SHIPFLOW耐波性计算方法介绍与案例

2023-5-25

TIANFU

目录

01

常规船型IGES模型波浪增阻与运动计算方法

计算模型

案例采用不带桨和舵的KCS标模

缩尺比	1:1（实尺度）
垂线间长	230m
吃水	10.8m
航速	24knots
Fn	0.26
ZCG	14.3m
转动惯量Kyy	0.252Lpp
运动自由度	垂荡和纵摇（heave&pitch）
IGES文件路径	D:\SOFT\FLOWTECH\SHIPFLOW7.0.17-x86_64\examples_motions\geometry

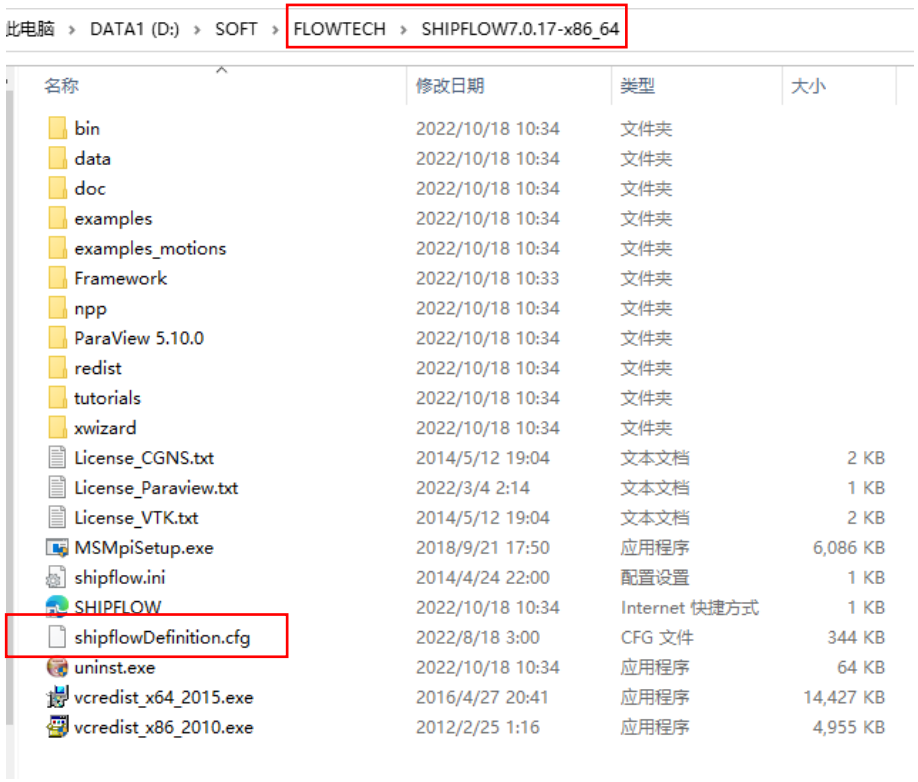
*数据来源：Tokyo 2015 CFD Workshop

静水阻力计算设置—文件同步

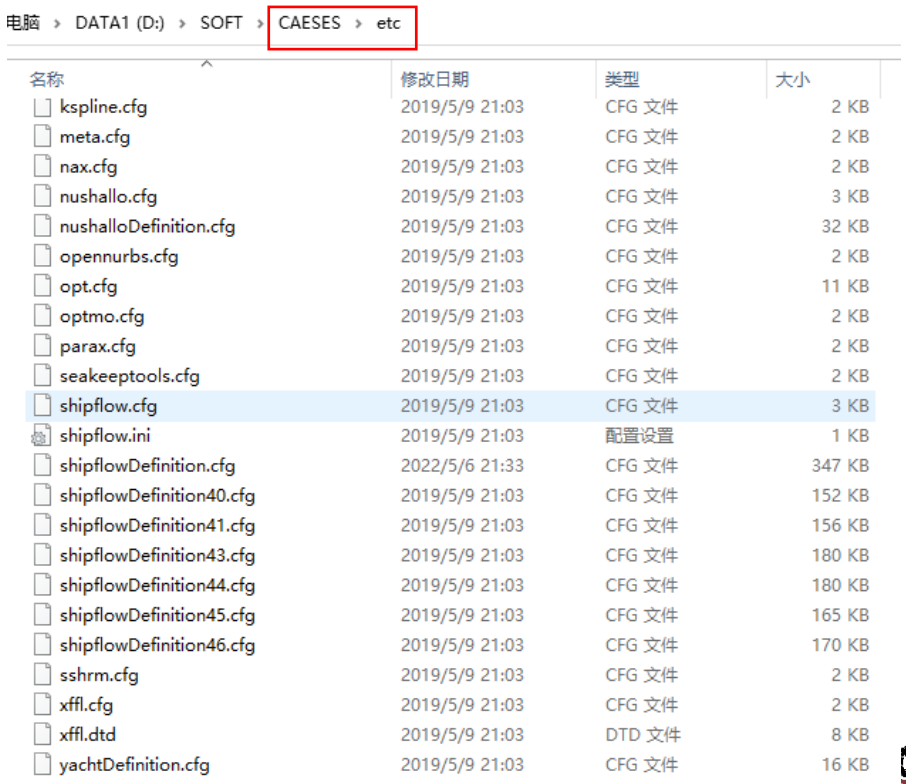
特别说明：对于使用CAESES的SHIPFLOW接口进行计算设置的情况，需要同步CAESES软件的指令文件，否则将无法使用SHIPFLOW新版本的功能。

CAESES4同步流程：

1. 复制shipflowDefinition.cfg文件，文件位置参考：



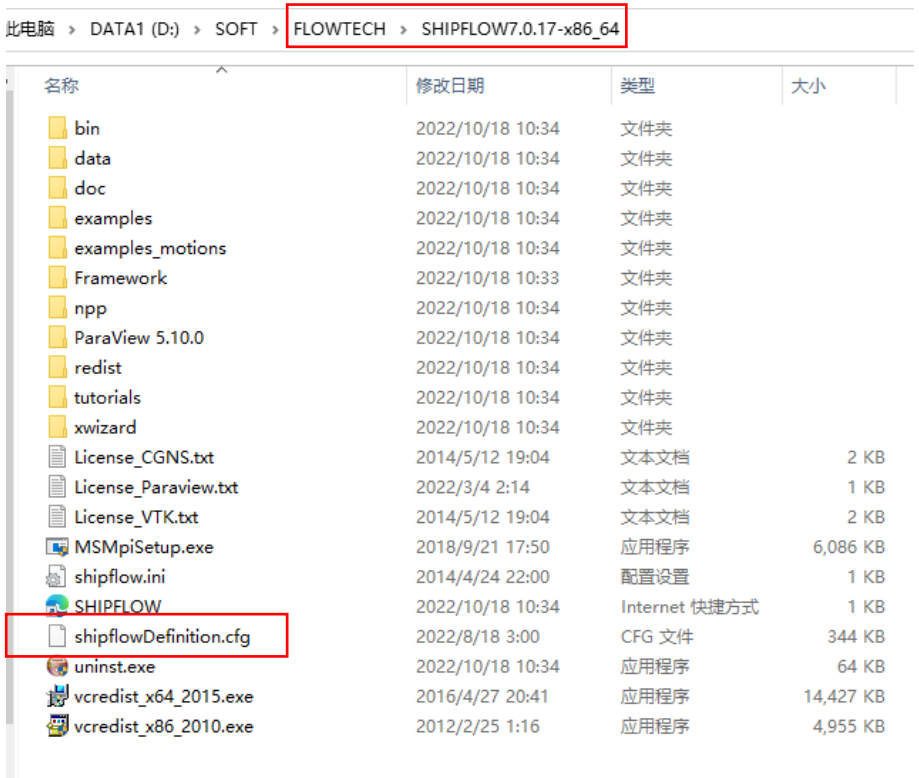
2. 拷贝文件到CAESES安装路径中，替换已经存在的shipflowDefinition.cfg文件，文件位置参考：



