

## 命令模式

SMod [(axis)] m | m1 @ l1, m2 @ l2, ...

Specifies a curve of section moduli to be used by subsequent Longitudinal Strength stress computations (see the LS command).

定义计算总纵强度时用到的剖面模数曲线。（查看 LS 命令）。

SMod [(axis)] l/c | l1/c1 @ l1, l2/c2 @ l2, ... [/E: elast] [/G: rigid]

Specifies a curve of section moduli as ratios of section moment of inertia to distance, to be used for both stress and deflection calculations.

截面惯性矩和应力点到水平中和轴垂直距离的比值来定义剖面模数曲线，可用来计算弯曲应力和变形。

SMod [(axis)] l/ | l1/ @ l1, l2/ @ l2, ... [/E: elast] [/G: rigid]

Specifies a curve of moments of inertia for deflection calculations only.

定义计算弯曲变形所用的惯性矩曲线。

SMod OFF

Deletes any section modulus information.

删除任何的剖面模数信息。

SMod

Displays current section modulus information.

显示当前定义的剖面模数信息。

## 参数说明

Axis

May be CENTERLINE or POLAR. If omitted, default transverse axis used by LS is assumed.

可以是中心线或极轴。如果省略，则假定 LS 使用的默认横轴。

mi

The section modulus value at location li.

Units: in<sup>2</sup>-ft (English); cm<sup>2</sup>-m (Metric); m<sup>3</sup> (Metric with kilonewtons).

在位置 li 处点的剖面模数。单位：平方英寸-英尺（英制），平方厘米-米（公制），立方米（公制千牛）。

li

A longitudinal location relative to the origin. (Units: feet or meters.)

相对于原点的纵向位置（单位：英尺或米）。

li

The section moment of inertia at location li.

Units: in<sup>2</sup>-ft<sup>2</sup> (English); cm<sup>2</sup>-m<sup>2</sup> (Metric); m<sup>4</sup> (Metric with kilonewtons).

在位置  $l_i$  处的惯性矩。单位：平方英寸-平方英尺（英制），平方厘米-平方米（公制），米四次方（公制千牛）。

ci

The distance from the neutral axis to the plane in which the stress is to be computed.  
Units: feet or meters.

应力点到水平中和轴的垂直距离。（单位：英尺或米）。

/E: elasticity

Specifies default modulus of elasticity (Young's modulus) for use in deflection computations. Units are current weight units per square inch (or square centimeter if metric) or megapascals with KN units. If not specified, 29 megapounds/in<sup>2</sup> (12946 LT/in<sup>2</sup> or 2039 MT/cm<sup>2</sup> or 199948 MPa) is used.

指定用于挠度计算的默认弹性模量（杨氏模量）。单位是每平方英寸（或公制的平方厘米）的当前重量单位或带有 KN 单位的兆帕斯卡。如果未指定，则使用 29 兆磅/英寸<sup>2</sup>（12946 LT/in<sup>2</sup> 或 2039MT/cm<sup>2</sup> 或 199948 MPa）。

/G: rigidity

Specifies default modulus of rigidity (shear modulus). Units are the same as for /E. If not specified, 10.9 megapounds/in<sup>2</sup> (4866 LT/in<sup>2</sup> or 766 MT/cm<sup>2</sup> or 75153 MPa) is used.

指定默认刚性模量（剪切模量）。单位与/E 相同。如果未指定，则使用 10.9 兆磅/英寸<sup>2</sup>（4866 LT/in<sup>2</sup> 或 766 MT/cm<sup>2</sup> 或 75153 MPa）。

Definitions:

参数定义：

$I$  (section moment of inertia) is of a cross section; ie. the section must be a plane perpendicular to the baseline. The direction of the moment arms is normal to the waterplane's intersection with that section. The moment must be taken about the neutral axis.

$I$  为横剖面的惯性矩。剖面必须是垂直于基线的平面。力矩的方向垂直于水面和截面的交线。力矩必须是相对于中和轴计算的。

$c$  is the distance (in the section plane and in the same direction as the moment arms) from the neutral axis to the plane in which stress is of interest. If this plane is above the neutral axis (eg. the deck) then  $c$  is a positive; if it is below the neutral axis (eg. the keel) then  $c$  is a negative.

$c$  为计算应力面到水平中和轴的垂直距离。如果面位于中和轴以上（比如甲板）， $c$  为正值。如果面位于中和轴以下（比如龙骨）， $c$  为负值。

$m = I/c$  is the section modulus. It may be positive or negative, depending on the sense of  $c$ .

$m = I/c$  是剖面模数。它可以是正的或负的，取决于系数  $c$  的符号。

## Operation

### 操作

There are five principle modes in which the SMOD command may be used:

命令 SMOD 可以有 5 种使用方式:

Mode 1 specifies section moduli directly. One or more values of the section modulus are given. The units are in<sup>2</sup>-ft or cm<sup>2</sup>-m. For example:

方式 1: 直接定义截面剖面模数。可以定义单个或多个剖面模数。单位为平方英寸-英尺或平方厘米-米。例如:

**SMOD = 50000**

Or 或

**SMOD = 50000 @ 25, 52500 @ 50, 52500 @ 200**

In the first example, the section modulus of 50000 is assumed to apply over the entire length of the vessel. The second example specifies how the section modulus varies, defining it from locations 25 to 200. Beyond those limits it is undefined. Between 25 and 50 the value varies linearly from 50000 to 52500.

