

命令模式

LS [/PERcent | LIM] [/E:elasticity] [/LIMStress:stress] [/PROfile | /PLAN]
 [/FRame[:ONLY | ALL | CURVEs]] [/NODeflect] [/NOSTress] [/NOCORrect]
 [/THIN] [/STYLE:SYM] [/NOWEIGHT] [/STERNZERO] [/INITSOLVE] [INITSOLVE | NOSOLVE]
 [/NOWARN] [/NOPRINT] [/NOTable [:PLOT[ONLY]]] [/PLOT: [LINear | OFF]]
 [/CURVE:[Weight] [Buoyancy] [Shear] [Moment]] [/SIZE: max[,min]]
 [/COLumn: [Weight] [Buoyancy] [Shear] [Moment] [/SEction]]

The LS module computes and displays Longitudinal Strength data for the current condition.

LS 模块计算并显示当前工况的总纵强度。

参数说明

/PERCENT

Specifies that the shear and bending moment data are to be shown only as a percentage of the maximum allowable values set by the LSLIM command.

用命令 LSLIM 定义的许用值的百分比来表示切力和弯矩值。

/LIM

Specifies that the shear and bending moments are to be shown as a percentage of the maximum allowable values set by the LSLIM command along with the actual values and the limit values.

使用命令 LSLIM 定义的许用值的百分比来表示切力和弯矩的实际值和许用值。

/E:elasticity

Specifies the modulus of elasticity (Young's modulus) for use in the deflection computations. Units are current weight units per square inch (or square centimeter in metric) or megapascals with KN units. If not specified, default elasticity from SMOD command is used.

指定计算变形时使用的弹性模量或杨氏模量。单位：当前重量单位每平方英寸(或平方厘米)，或兆帕 MPA。如果省略不指定，默认使用 SMOD 命令的数值（12,946 长吨每平方英寸/2039 公吨每平方厘米或 199950 兆帕）。

/LIMSTRESS:stress

Specifies a limit to which the stress may be compared. Causes the summary to show the maximum stress as a percentage of this limit. Units: same as for elasticity.

指定应力的许用值。用许用值的百分比来表示最大的应力值。单位和弹性模量单位相同。

/PROFILE | /PLAN

Includes the vessel profile and plan on plots.

显示船舶侧面投影和平面图。

/FRAME [: ONLY | ALL]

Causes frame descriptions to appear in the table, optionally omitting locations if ONLY is included. LS results are shown just at prescribed frame locations (with the incomplete weight and buoyancy columns omitted) unless ALL points are requested.

在表格中显示肋位，如果附加参数 ONLY 会省略坐标位置。LS 只会显示指定肋位的结果（省略重量和浮力列），除非附加参数 ALL 要求都要显示所有点的结果。

译者注：参数的缺省值为 ONLY。

/FRAME:CURVES

Shows just frame location points in table curves, including any weight and buoyancy columns, but omitting frame descriptions.

在表格曲线中显示肋位位置点，包含重量和浮力列，但省略肋位说明。

/NODEFLECT

Prevents deflection data from being computed (in case section moments of inertia are present but deflection is not wanted).

不要显示计算的挠度结果（适用于已给定截面惯性矩但是不需要挠度变形量的情况）。

/NOSTRESS

Causes stress to be omitted even when section modulus data has been defined.

省略应力即使当剖面模数已经定义。

/NOCORRECT

Prevents bulkhead correction factors from being used to correct shear.

不使用横舱壁修正系数来校正切力。

/THIN

Causes extra "thinning" of points in the output table.

在计算结果中输出附加的沿薄壁分布点的扭矩值。

译者注：该参数只适用于扭矩计算。

/STYLE:SYM

Causes shear limits in the graph to be shown symmetrically positive and negative (using the value from the shear limit curve selected according to the sign of the shear).

使许用切力在图表中正负对称显示。

/NOWEIGHT

Uses the buoyancy curve by itself as the load curve, producing "s-value" shear and bending moment curves.

使用浮力曲线做为载重曲线，用“S-Value”法生成切力和弯矩曲线。

译者注：S-Value 法是日本人发明的一种计算船舶弯矩和切力手算方法。

/STERNZERO

Useful with /NOWEIGHT - causes the s-value curves to begin at zero from the stern.