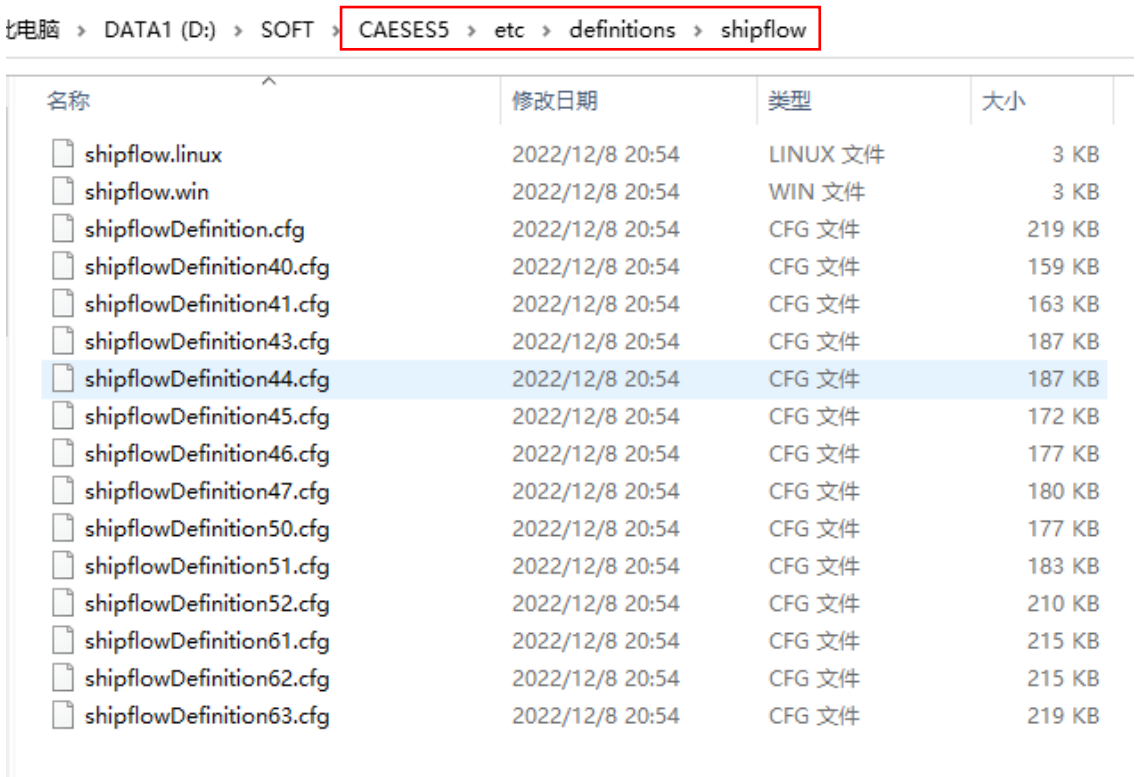
静水阻力计算设置—文件同步

CAESES5同步流程：

1. 复制shipflowDefinition.cfg文件，文件位置参考：

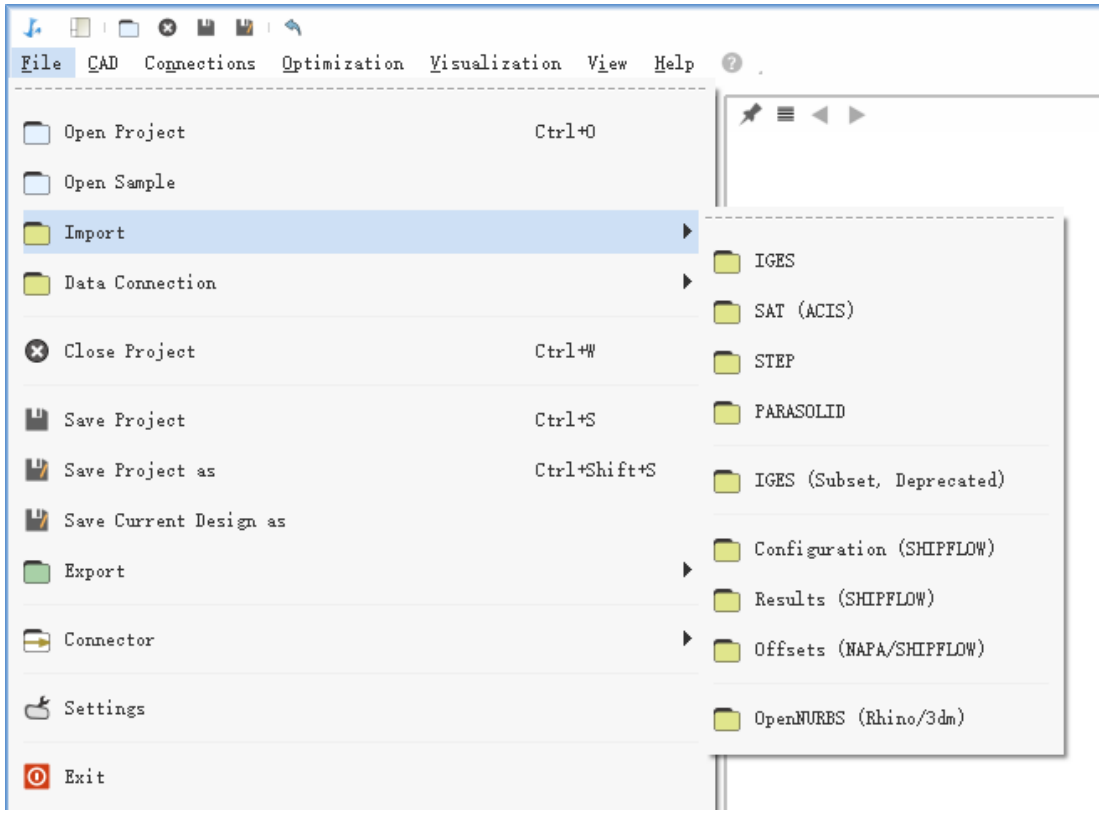


2. 拷贝文件到CAESES安装路径中，替换已经存在的shipflowDefinition.cfg文件，文件位置参考：

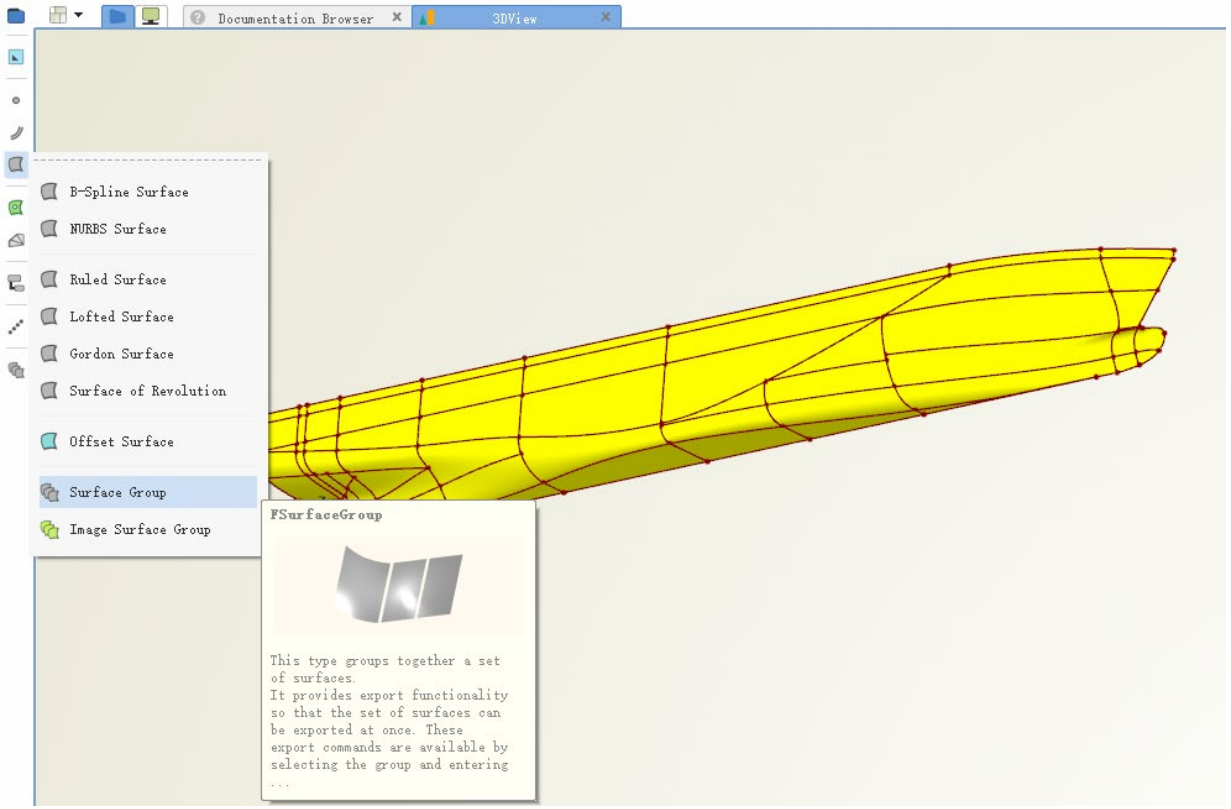


静水阻力计算设置—导入IGES模型

- 开始菜单运行SHIPFLOW design
- 导入船体几何，格式IGES

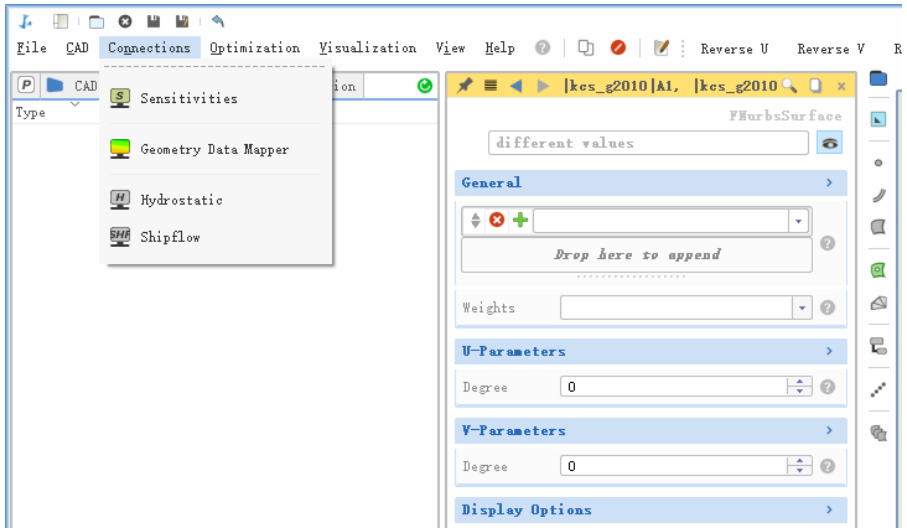


- 选择所有面，创建surface group

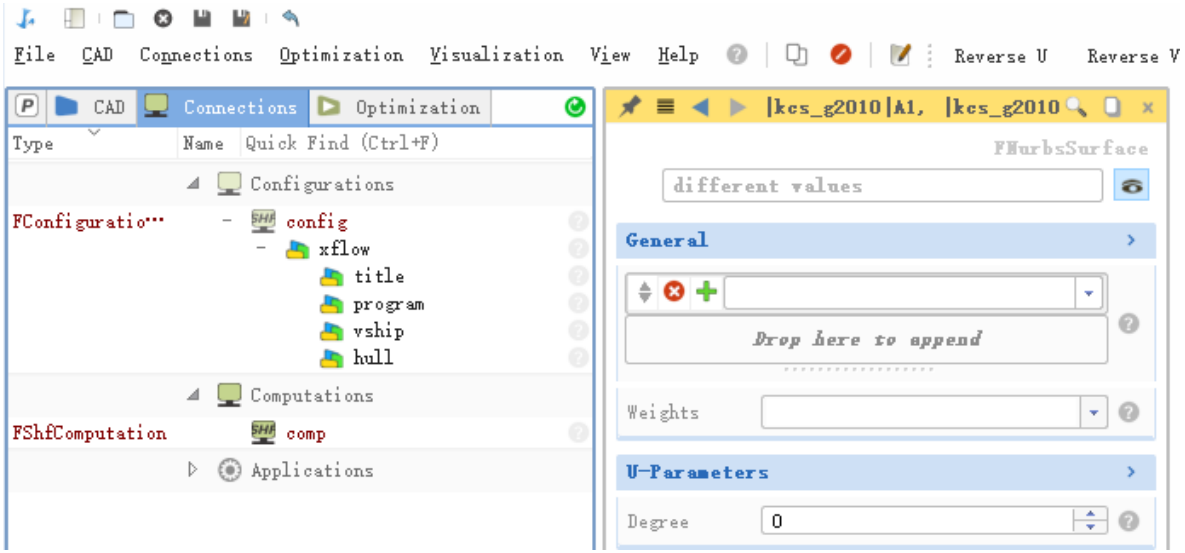


静水阻力计算设置—新建设置

- 点击Connections下面的Shipflow新建设置

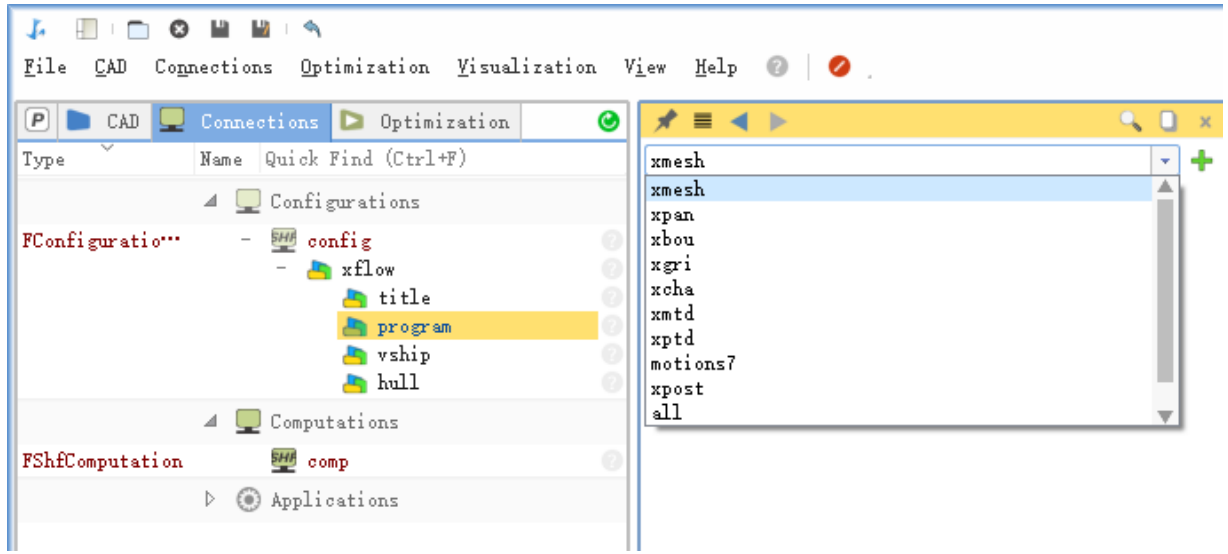


- 展开config>>xflow

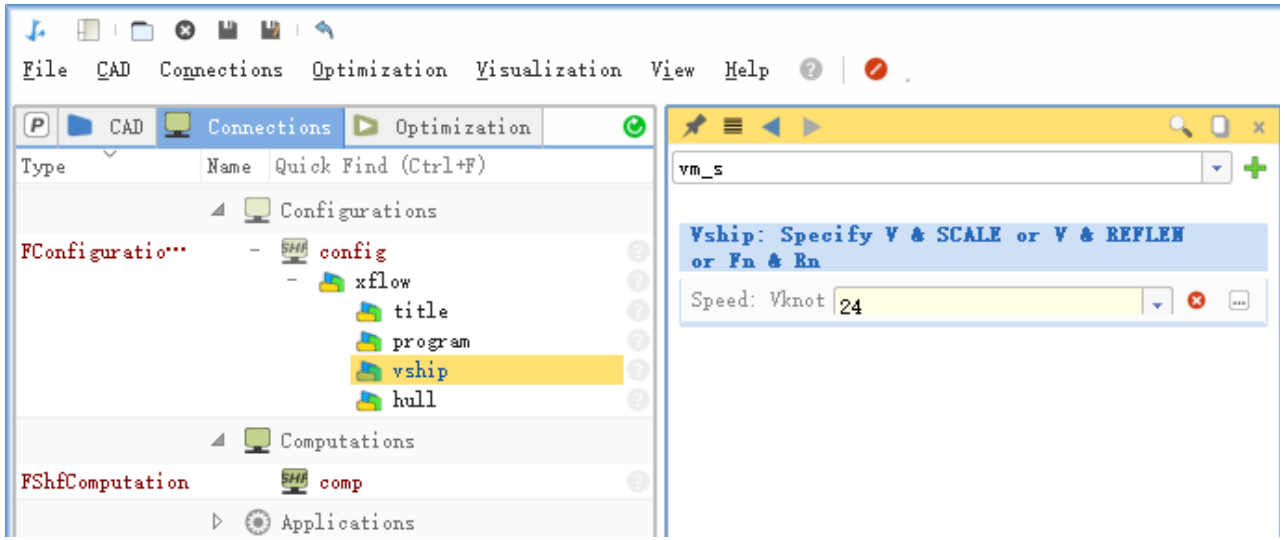


静水阻力计算设置—选择耐波性程序&设置航速

- 点击xflow>>program，下拉菜单中选择motions7，点击绿色加号添加