在第一个例子中, 设定全船长度范围内的剖面模数均为 50000。在第二个例子中, 定义位置 25 到位置 200 的剖面模数为 50000 到 52500 线性变化, 其余长度范围的剖面模数未定义。

Mode 2 specifies section moduli as a ratio of I/c. The units of I are in<sup>2</sup>-ft<sup>2</sup> or cm<sup>2</sup>-m<sup>2</sup>. Correspondingly, c is in feet or meters. For example:

方式 2: 按照惯性矩和距离的比值来定义剖面模数。单位为平方英寸-平方英尺或平方厘米-平方米。C 的单位为: 英尺或米。例如:

**SMOD = 25E5/5**

Or 或

**SMOD = 25E5/5 @ 25, 36.75E5/7 @ 50, 36.75E5/7 @ 200**

(The "En" in the above examples stand for "times 10 to the nth power".)

(在上例中的“En”表示 10 的 n 次方。)

Mode 3 is an oddity because it actually gives moments of inertia only, not section moduli. It is interpreted to mean "we don't care what the section modulus is but here are the moments of inertia for the deflection computations". Example:

方式 3: 只是给定惯性矩, 而不是剖面模数。表示: 不必关心剖面模数是多少, 只要知道计算弯曲变形所需的惯性矩是多少就可以。例如:

**SMOD = 25E5/**

Or 或

**SMOD = 25E5/ @ 25, 36.75E5/ @ 50, 36.75E5/ @ 200**

Mode 4 "turns off" or deletes any section modulus information. This would only be necessary if a subsequent use of LS were to ignore the section modulus and show only bending moments. Example:

方式 4: 关闭或删除任何的剖面模数信息, 如果命令 LS 忽略剖面模数只显示弯矩时, 这样做是需要的。例如:

#### **SMOD OFF**

Mode 5 displays the current section modulus specification on the screen. Example:

方式 5: 屏幕显示当前使用的剖面模数。例如:

#### **SMOD**

#### **Some things to note:**

#### **注意事项:**

- 1) Since a given section modulus is valid only at a particular heel angle (unless the structure has circular sections), the SMOD command stores the present heel angle as part of the specification. When the LS command is subsequently invoked, the current heel is checked against the angle stored with the SMOD specification. Therefore, it is prudent to use a HEEL command to set the appropriate heel angle just before the SMOD command is given.
- 1) 因为在特定的横倾角度下给定的剖面模数才是有效的 (除非是圆形截面), 命令 SMOD 会存储当前横倾角作为设定命令的一部分。当随后使用命令 LS 时, 会检查当前的横倾角和命令 SMOD 存储的横倾角是否一致。因此, 谨慎起见, 在给定命令 SMOD 前, 使用命令 HEEL 定义恰当的横倾角。
- 2) When using mode 1 or 2 you must decide whether you want stress above or below the neutral axis. Be sure to make your section modulus negative for below.
- 2) 当使用方式 1 或 2 时, 必须决定想要中和轴上面或下面的应力。确定位于中和轴下面的剖面模数是负的。
- 3) The longitudinal order in which the section modulus values are given is not important, since they are sorted automatically. However, no two points should have the same location, unless they are in bow-to-stern order.
- 3) 给定剖面模数时, 纵向位置的顺序并不重要, 因为它为自动存储。但是, 不能定义 2 点在同一位置, 除非是从首向为的顺序。
- 4) A section modulus curve whose slope changes sign more than once can produce hull deflection which is not well modeled by a parabolic curve. Since the longitudinal-strength calculations render deflection as a parabola, the section modulus curve should not have multiple reversals. This rules out jointed structures where joints are not as stiff as the structures they connect. In such cases, shear, bending moment and stress are valid insofar as they are not significantly modified by deflection.

- 4) 如果定义的剖面模数曲线变化太大，由此计算的变形无法拟合成抛物线。因为船的总纵弯曲变形是抛物线，剖面模数曲线不应该有如此突变。船体结构的连续性也证明了这一点。此时，切力、弯矩和应力是有效的，因为变形对这些并无显著影响。

## Display Output

### 显示输出

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A display of the current section modulus specification occurs (on the screen only) if SMOD is given without parameters. The interpolated values of the section modulus are also shown in the output produced by the LS command.

如果给定命令 SMOD，不附加任何的参数，会屏幕显示当前定义的剖面模数。命令 LS 输出的报告中可以显示插值得到的剖面模数。

### Nondisplay Output:

### 非显示输出

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none.

无

## Examples

### 样例

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Specifying a constant section modulus for the entire vessel length applicable to stress at deck:

设定全船长范围适用于甲板应力的剖面模数为 6500000:

**HEEL = 0**

**SMOD = 6500000**

Specifying section modulus applying to the keel through the midbody sections only:

设定通过船中横剖面作用于龙骨的剖面模数:

**HEEL = 0**

**SMOD = -4.5E4 @ 150F, -4.5E4 @ 150A**

Specifying a section modulus calculated for 20° heel applied to the midbody bilge strake:

设定横倾 20 度时，作用于船舳舳龙骨的剖面模数:

**HEEL = 20**

**SM = -425000 @ 150F, -425000 @ 150A**

Giving section modulus in terms of moment of inertia and distance of the deck from the neutral axis:

通过给定相对于中和轴的惯性矩和甲板距中和轴的距离，来定义剖面模数:

HEEL = 0

SM = 8.0E5/ 5.00 @ 340F,

14.5E5/15.42 @ 310F,

16.5E5/25.11 @ 280F,

17.2E5/27.25 @ 200F,

17.2E5/27.25 @ 290A,

15.3E5/25.25 @ 320A,

14.0E5/21.33 @ 340A

Deleting the current section modulus specification:

删除当前定义的剖面模数:

**SM OFF**

Displaying the current section modulus specification:

显示当前定义的剖面模数:

**SM**