使用参数/NOWEIGHT，使应力曲线从船尾应力为 0 开始。

/INITSOLVE

Initializes heel and trim to zero along with history-dependent data before LS solving.

在运行 LS 前，将横倾和纵倾设置为 0，并将历史数据初始化。

/NOWARN

Suppresses reporting "Deflection removed" when subsequent waterplane changes implicitly remove any deflection retained after the LS operation completes.

当后续水平面更改隐式删除，LS 操作完成后保留的任何挠度时，报告中会提醒“挠度已移除”。

/NOPRINT

Omits the report output and, when the /FRA parameter is present, sets values in certain user variables.

省略输出报告，当附加参数/FRA 时，设定某些值为用户变量。

/NOTABLE [:PLOT[ONLY]]

Prevents the tabular data from being displayed. Plots are omitted unless PLOT subparameter is included. The summary is shown unless PLOTONLY is used. It can be restricted to just shear or moment information using the /COL:S or /COL:M parameter.

不显示表格数据。如果无附加参数 PLOT，会省略分布曲线显示。如果附加参数 PLOTONLY，只显示分布曲线不会显示最大/最小值以及所在位置。通过参数/COL:S 或/COL:M，报告仅包括弯矩和切力。

/PLOT: LINEAR

Causes the plots to use straight lines between points for all curves.

在分布曲线图表显示时，点与点之间使用直线。

/PLOT:OFF

Omits the plots.

省略分布曲线显示。

/CURVE: [WEIGHT] [BUOYANCY] [SHEAR] [MOMENT]

Shows only the selected plot curve categories.

只显示指定的分布曲线。

/SIZE: max [,min]

Sets the General Scale of the plot so the top is at least max and optionally the bottom is at most min. Assuming this range is large enough to include any expected curve values, this provides uniform scaling for easy comparison of a series of LS plots. If /SIZE:* is given, then sizes from the last LS plot are reused, along with all associated scale factors.

设定分布曲线图表显示比例，使图表的顶部尽可能在页面的顶端，图表的底部尽可能在页面的底端。假定这个范围足够显示所有的曲线，这提供了可供不同输出参考的标准比例。如果使用参数 /size:*，会默认使用最后一次 LS 输出使用的比例，以及相关的比例系数。

/COLUMN: [WEIGHT] [BUOYANCY] [SHEAR] [MOMENT] [SECTION]

Shows only the selected middle table columns (allowing /LIM just SH & MOM, /PER none). Note left columns are set by /FRAME and right columns by /NODEFLECT and /NOSTRESS.

仅显示选定的中间表列（允许/LIM 仅显示切力和弯矩，/PER 无）。请注意，左列由/FRAME 设置，右边列由/NODEFLECT 和/NOSTRESS 设置。

Operation

操作

LS makes use of the weight density curves provided via the WEIGHT and ADD commands, along with the current tank loading and wave configuration. Any point forces in the vertical direction originating from GROUND, THRUST and PULL commands are included as well. It computes values of shear and bending moment at certain locations along the length of the vessel. The locations used are those at which the sections are located (in the geometrical model) plus any other locations involved in the weight curves.

命令 WEIGHT, ADD 提供的重量，以及当前工况装载和波浪作用，形成重量分布曲线。同时要考虑命令 GROUND, THRUST 和 PULL 生成的竖直向上的力。LS 沿船长方向计算某些位置的切应力和弯矩，其位置为所模型中计算截面的位置和重量分布曲线中涉及的位置。

The first thing that LS does is find the equilibrium draft and trim (and heel if it is not fixed). Once this is achieved, it gets the detailed buoyancy data on all displacer components and puts together a composite buoyancy curve. As a check, it integrates the buoyancy curve and compares the results with the displacement and LCB obtained when equilibrium was found.

首先 LS 要找到平衡位置的吃水，纵倾（假如未锁定横倾），然后得到所有浮体的浮力信息并形成浮力分布曲线。可以把生成的浮力曲线与排水量和浮心位置做比较来检查浮力曲线的正确性。

A similar process produces a composite weight curve from the weight and tank loading data. Tank property tables are ignored.

同理，利用重量和舱室装载求得复合的重量分布曲线，省略舱室属性列表。

Both weight and buoyancy curves are then multiplied by the cosine of the trim angle. This results in a reduction which will be noticed particularly on point weights when there is a substantial amount of trim. The two curves are then subtracted to produce the load curve.