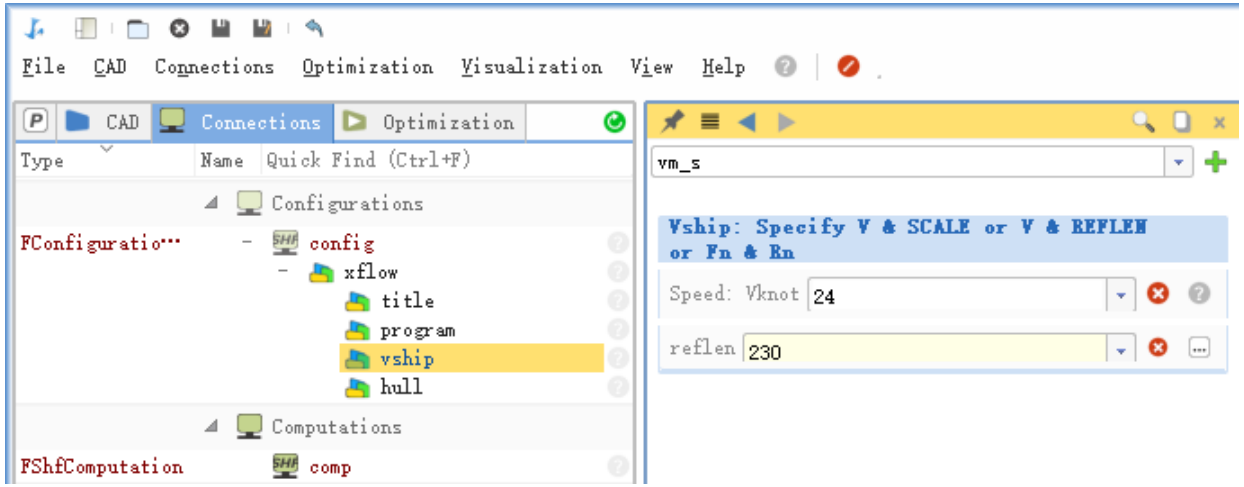


- 点击xflow>>vship，下拉菜单中选择vknot，设置航速24

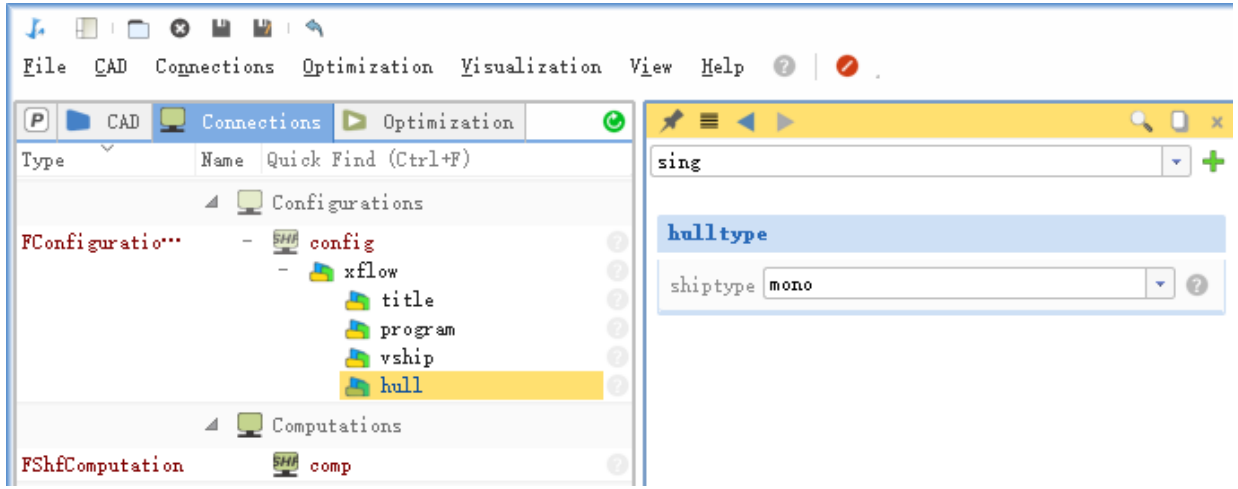


静水阻力计算设置—设置缩尺比&指定船型

- 点击xflow>>vship，下拉菜单中选择reflen，设置230，或者选择scale，设置1，两者等效

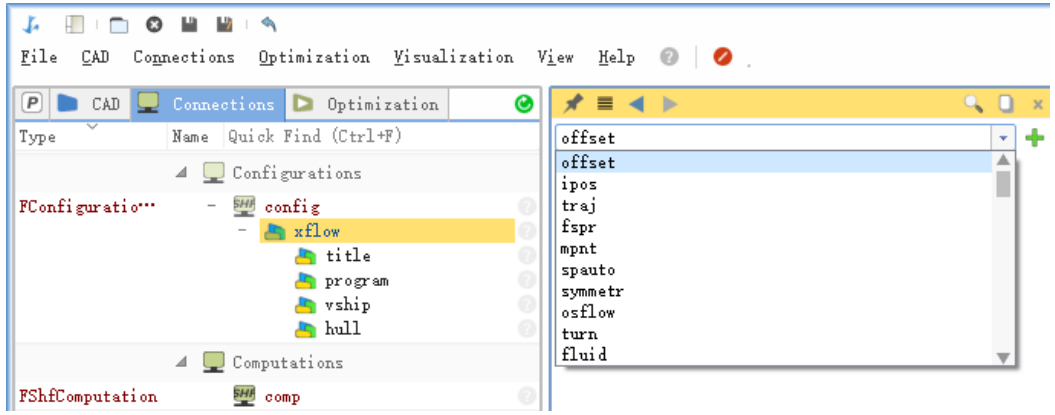


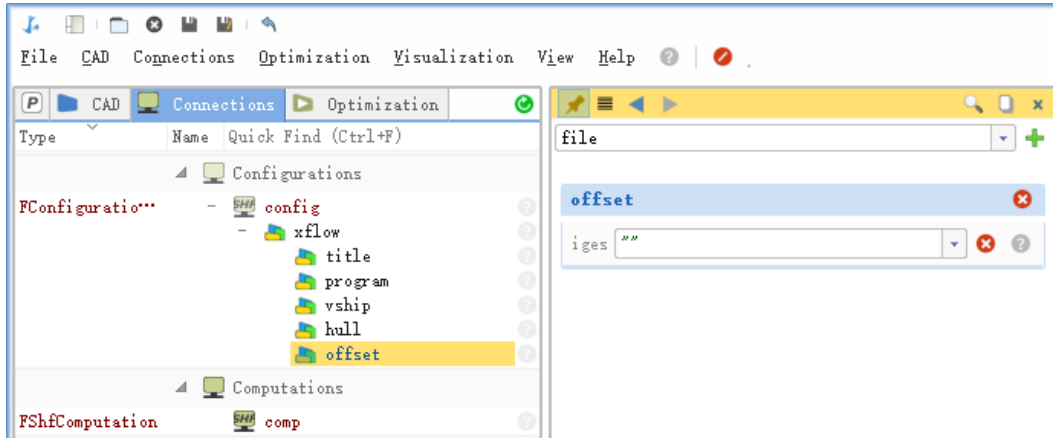
- 点击xflow>>hull，shiptype默认mono，即单体船



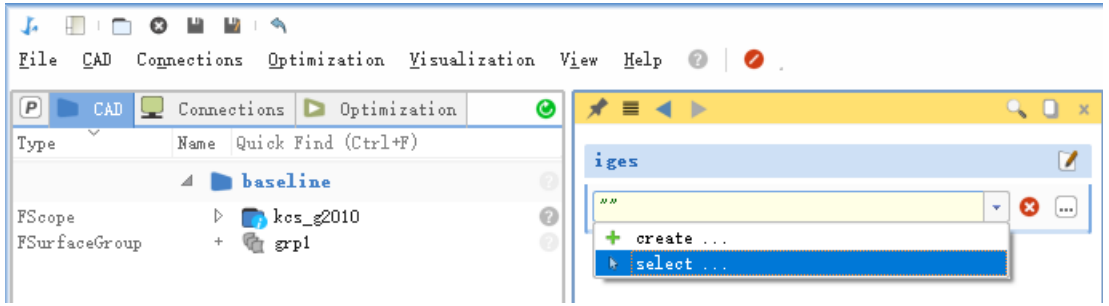
静水阻力计算设置—IGES模型输入输出

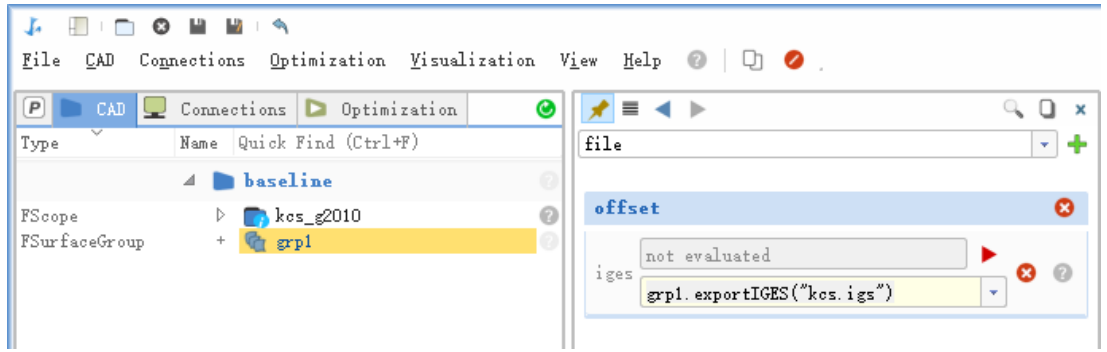
- 点击xflow，下拉菜单中选择offset
- 点击xflow>>offset，下拉菜单中选择iges





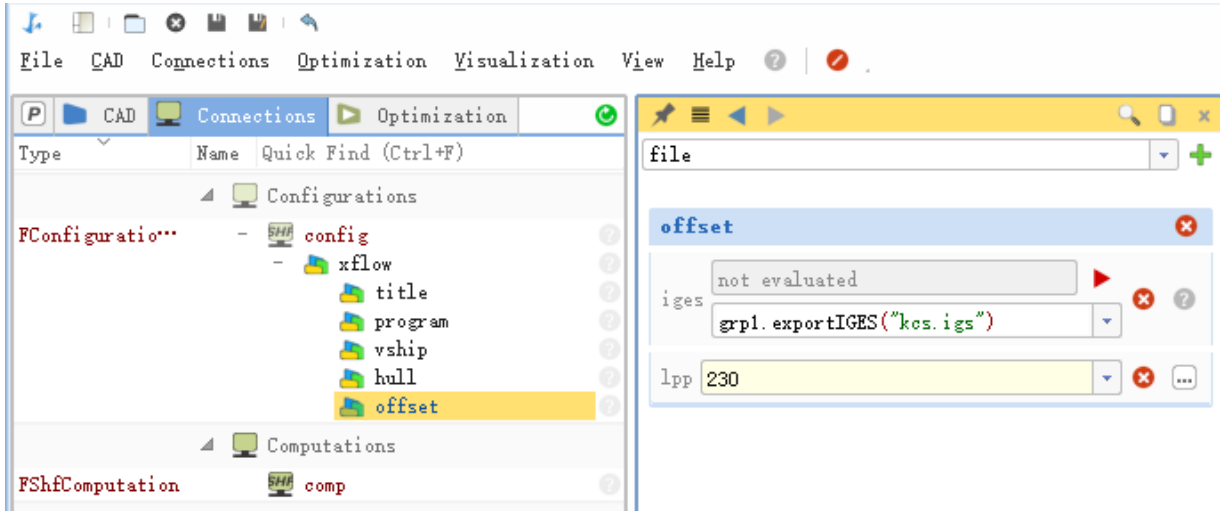
- 点击offset>>iges输入框下拉菜单，选择select
- 点击CAD，选择grp1
- 在offset>>iges输入框中输入grp1.exportIGES("kcs.igs")



