exits macro and reruns macro step
/

REPORT FVLIFT.PF

.STEP

SOLVE NORMAL

WAIT 0.5

REPORT /PREVIEW
REPORT OFF
END
```

### 8.10 STBDLIFT.RF

```
CLEAR
READ CS1100.GF
VARIABLE READY=0, STARTED=0
`-----

WEIGHT 300 50 0 6
LOAD (TANK2.S,TANK3.S) 0.2
`-----

`initial critical points, should be location of support, sheave, fairlead, etc
CRTPT (5) "FWD PORT WINCH" 30.75, -20, 11
CRTPT (6) "AFT PORT WINCH" 69.25, -20, 11
SOLVE
ST CRT

`adjust the height of the critical points to a height near the connection on the sunken vessel
CRTPT (5) *-33 `<===== make adjustments here
CRTPT (6) *-33 `<===== and here

MACRO HOIST
`crtpts heights to be redefined for each step
CRTPT (5) *+%1
CRTPT (6) *+%2
/

SOLVE PRIMARY:LIFT1.MB    `sets barge as the primary vessel
                          `establishes a channel for communication with other ghs sessions
                          `/wait causes execution to pause until a connection is made

MACRO IFREADY            `creating a looping macro
WAIT 0.1                 `pauses execution, for 0.01 seconds
IF {READY}=0 THEN EXIT IFREADY `exits macro when variable ready is other than 0, set in
```

## Salvage Procedures using GHS – 7/2011

```
secondary session
/

MACRO STEP                                `macro to change load of primary vessel
.HOIST %1 %2                              `sets load in tank %1 to %2
SOLVE SEND SET NEWLOADS=1                `sends the command set newloads=1 to the second session
.IFREADY                                  `starts looping until ready=1 is received from second session
CLS
IF {STARTED}=0 THEN SET STARTED=1 ELSE PAGE
STATUS CRT GHS
DI STATUS PROFILE:OUTBOARD ,BODY @30.75 @69.25
SET READY = 0
WAIT 0.1
/

REPORT ST_BARGE.PF

`hoisting sequence
.STEP 1 1
.STEP 1 1
.STEP 1 1
.STEP 1 1
.STEP 1 1
.STEP 1 1
.STEP 1 1
.STEP 1 1
.STEP 1 1
.STEP 1 1
.STEP 1 1
.STEP 1 1

SOLVE SEND SET NEWLOADS=-1

REPORT /PREVIEW
REPORT OFF
END
```

### 8.11 PORTLIFT.RF

```
CLEAR
READ CSI100.GF
VARIABLE READY=0, STARTED=0
`-----

WEIGHT 300 50 0 6
ADD "COUNTER WEIGHT" 25 50 -15 12
`-----

`initial critical points required to establish communication
CRTPT (7) "FWD STBD WINCH" 30.75, 20, 11
CRTPT (8) "AFT STBD WINCH" 69.25, 20, 11
SOLVE
ST CRT

`adjust the height of the critical points to a height near the connection on the sunken vessel
CRTPT (7) *-33 `<===== make adjustments here
CRTPT (8) *-33 `<===== and here

MACRO HOIST
`Crtpts heights to be redefined for each step
CRTPT (7) *+%1
CRTPT (8) *+%2
/

SOLVE PRIMARY:LIFT2.MB                    `sets barge as the primary vessel
                                           `establishes a channel for communication with other GHS sessions
                                           `/wait causes execution to pause until a connection

MACRO IFREADY                            `creating a looping macro
WAIT 0.1                                  `pauses execution, for 0.01 seconds
IF {READY}=0 THEN EXIT IFREADY `loop if not ready
/
```

## Salvage Procedures using GHS – 7/2011

```
MACRO STEP                                `macro to change load of primary vessel
.HOIST %1 %2                               `sets load in tank %1 to %2
SOLVE SEND SET NEWLOADP=1                 `sends the command set newloadp=1 to the second session
.IFREADY                                   `starts looping until ready=1 is received from second session
CLS
IF {STARTED}=0 THEN SET STARTED=1 ELSE PAGE
STATUS CRT GHS
DI STATUS PROFILE:OUTBOARD ,BODY @30.75 @69.25
SET READY = 0
WAIT 0.1
/
```

```
REPORT PT_BARGE.PF
```

```
`Hoisting sequence
```

```
.STEP 1 1
.STEP 1 1
.STEP 1 1
.STEP 1 1
.STEP 1 1
.STEP 1 1
.STEP 1 1
.STEP 1 1
.STEP 1 1
.STEP 1 1
.STEP 1 1
```

```
SOLVE SEND SET NEWLOADP=-1
```

```
REPORT /PREVIEW
REPORT OFF
END
```

### 8.12 FVDEBALL.RF

```
CLEAR
READ FV.GF
```

```
`sets up the fishing vessel supported by the ground points
`used in the MB lifting example
```

```
TR 1/100
DR 10.5
SO WE LCG TCG
VCG 10
```

```
TYPE (LAZ.C, FOCSLE.C, ENGRM.C, HOLD*) FL
```

```
CRTPT (5) "PILOTHOUSE TOP" -24 0 28
HEIGHT (5) 7
```

```
`crtpt from multi body connections
```

```
GROUND "FWD STBD CONNECTION" * -19.25 12 12.90
GROUND "FWD PORT CONNECTION" * -19.25 -12 12.90
GROUND "AFT STBD CONNECTION" * 19.25 12 13.36
GROUND "AFT PORT CONNECTION" * 19.25 -12 13.36
```

```
MACRO OUTPUT
SO
STATUS CRT GHS
DI (*) STATUS PROFILE
/
```

```
REPORT FVDEBALL.PF
.OUTPUT
```

```
REFPT (FOCSLE.C) -23.1 0 14
CRTPT "FOCLSE OPENING" -23.1 0 14 /NOFLOOD
TYPE (FOCSLE.C) PR /HEAD:5
```

```
type (hold2.c) intact
load (hold2.c) 0.75
.output
load (hold2.c) 0.50
```

# Salvage Procedures using GHS – 7/2011

```
.output.OUTPUT  
  
REFPT (ENGRM.C) -30 6.5 4.5  
CRTPT "ENGINE ROOM OPENING" -30 6.5 4.5 /NOFLOOD  
TYPE (ENGRM.C) PR /HEAD:15  
.OUTPUT  
  
TYPE (ENGRM.C) BUBBLE  
LOAD (ENGRM.C) * /PR:1.23  
  
TYPE (FOCSLE.C) DAMAGE  
TYPE (FOCSLE.C) INTACT /HBL  
  
REFPT (HOLD1.C) -15.5 3.5 12.5  
TYPE (HOLD1.C) DAMAGE  
LOAD (HOLD1.C) 1.0  
  
TYPE (LAZ.C) INTACT  
LOAD (LAZ.C) 0.75  
.OUTPUT  
TYPE (LAZ.C) INTACT  
LOAD (LAZ.C) 0.50  
.OUTPUT  
TYPE (LAZ.C) INTACT  
LOAD (LAZ.C) 0.25  
.OUTPUT  
TYPE (LAZ.C) INTACT  
LOAD (LAZ.C) 0.05  
.OUTPUT  
LOAD (HOLD2.C) 0.25  
.OUTPUT  
LOAD (HOLD2.C) 0.05  
.OUTPUT  
  
REPORT /PREVIEW  
REPORT OFF
```