当纵倾角较大时，重量曲线和浮力曲线都乘以纵倾角的余弦值，这样会导致载荷特别是点载荷有所减小。然后两条曲线相减得到载荷曲线。

The first integration of the load curve produces the shear curve. The second integration produces the bending moment curve.

切力分布曲线是以上载荷曲线的一次积分，而弯矩分布曲线则是载荷曲线的二次积分。

If the geometrical model carries shear (bulkhead) correction factors, these are applied to the shear curve after bending moments have been derived. If the /NOCORRECT parameter is present, the shear curve is not modified.

如果几何模型含有切力(横舱壁)修正系数, 得到弯矩曲线后, 再对切力曲线进行修正, 如果附加参数/NOCORRECT, 将不修正切力曲线。

If section modulus and/or moment of inertia information is available, the current heel angle is checked against the heel angle at which that information was given. If the angles differ by more than 5° the stress and/or deflection computations are skipped. Otherwise, the bending moment curve is divided by section modulus curve, resulting in a stress curve.

如果给定了剖面模数和惯性矩, 当前横倾角度和给定的横倾角度比较, 如果相差超过 5 度, 那么跳过应力和变形计算。否则, 通过弯矩除以剖面模数得到应力分布曲线。

If section moment of inertia data is available for the entire length of the vessel, it is used with two additional integrations of the bending moment curve to arrive at a deflection curve. The constants of integration are chosen such that the deflection curve returns to zero at both ends. Since the buoyancy curve is modified by the deflection, the model is deflected using a parabolic deflection curve fitted to the deflection data and the entire process is repeated starting with solving for equilibrium. This iteration loop continues until the difference in deflection between two successive iterations is negligible.

如果已知全船长的截面惯性矩, 对弯矩曲线进行两次积分得到弯曲变形曲线, 利用在艏艉端点处变形为 0 求得积分常数。因为浮力曲线是由变形曲线修正得到的, 从计算平衡位置开始重复得到弯曲数据以得到与实际吻合的二次抛物线变形曲线。这种迭代计算要重复多次直到二者的差别可以忽略。

When doing deflection, the modulus of elasticity is assumed to be constant throughout the length of the vessel. Its value may be specified via the /E parameter, or the default value may be accepted (see above).

当计算变形时, 在船长范围内假设弹性模量是不变的, 其值可以通过参数/E 设定, 或采用默认的值。(参考以上)。

Normally, deflection is computed whenever the section moments of inertia are available (see the SMOD command). If you have provided section moments but want to prevent the deflection computation, simply include the /NODEFLECT parameter.

一般情况, 得知截面惯性矩后计算变形(查看命令 SMOD)。如果提供截面惯性矩后但不需要计算变形, 只要附加参数/NODEFLECT 即可。

Unless a wave is present, deflection is retained after the completion of the LS command operation.

如果不出现波浪, 命令 LS 操作完成后, 不会保留变形。

A full tabular listing of the strength data (at each longitudinal location for which it is computed) is shown on the output, followed by a summary giving the maximum

values of shear, bending moment, stress and deflection. The /NOTABLE parameter has the effect of omitting the table and showing only the summary information.

会表格显示输出每一个计算位置的应力信息，以及总结显示最大切力，弯矩，应力和变形量。参数/NOTABLE 可以省略表格显示，只显示总结信息。

The /FRAME parameter causes the strength data to be shown only at locations described in the geometry file's frame data structures; if absent, frame data is taken from any filename.FRA frame file in the same directory, where filename is the geometry file name without extension. The frame file is a standard ASCII text file, composed of lines in the following format:

参数/FRAME 会只显示模型文件中定义的肋位位置的应力。如果省略，会采用同一目录下的肋位文件的肋位信息，文件名为模型文件同名，扩展名为 FRA。文件为标准的 ASCII 文本文件，格式如下：

"description", L

where description is up to 12 characters and L is longitudinal location with optional "M" suffix for meters (the default is feet). For example,

描述说明最多 12 个字符，L 为纵向位置，后缀可以为 M，表示米。（默认为尺）。例如：

"Frame 20", -40.00 (synonyms: 40f, -12.192m, 12.192f M)

"Frame 40", 0.00

"Frame 60", 40.00

If the geometry file were named VESSEL1.GF, the name of this file would be VESSEL1.FRA and its contents would be the three lines above. The LS output would then show results only at these locations.