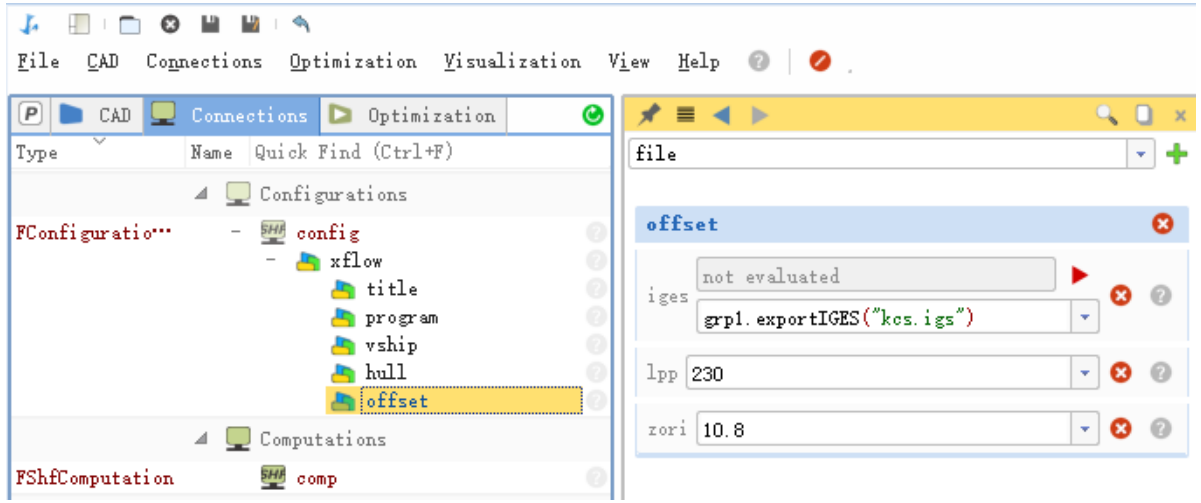


静水阻力计算设置—设置船长和吃水

- 点击xflow>>offset，下拉菜单中选择lpp，输入230

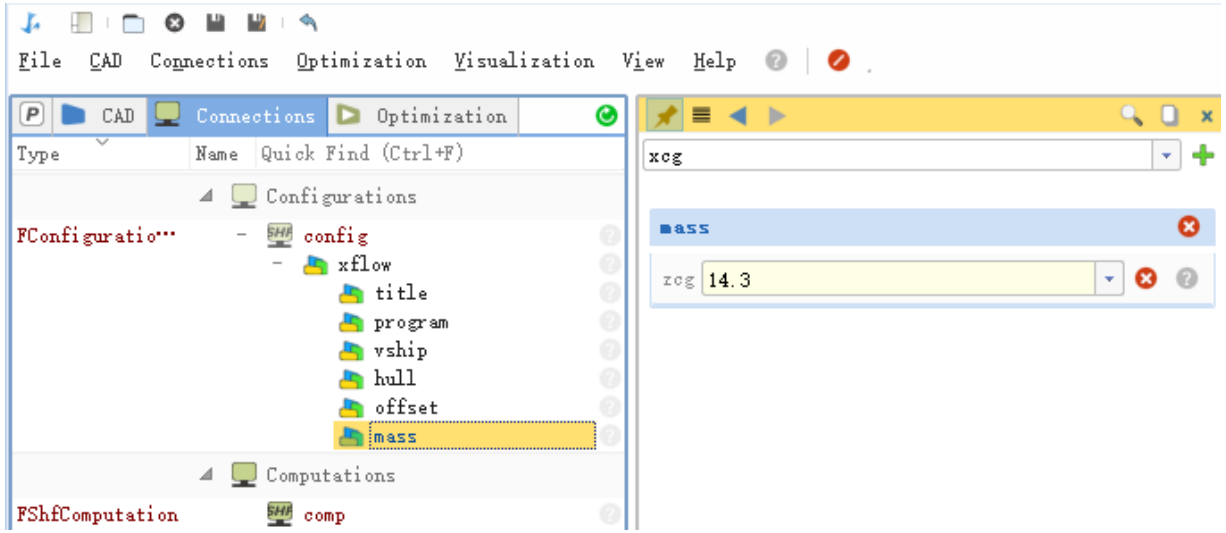


- 点击xflow>>offset，下拉菜单中选择zori，输入10.8

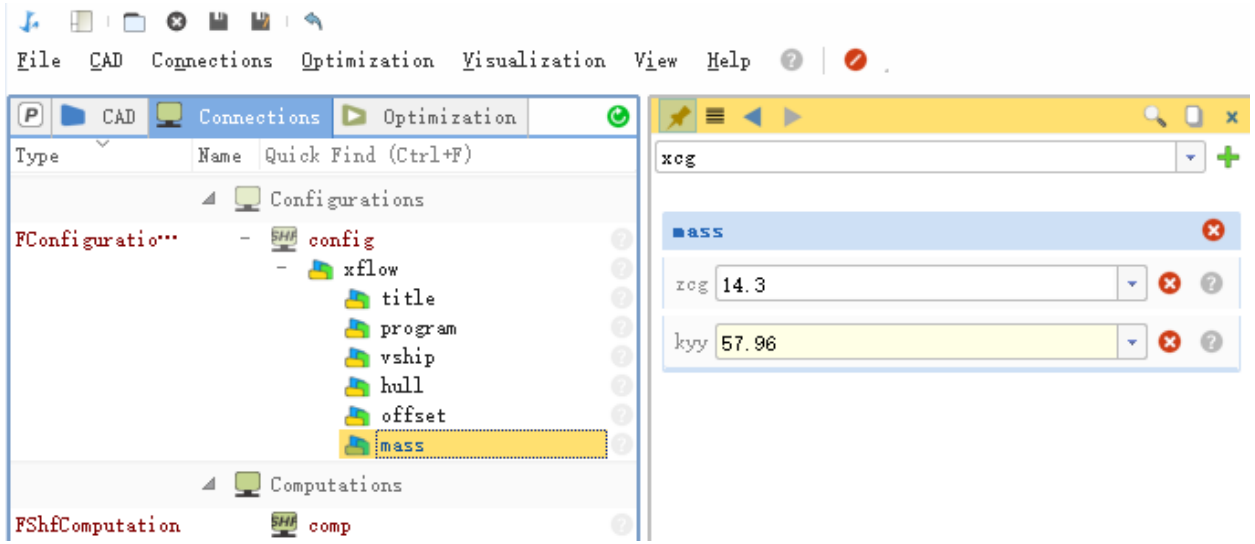


静水阻力计算设置—设置质量属性

- 点击xflow，下拉菜单中选择mass
- 点击xflow>>mass，下拉菜单中选择zcg，输入14.3

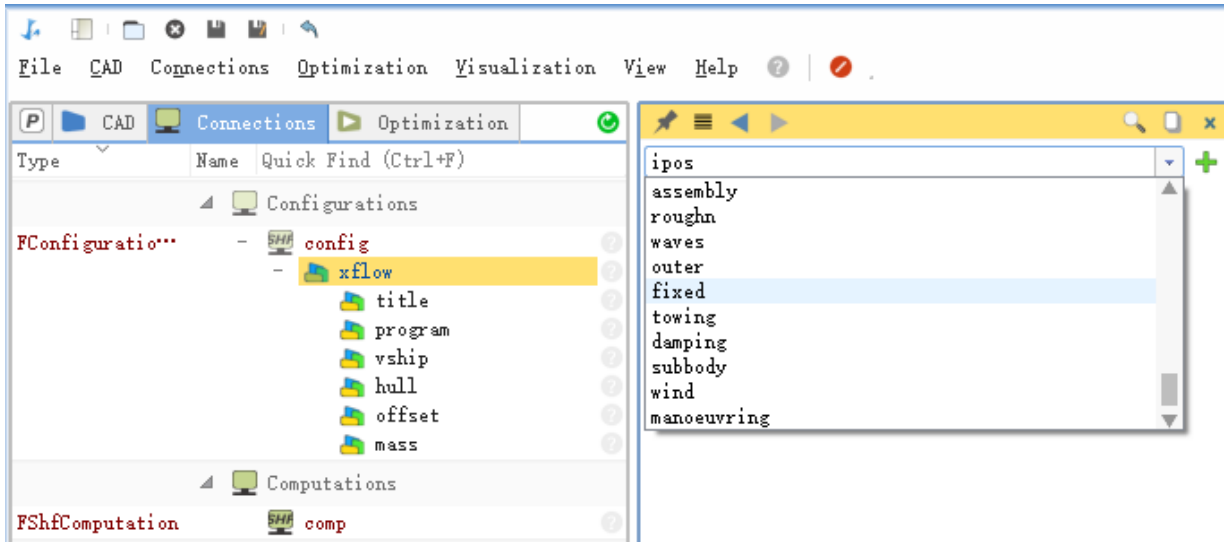


- 点击xflow>>mass，下拉菜单中选择kyy，输入57.96

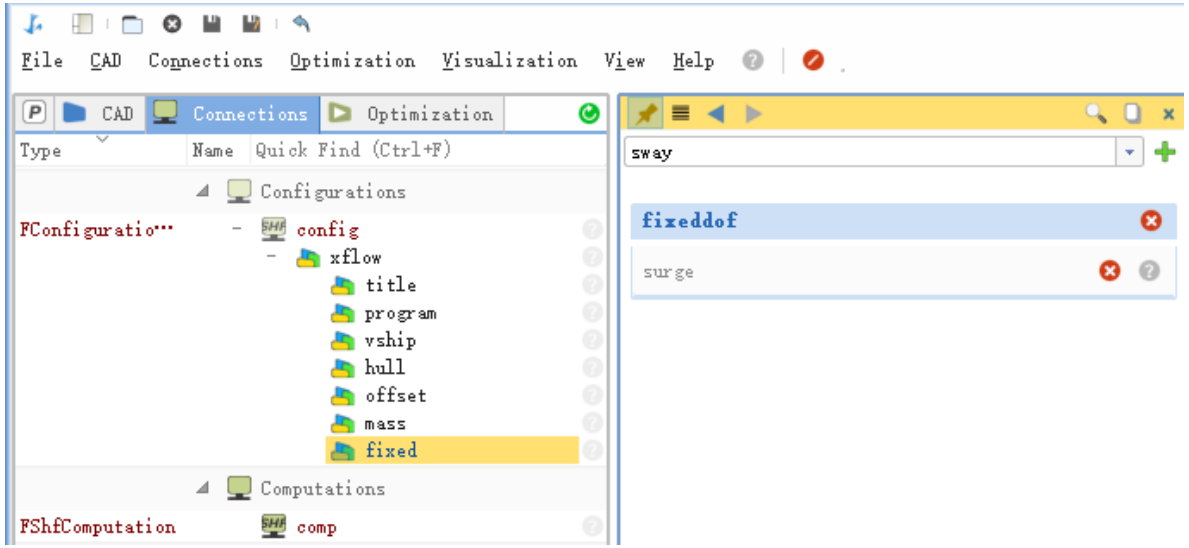


静水阻力计算设置—设置运动自由度

- 半船、对称条件，因此sway，roll和yaw三个自由度默认固定
- 点击xflow，下拉菜单中选择fixed

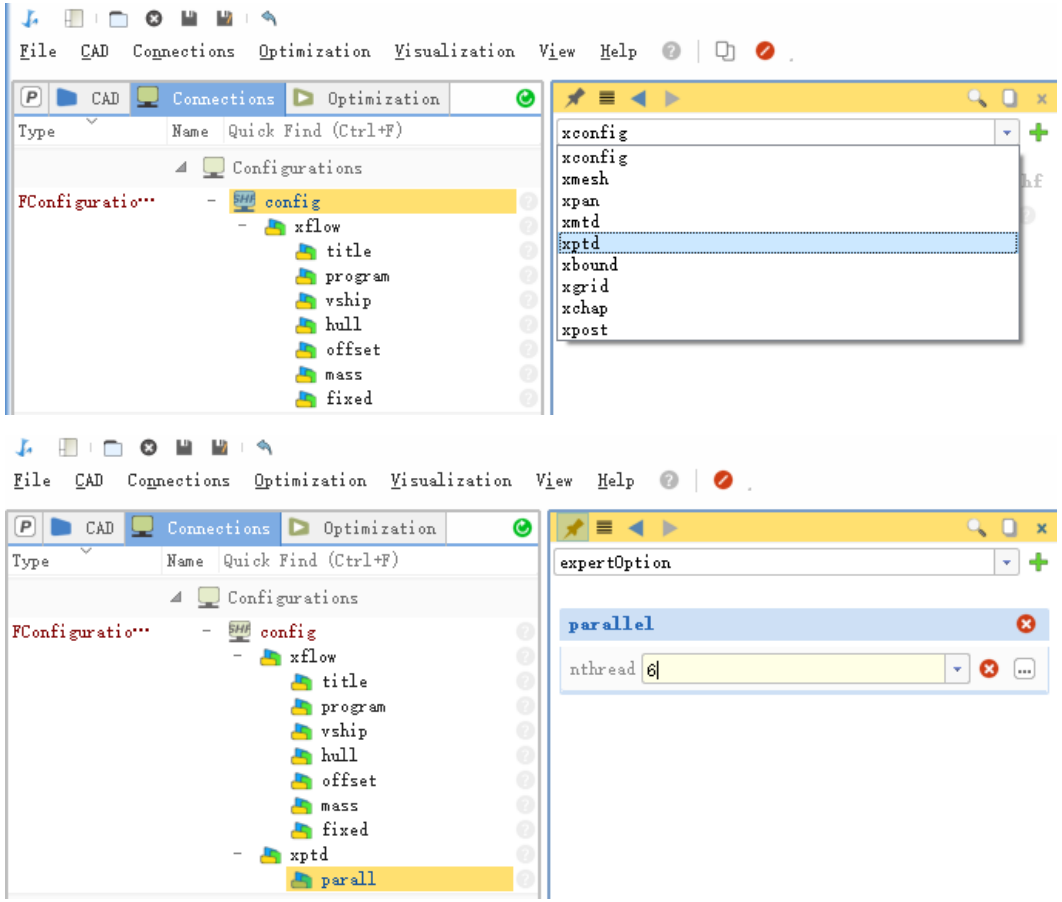