如果模型文件名称为 VESSEL1.GF，那么此文件的名称为 VESSEL1.FRA，文件内容要 3 行以上。命令 LS 只会显示这些位置的应力结果。

Where values are shown at frame locations by interpolation and where there exists a discontinuity, the greater (in magnitude) of two values is always reported.

通过插值获得的值和曲线不连续处的值，总会报告较大的值。

The /LIMSTRESS parameter allows you to input a stress limit for comparison purposes. Its only effect is to cause the maximum stress value to be shown also as a percentage of the limit.

出于比较的目的，附加参数/LIMSTRESS 可以输入应力许用值，那么最大的应力值可以用应力许用值的百分比来表示。

The LSLIM command can be used to set limits on the shear and bending moments. If these limits have been set, the /PERCENT parameter will cause the shear and bending moment data to be shown as a percentage of these limits (see the LSLIM command).

命令 LSLIM 可以用来设定切力和弯矩的许用值。如果许用值已经设定，附加参数/PERCENT，可以用许用值的百分比来表示切力和弯矩值。（查看命令 LSLIM）。

The /LIM parameter results in a different format, where shear force and bending moment are shown as values and percentages of the applicable limits as established with the LSLIM command.

参数/LIM 会使结果以不同的格式显示，即切力和弯矩值以数值和许用值（命令 LSLIM 设定）的百分比来显示。

Display Output

显示输出

In its standard mode, LS displays a table with columns for longitudinal location, weight density, buoyancy and shear. Additionally, one, two or three columns are shown depending on the section modulus information provided by the SMOD command.

在标准模式中，LS 表格显示下面信息：纵向位置，重量密度，浮力和切力。另外是否增加 1，2 或 3 行显示取决于命令 SMOD 提供的剖面模数信息。

- If no section modulus information is available, then only one additional column appears. It contains bending moments.

- 如果没有剖面模数信息，只增加一行弯矩信息。

- If section moduli are available but no section moments of inertia, then two additional columns are shown: section moduli and stresses.

- 如果已知剖面模数信息，但是未知截面惯性矩，那么会增加另外的 2 列信息：剖面模数和应力。

- If section moments of inertia are available for the entire vessel length, then three additional columns are shown: section moduli, stresses and deflection; or bending moments, section moments of inertia, and deflection. The latter combination results when only the moments of inertia are available.

- 如果已知全船长的截面惯性矩，那么会增加另外的 3 列显示：剖面模数，应力和变形。或弯矩，截面惯性矩和变形。只有已知惯性矩后，后面才会组合结果。

In the weight column, point weights are indicated by an asterisk. Other weights are actually weight densities (weight per unit length).

在重量列中，点集中重量用星号表示，其它重量为重量密度表示（重量每单位长度）。

Some of the points on the weight and buoyancy curves which were used in the calculations may be omitted from the table if they are redundant or very close together or if they do not represent significant changes in the curves. Even more of this "thinning" will take place if the /THIN parameter is used.

某些在重量和浮力曲线上计算的点，如果点太多，太集中或在曲线中不表示大的变化，那么这些点可能被省略。在参数/THIN 的情况下，沿薄壁分布的点太密或集中，也可能被省略。

The sense of the bending moment and stress curves is such that a sagging condition has negative bending moments and a hogging condition positive moments. If the section moduli are positive (as would be the case for stress at the deck), the sense of the stress curve is the same as that of the bending moment curve. The opposite is true of negative section moduli (which would normally apply to the keel). Therefore, positive stress values indicate tension; negatives indicate compression.

弯矩和应力的符号定义如下：中垂弯曲为负，中拱为正。如果剖面模数是正的（可以是甲板应力），应力曲线的符号和弯矩曲线相同。相反如果剖面模数是负的（可以适用于龙骨），应力曲线的符号和弯矩曲线相反。正的应力表示拉力，负的应力表示压力。

The sense of the deflection curve, like the bending moment curve, is positive for hogging and negative for sagging. The ends of the deflection curve are fixed at zero in either case.