- 点击xflow>>fixed，下拉菜单中选择surge，固定此自由度
- 仅开放heave和pitch两个自由度

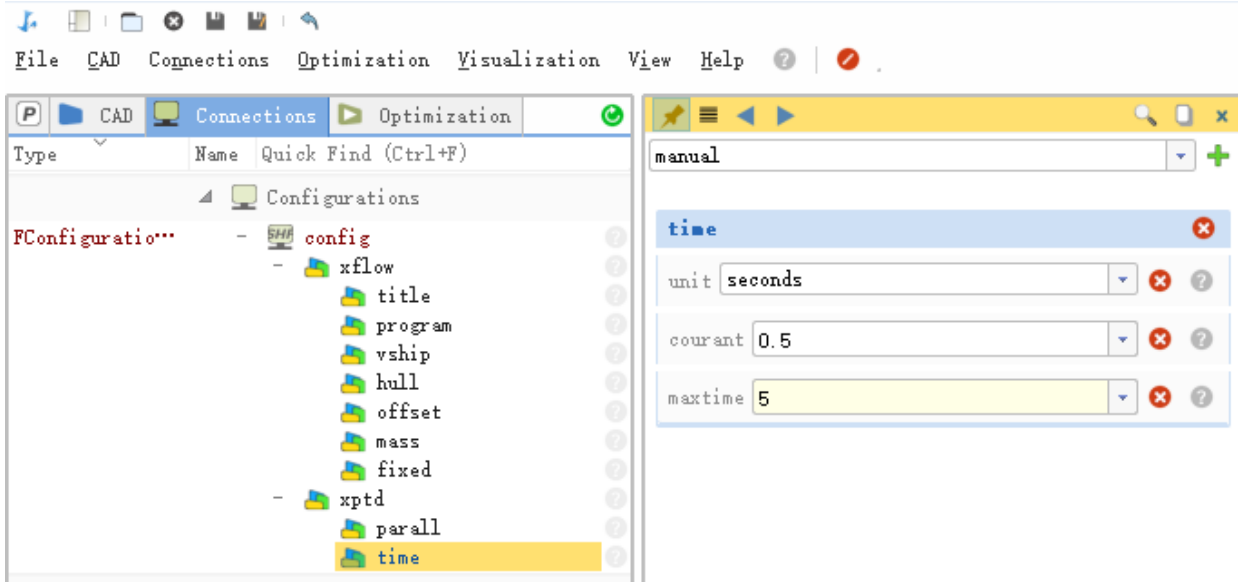


静水阻力计算设置—求解设置

- 点击config，下拉菜单中选择xptd
- 点击config>>xptd，下拉菜单中选择parall
- 展开config>>xptd，点击parall，下拉菜单中选择nthread，设置并行计算线程数

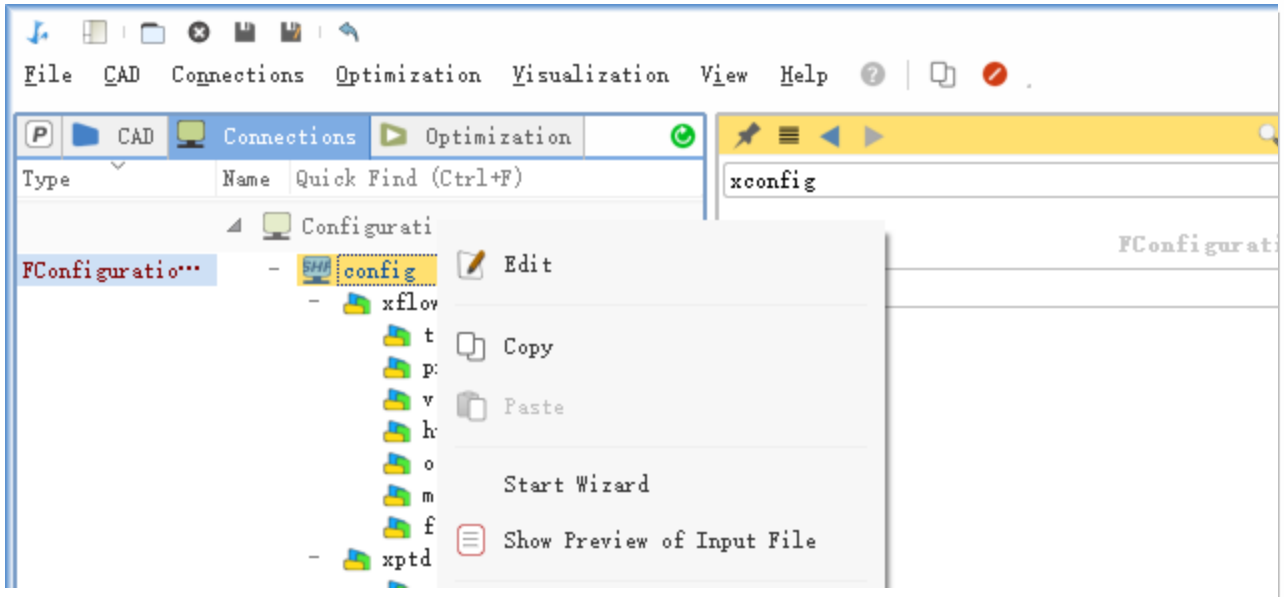


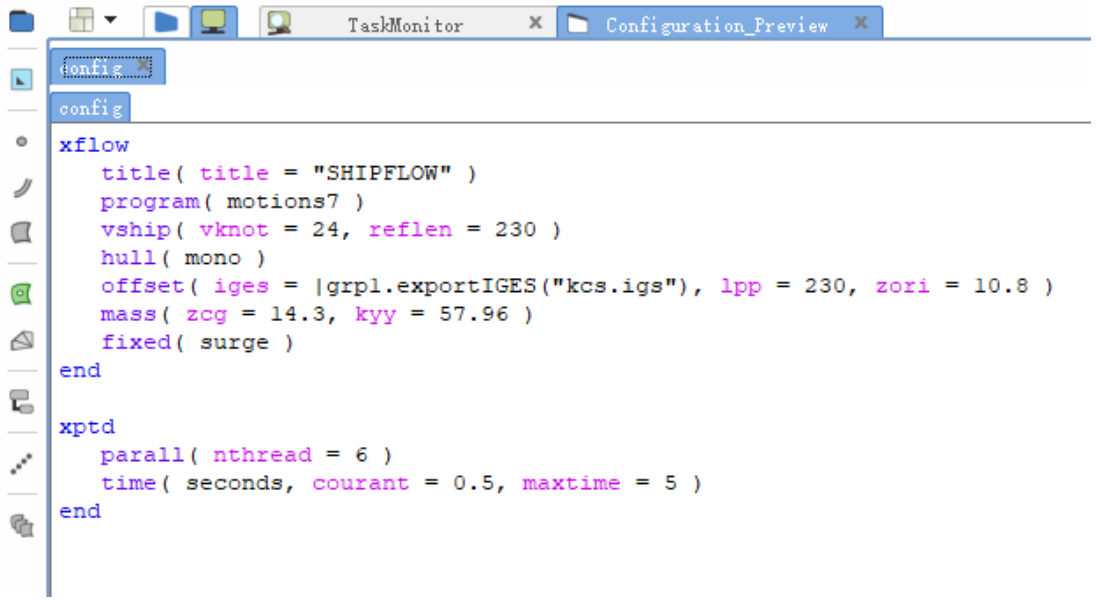
- 点击config>>xptd，下拉菜单中选择time
- 点击config>>xptd>>time，下拉菜单中选择unit，courant，maxtime
- 自行设置最大计算时间，默认最大计算时间是航行10倍船长



静水阻力计算设置—设置预览

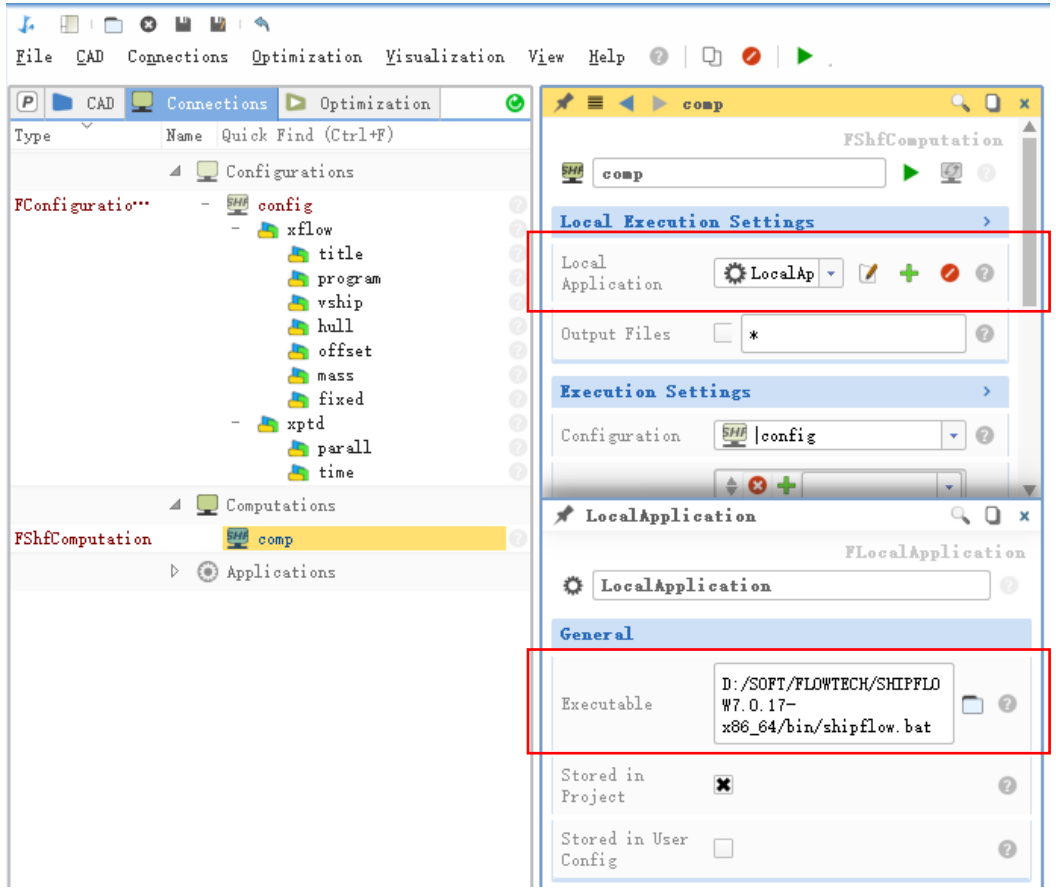
- 点击config，右键选择Show Preview of Input File，对完成的设置进行计算前的预览和检查





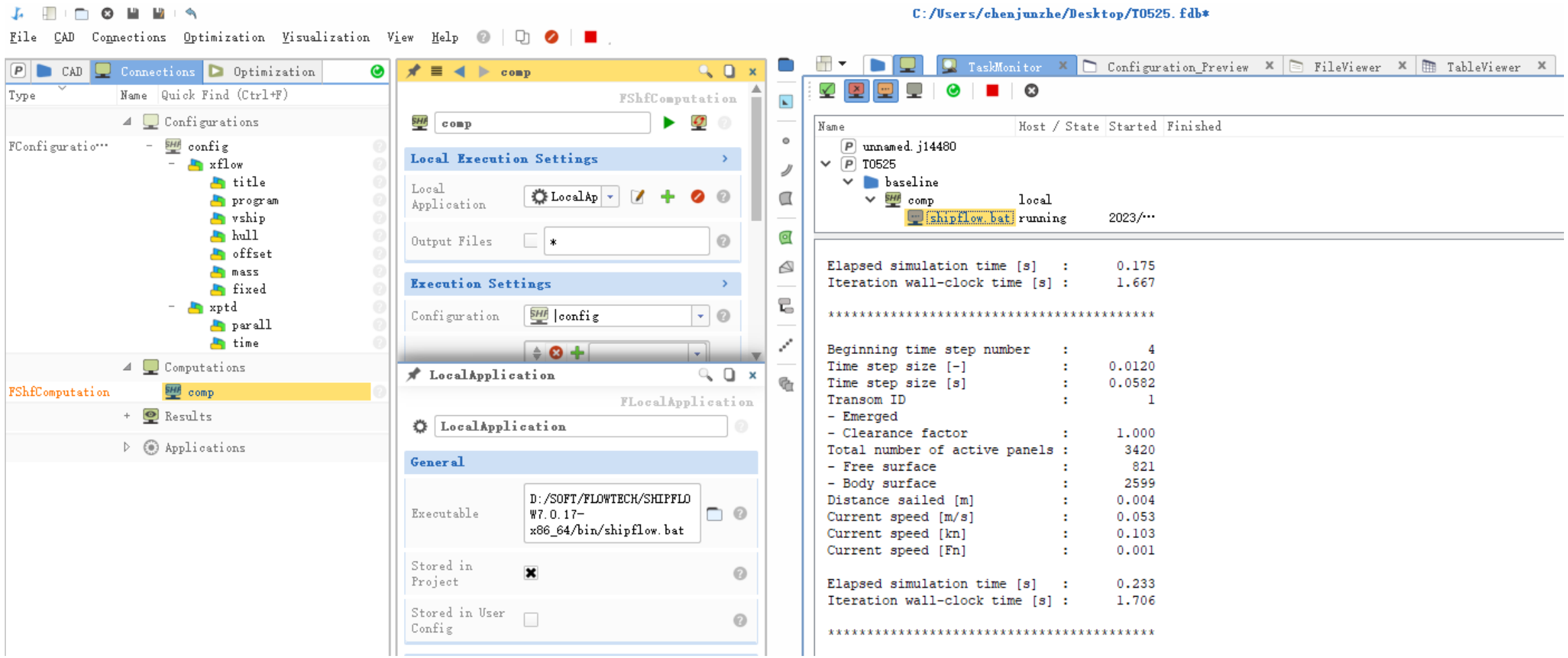
静水阻力求解

- 点击comp，LocalApplication默认添加求解器程序shipflow.bat的路径
- 如果是通过CAESES接口进行计算的情况，需要点击LocalApplication后面的绿色加号，然后指定shipflow.bat程序的路径
- 保存文件
- 点击绿色箭头开始计算



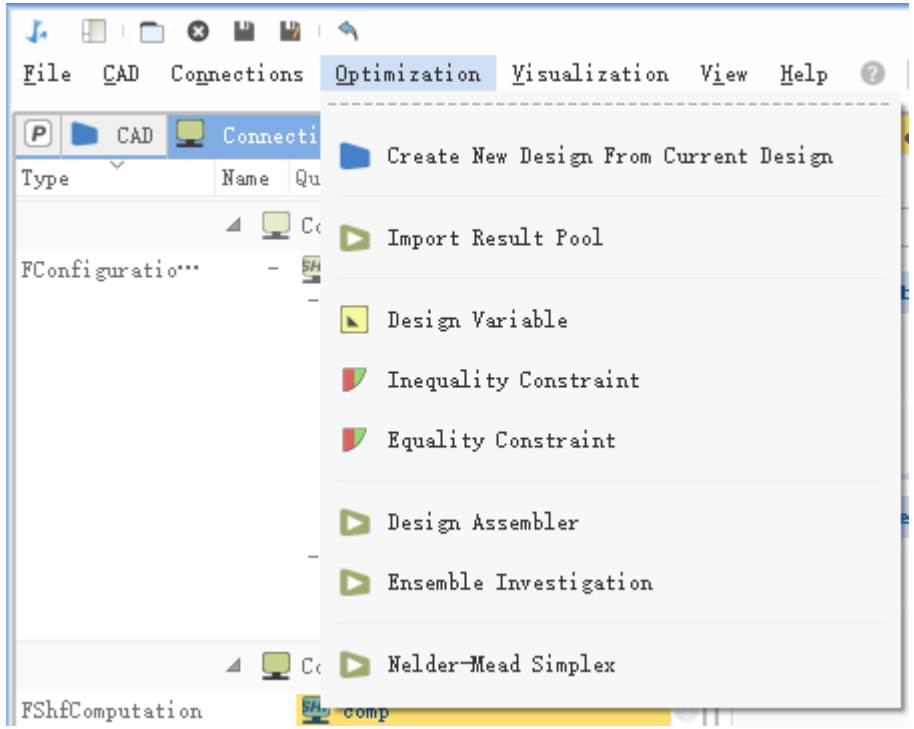
静水阻力求解—运行监控

- 点击TaskMonitor
- 点击shipflow.bat查看运行监控



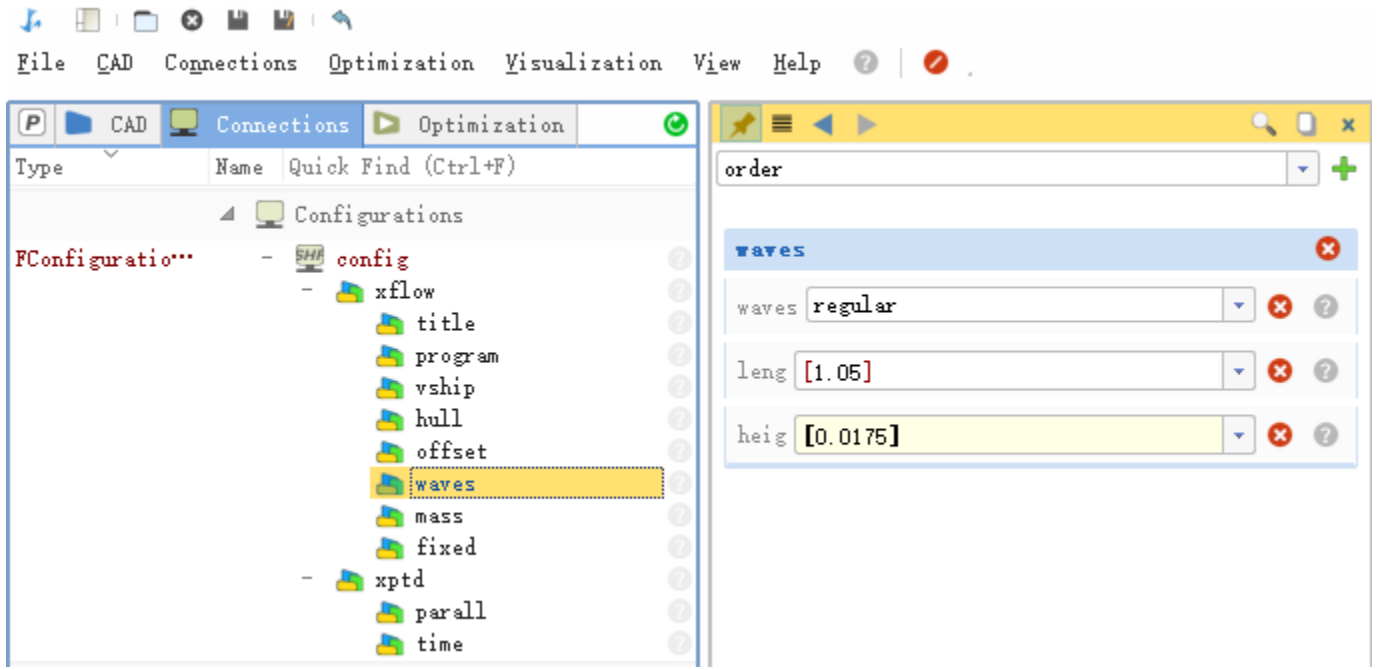
规则波阻力计算设置—新建设置

- 点击Optimization
- 点击Create New Design From Current Design新建设置



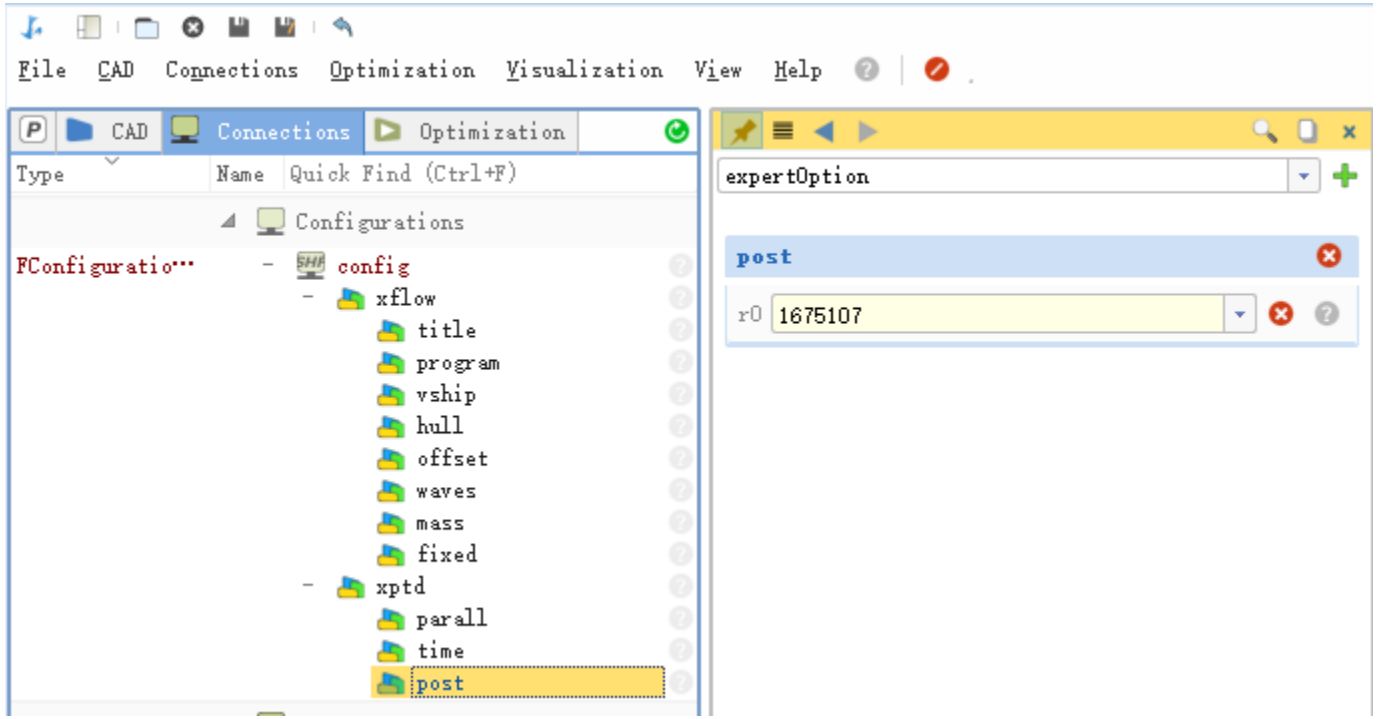
规则波阻力计算设置—波浪设置

- 点击xflow，下拉菜单中选择waves
- 点击xflow>>waves，下拉菜单中选择waves，waves选项菜单中选择regular
- 点击xflow>>waves，下拉菜单中选择leng，输入1.05，设置规则波的波长，此处数值为Lpp的倍数
- 点击xflow>>waves，下拉菜单中选择heig，输入0.0175，设置规则波的波高，此处数值为Lpp的倍数