挠度曲线的符号，和弯矩曲线相似，中拱为正，中垂为负。在任何工况下，挠度曲线的两端点位移为 0。

Closure should also be observed on the shear and bending moment curves; i.e. they should have values very near to zero at both ends. If the stress curve extends to the ends of the vessel, it too should close.

切力和弯矩曲线在船长端点处应该接近于 0，如果应力曲线延伸到船长端点处，应力值也应该接近于 0。

The summary presents maximum (absolute) shear, bending moment, and stress and deflection if available. The locations at which the maxima occur are also given (except for maximum deflection, the location of which - whether at the ends or the middle - is subject to interpretation). These locations are taken from the table without attempting to interpolate for slightly higher values which may fall between the tabulated locations.

总结会显示最大切力，弯矩，应力和变形。也会显示最大值出现的位置（除了最大变形位置，插值位置）。如果按表输出，其最大/最小值出现的位置从表中读取，不再插值。

When the /LIM parameter is given, a different format is used that compares shear force and bending moment with the positive and negative limits as they have previously been established with the LSLIM command. Stress and deflection are not available in this format.

当附加参数/LIM 后，可以把切力与弯矩值和命令 LSLIM 定义的正负许用值做比较。应力和变形不适用这种方式。

Both uncorrected and corrected shear values are normally shown when bulkhead correction factors are used. However, in some formats lack of space prevents the uncorrected values from being shown. The tanks involved in bulkhead shear corrections along with their correction factors are listed at the end of the tabular report.

当使用横舱壁修正系数时，一般修正前和修正后的切力值都会显示。然而，表列不足时，将不会显示修正前的切力值。在报告表格的结尾会列出涉及到横舱壁校正系数的舱室和校正系数。

Nondisplay Output

非显示输出

A table is defined which includes columns for location, weight, buoyancy, shear, bending moment, stress and deflection. Section moduli are not included since they are equal to bending moment divided by stress.

定义含有如下信息的表格：位置，重量，浮力，切力，弯矩，应力和变形。不包含剖面模数，因为它等于弯矩除以应力。

Preceding the table is the heel angle at which the strength curves were computed.

在表格前面是计算应力强度时的横倾角度。

In the /LIM mode, columns representing the shear and moment limits are included along with the actual shear and moment values.

在/LIM 模式中，会含有显示切力和弯矩的许用值列及实际值列。

Units are the same as in the display output.

在输出显示中单位相同。

Output to User Variables

输出到用户变量

When both /NOPRINT and /FRAME parameters are present, no report output is produced; rather certain user variables, if such variables exist, receive the shear and bending results. The variable names must begin with frame descriptions as represented in the frame data, and one of the following must be appended to these descriptions:

当附加参数/NOPRINT 和 /FRAME 时，不会生成输出报告，而会生成部分用户变量，如果这种变量存在，会接收切力和弯矩值。变量名称必须以肋位号说明开头，并且下面的一种必须附加在肋位号说明后面：

Variable Suffix	Meaning
\$SF	Shear force at this frame 此肋位切力
\$SQ	Shear force fraction of limit at this frame 许用值的百分比表示此肋位的切力
\$BM	Bending moment at this frame 此肋位弯矩
\$BQ	Bending moment fraction of limit at this frame 许用值的百分比表示此肋位的弯矩
\$LOC	Longitudinal location of this frame 此肋位的纵向位置

For example, the variable named FR35\$BM would receive the bending moment value at the location described by "FR35" in the frame data.

例如：变量名 FR35\$BM 会接收肋位 FR35 位置处的弯矩。

Examples

样例

Longitudinal strength table and summary:

总纵强度列表和总结信息

LS

Omitting the table:

省略表格

LS /NOTAB

Specifying a modulus of elasticity for aluminum (in long tons/in²):

指定铝的弹性模量（长吨每平方英尺）

LS /E:4598

Specifying that the output report stress as a percentage of the specified limit (15 kpsi in long tons units):

指定输出的应力用许用值的百分比表示。

LS /LIMSTR: 6.696

Specifying that the output report shear and bending moments as a percentage of the limits specified with the LSLIM command at prescribed longitudinal locations.

指定纵向位置的切力和弯矩用命令 LSLIM 定义的许用值的百分比来显示输出。

LSLIM SHR = 1000 @ 0, 1500 @ 100, 1000 @ 200

LSLIM MMT = 10000

LS /PER /FRA