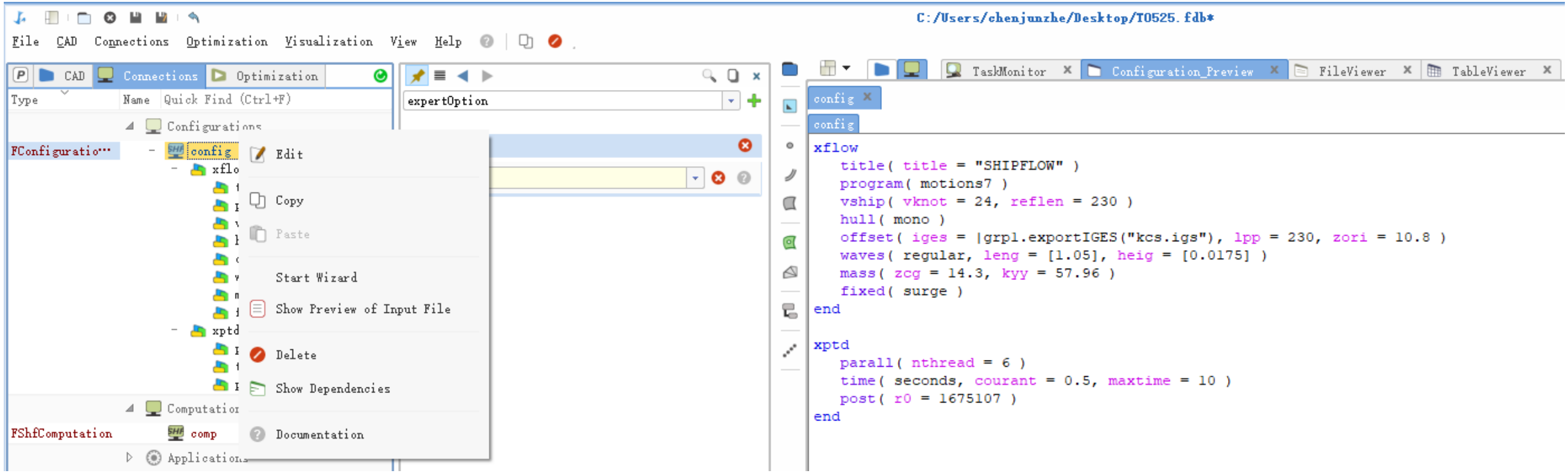
规则波阻力计算设置—静水阻力结果输入

- 点击xptd，下拉菜单中选择post
- 点击xptd>>post，下拉菜单中选择r0，输入静水阻力数值



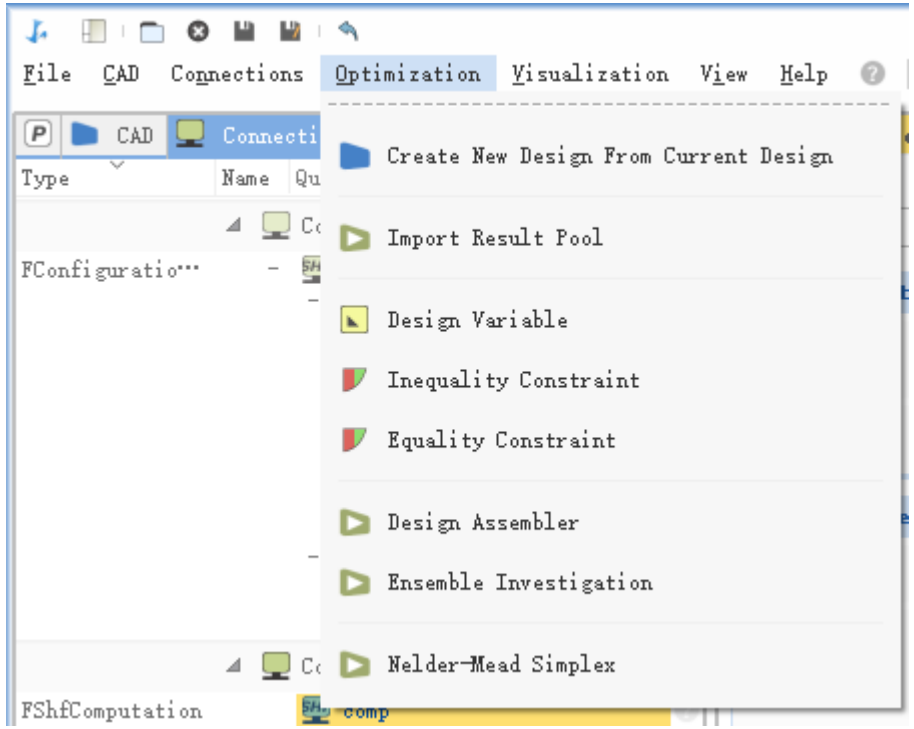
规则波阻力计算设置—设置预览

- 点击config，右键选择Show Preview of Input File，对完成的设置进行计算前的预览和检查



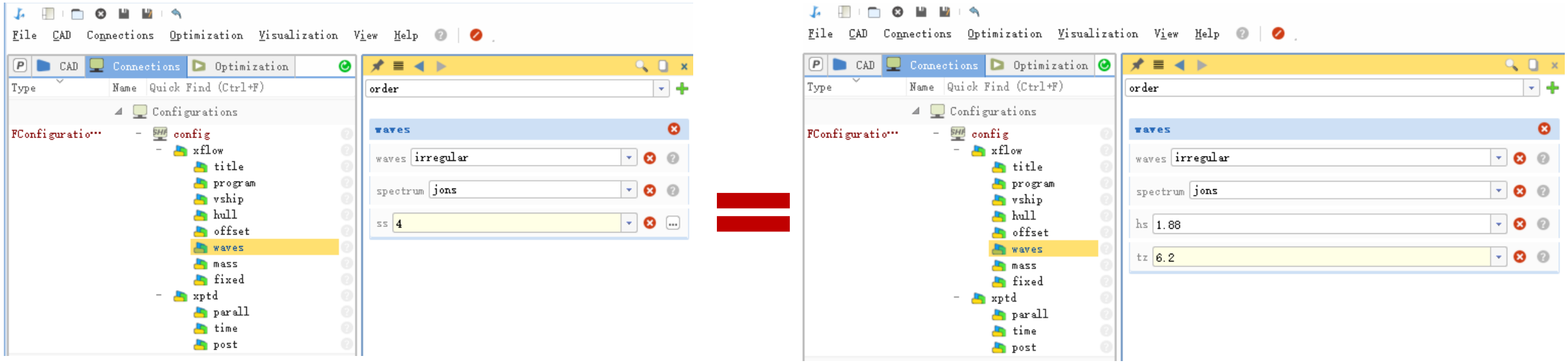
不规则波阻力计算设置—新建设置

- 点击Optimization
- 点击Create New Design From Current Design新建设置



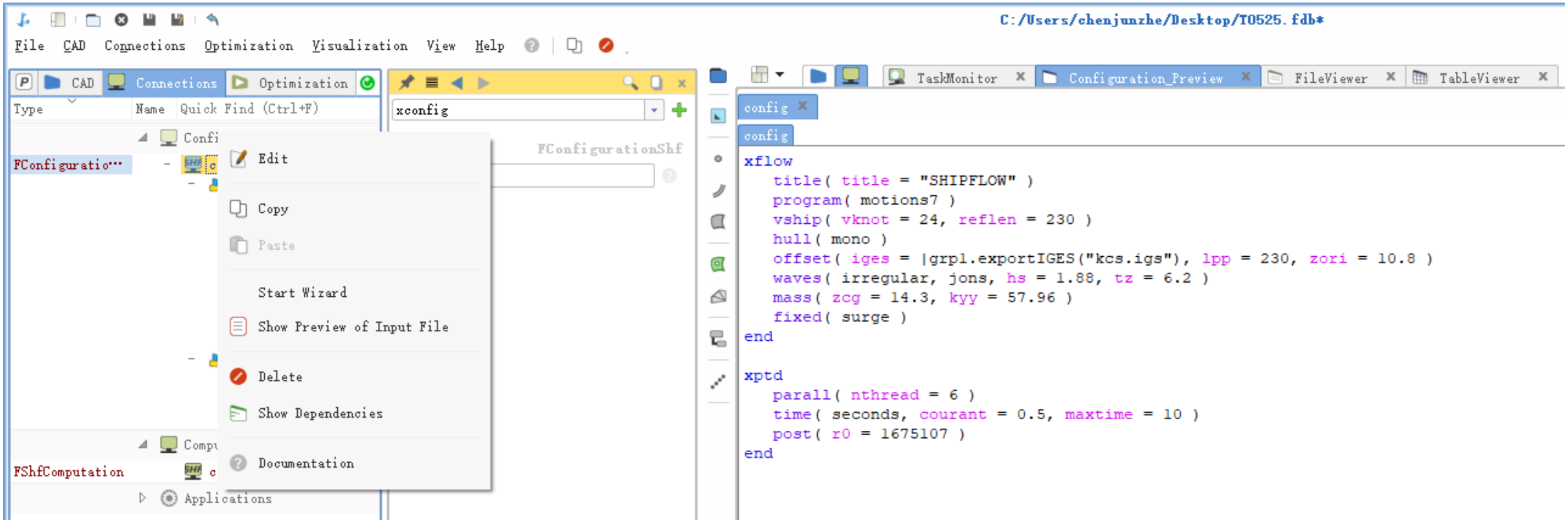
不规则波阻力计算设置—波浪设置

- 点击xflow>>waves，删除leng和heig
- 点击xflow>>waves，waves选项菜单中选择irregular
- 点击xflow>>waves，下拉菜单中选择spectrum，spectrum选项菜单中自行选择波谱
- 点击xflow>>waves，下拉菜单中选择ss，自行输入海况等级，范围2~8级；或者选择hs和tz分别指定有义波高和跨零周期



不规则波阻力计算设置—设置预览

- 点击config，右键选择Show Preview of Input File，对完成的设置进行计算前的预览和检查



波浪增阻计算流程

1. 求解静水阻力RT_{calm}
2. 求解规则波/不规则波阻力RT
3. 计算波浪增阻RAW，如果在求解波浪阻力的设置中添加了静水阻力，则软件自动计算RAW，否则需要手动相减

$$\mathrm{RAW} = \mathrm{RT\text{-}RT}_{calm}$$

$$\mathrm{CAW} = \mathrm{RAW} \;/\; (\rho * \mathrm{g} * \mathrm{B}^2 * \mathrm{H}^2/\mathrm{Lpp})$$

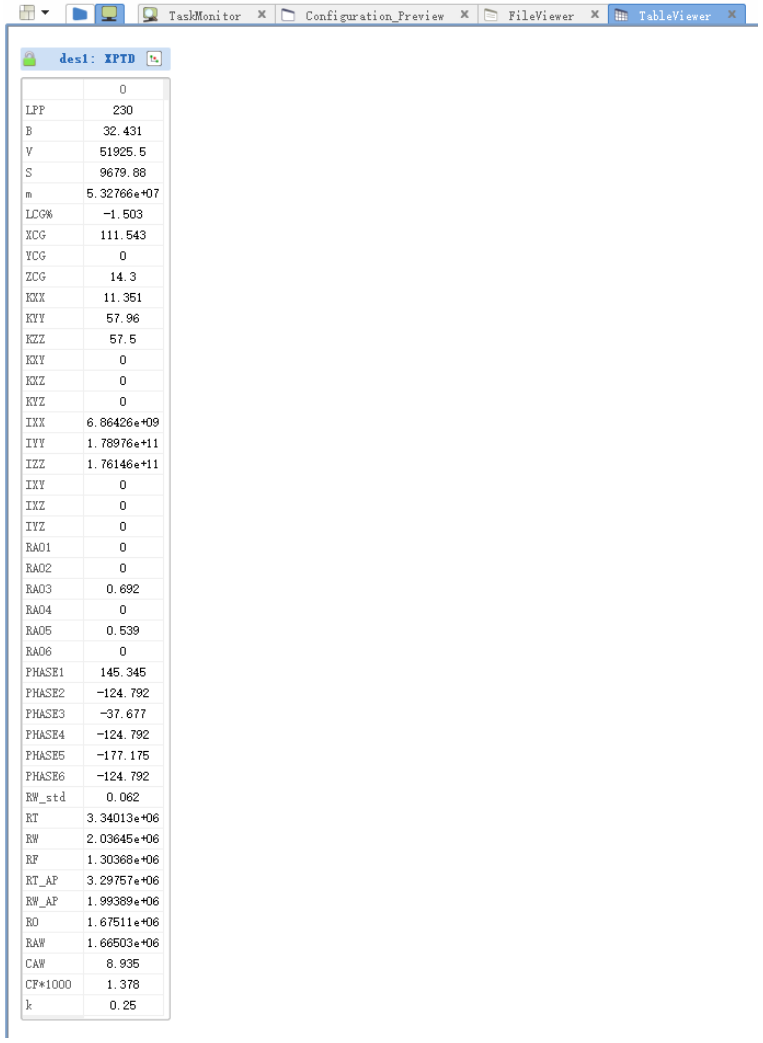
or

$$\mathrm{CAW} = \mathrm{RAW} \;/\; (\rho * \mathrm{g} * \mathrm{B}^2 * \mathrm{A}^2/\mathrm{Lpp})$$

where:
ρ - water density [$\mathrm{kg/m^3}$],
g - gravitational acceleration (9.81 [$\mathrm{m/s^2}$]),
B - Beam [m],
H - Wave height [m],
A - Wave amplitude [m],

计算结果查看

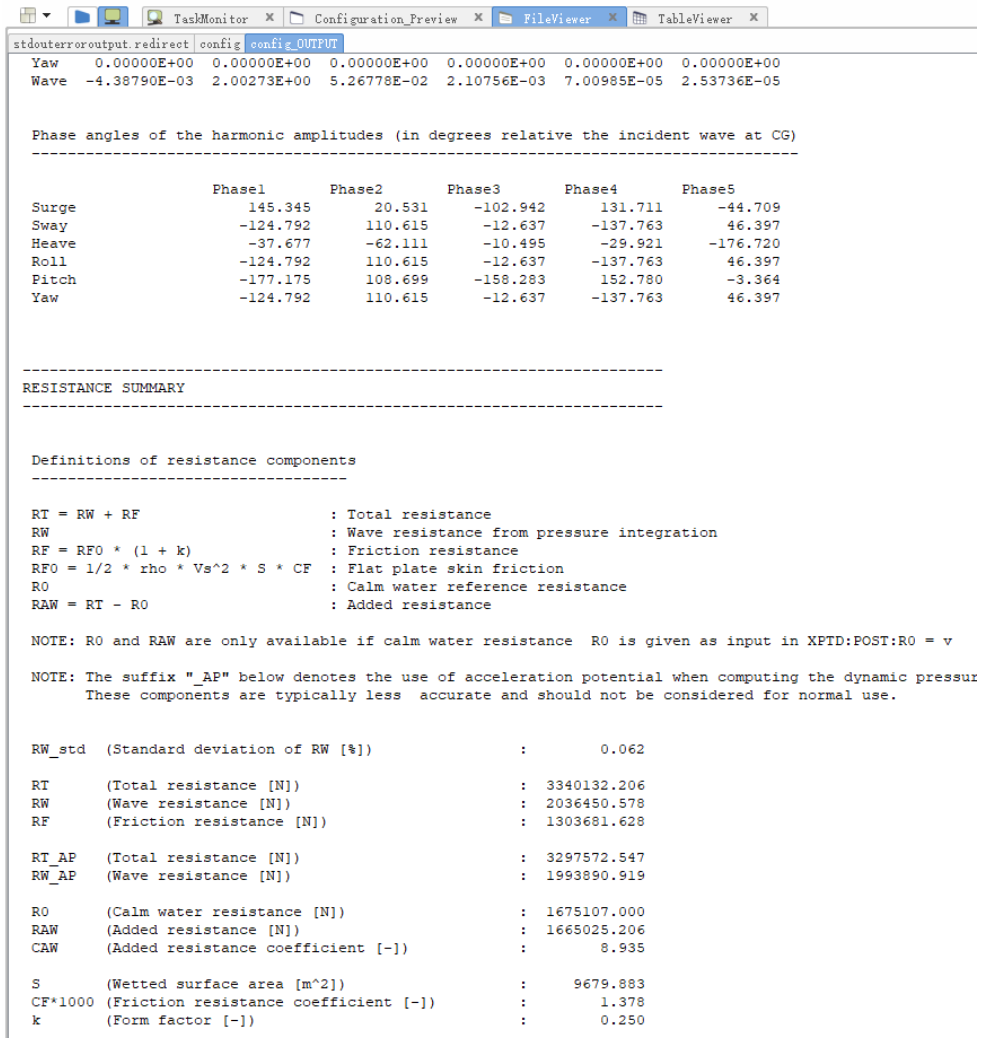
- 点击TableViewer，查看计算结果列表，包含阻力数据和运动数据
- 点击FileViewer>>config_OUTPUT，查看完整的输出文件，内容包括输入参数、默认参数和计算结果



TaskMonitor | Configuration_Preview | FileViewer | TableViewer

des1: XPTD

	0
LPP	230
B	32.431
V	51925.5
S	9679.88
m	5.32766e+07
LCG%	-1.503
XCG	111.543
YCG	0
ZCG	14.3
KXX	11.351
KYY	57.96
KZZ	57.5
KXY	0
KXZ	0
KYZ	0
IXX	6.86426e+09
IYY	1.78976e+11
IZZ	1.76146e+11
IXY	0
IXZ	0
IYZ	0
RA01	0
RA02	0
RA03	0.692
RA04	0
RA05	0.539
RA06	0
PHASE1	145.345
PHASE2	-124.792
PHASE3	-37.677
PHASE4	-124.792
PHASE5	-177.175
PHASE6	-124.792
RW_std	0.062
RT	3.34013e+06
RW	2.03645e+06
RF	1.30368e+06
RT_AP	3.29757e+06
RW_AP	1.99389e+06
R0	1.67511e+06
RAW	1.66503e+06
CAW	8.935
CF*1000	1.378
k	0.25

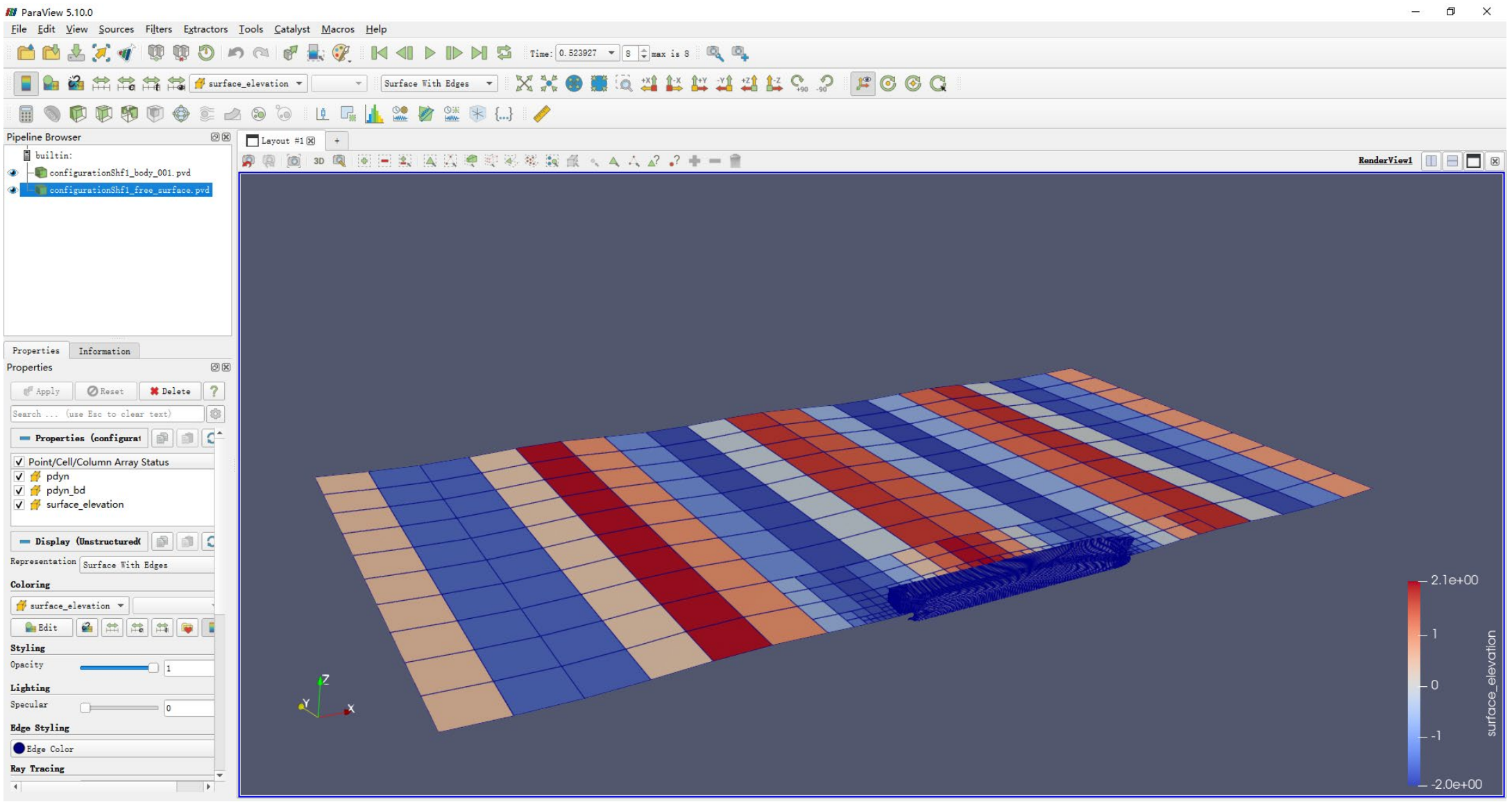


TaskMonitor | Configuration_Preview | FileViewer | TableViewer

stdouterroroutput.redirect | config | config_OUTPUT

```
  Yaw    0.00000E+00  0.00000E+00  0.00000E+00  0.00000E+00  0.00000E+00  0.00000E+00
  Wave  -4.38790E-03  2.00273E+00  5.26778E-02  2.10756E-03  7.00985E-05  2.53736E-05


  Phase angles of the harmonic amplitudes (in degrees relative the incident wave at CG)
  ------------------------------------------------------------------------------------

                      Phase1       Phase2       Phase3       Phase4       Phase5
  Surge                145.345       20.531     -102.942      131.711      -44.709
  Sway                -124.792      110.615      -12.637     -137.763       46.397
  Heave                -37.677      -62.111      -10.495      -29.921     -176.720
  Roll                -124.792      110.615      -12.637     -137.763       46.397
  Pitch               -177.175      108.699     -158.283      152.780       -3.364
  Yaw                 -124.792      110.615      -12.637     -137.763       46.397



 ------------------------------------------------------------------------
 RESISTANCE SUMMARY
 ------------------------------------------------------------------------


  Definitions of resistance components
  ------------------------------------

  RT = RW + RF                    : Total resistance
  RW                              : Wave resistance from pressure integration
  RF = RF0 * (1 + k)              : Friction resistance
  RF0 = 1/2 * rho * Vs^2 * S * CF : Flat plate skin friction
  R0                              : Calm water reference resistance
  RAW = RT - R0                   : Added resistance

  NOTE: R0 and RAW are only available if calm water resistance  R0 is given as input in XPTD:POST:R0 = v

  NOTE: The suffix "_AP" below denotes the use of acceleration potential when computing the dynamic pressur
        These components are typically less  accurate and should not be considered for normal use.


  RW_std  (Standard deviation of RW [%])               :        0.062

  RT      (Total resistance [N])                       :  3340132.206
  RW      (Wave resistance [N])                        :  2036450.578
  RF      (Friction resistance [N])                    :  1303681.628

  RT_AP   (Total resistance [N])                       :  3297572.547
  RW_AP   (Wave resistance [N])                        :  1993890.919

  R0      (Calm water resistance [N])                  :  1675107.000
  RAW     (Added resistance [N])                       :  1665025.206
  CAW     (Added resistance coefficient [-])           :        8.935

  S       (Wetted surface area [m^2])                  :     9679.883
  CF*1000 (Friction resistance coefficient [-])        :        1.378
  k       (Form factor [-])                            :        0.250
```

后处理—动画播放



02

特殊船型IGES模型波浪增阻与运动计算方法

计算方法选择说明

特殊船型计算方法适用于软件不能正常将导入的IGES模型转换为Offset模型的情况，通常情况下，推荐使用常规船型的计算方法

常规船型：	特殊船型：
• 集装箱	• 单体+特殊附体
• 散货	• 双体
• 油船	• 三体
	• 潜器和其他

静水阻力计算设置

TaskMonitor | fileViewer1 | tableViewer1 | Configuration_Preview

configurationShf1 | :onfigurationShf' | configurationShf1

:onfigurationShf'

```
xflow
   title( title = "SHIPFLOW" )
   program( motions7 )
   vship( vknot = 24,reflen = 230 )
   hull( mono )
   offset( file = |SHF_Import_off_dummy|as_off_dummy.exportSHF("as_off_duy"),
lpp = 230,
           zori = 10.8 )
   mass( zcg = 14.3,kyy = 57.96 )
   fixed( surge )
end

xmtd
   import( file = "C:\Users\chenjunzhe\Desktop\kcs\_hull.obj" )
   import( file = "C:\Users\chenjunzhe\Desktop\kcs\_transom.obj",tran )
end

xptd
   parall( nthread = 6 )
end
```

通过Rhino软件分别生成船体和尾封板网格，然后导入网格进行计算

规则波阻力计算设置

TaskMonitor | fileViewer1 | tableViewer1 | Configuration_Preview

configurationShf1 | :onfigurationShf' | configurationShf1

:onfigurationShf'

```
xflow
   title( title = "SHIPFLOW" )
   program( motions7 )
   vship( vknot = 24,reflen = 230 )
   hull( mono )
   offset( file = |SHF_Import_off_dummy|as_off_dummy.exportSHF("as_off_duy"),
lpp = 230,
           zori = 10.8 )
   waves( regular,leng = [1.05],heig = [0.0175] )
   mass( zcg = 14.3,kyy = 57.96 )
   fixed( surge )
end

xmtd
   import( file = "C:\Users\chenjunzhe\Desktop\kcs\_hull.obj" )
   import( file = "C:\Users\chenjunzhe\Desktop\kcs\_transom.obj",tran )
end

xptd
   parall( nthread = 6 )
end
```

不规则波阻力计算设置

TaskMonitor | fileViewer1 | tableViewer1 | Configuration_Preview

configurationShf1 | configurationShf1 | :onfigurationShf'

:onfigurationShf'

```
xflow
   title( title = "SHIPFLOW" )
   program( motions7 )
   vship( vknot = 24,reflen = 230 )
   hull( mono )
   offset( file = |SHF_Import_off_dummy|as_off_dummy.exportSHF("as_off_duy"),
lpp = 230,
           zori = 10.8 )
   waves( irregular,jons,ss = 4 )
   mass( zcg = 14.3,kyy = 57.96 )
   fixed( surge )
end

xmtd
   import( file = "C:\Users\chenjunzhe\Desktop\kcs\_hull.obj" )
   import( file = "C:\Users\chenjunzhe\Desktop\kcs\_transom.obj",tran )
end

xptd
   parall( nthread = 6 )
end
```

谢 谢 观 看 ！

天 洑 - 智 能 工 业 设 计 软 件 全 球 引 领 者

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