FEGATE FOR SHIP

Raonx Solutions㈜

CONTENTS

- 개발 배경, 목적
- GUI & HOTKEY
- Fine mesh
- Functions
- Script를 이용한 하중 생성
- Script를 이용한 Result combine
- 보고서
- POST

개발 배경

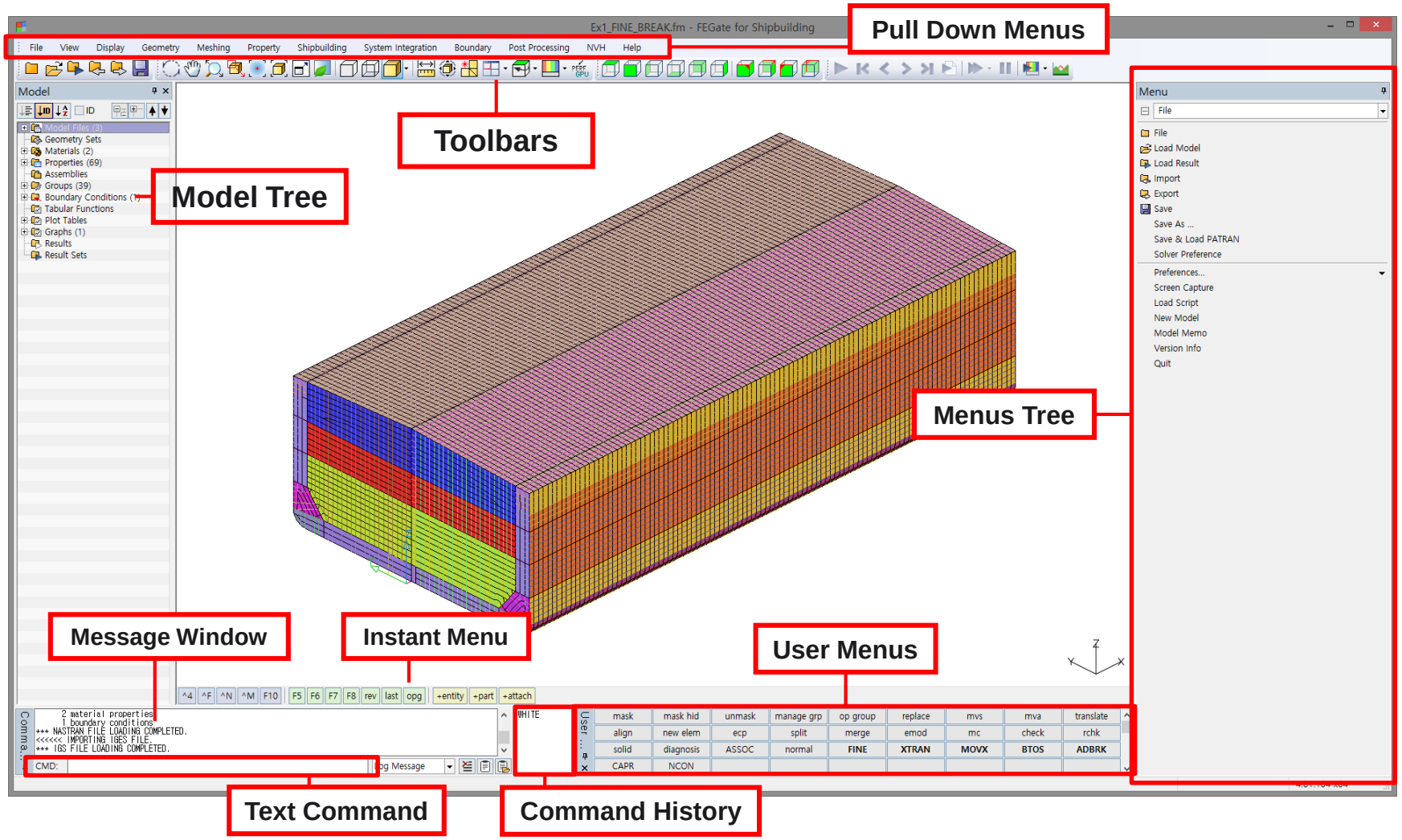
- 급변하는 Pre/Post processor 시장에서 조선분야에서 주로 사용하는 MSC.Patran을 뛰어 넘을 프로그램의 요구가 급증함
- CSRH에서는 더 많은 관심영역 요구에 따라 많은시수증가 예상
- 수백만 개의 요소를 원활하게 작업할 수 있는 프로그램이 필요
- FEGate for ship은 RaonX 와 SVD가 공동으로 개발한 조선 전용 Pre/Post Processor
- 조선분야의 해석 업무에 요구되는 기능 및 해석 기술을 집약하고, 자동화 하여 FEGate For ship 개발
- Raonx만의 조선분야 특화 기능 노하우 접목

개발 목적

- 더 빠르고 더 간편하게 구조해석을 수행
- 다양한 자동화 기능을 통하여 시수 절감
- 수백만 개의 요소를 원활하게 컨트롤 가능
- 고객의 Needs 반영

GUI & HOTKEY

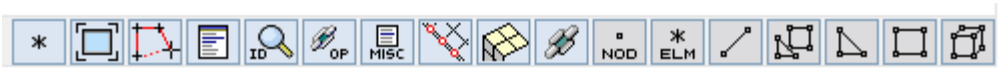
GUI


Pull Down Menus
Toolbars
Model Tree
Menus Tree
Message Window
Instant Menu
User Menus
Text Command
Command History
File View Display Geometry Meshing Property Shipbuilding System Integration Boundary Post Processing NVH Help
Model
Geometry Sets
Materials (2)
Properties (69)
Assemblies
Groups (39)
Boundary Conditions (7)
Tabular Functions
Plot Tables
Graphs (1)
Results
Result Sets
Menu
File
Load Model
Load Result
Import
Export
Save
Save As ...
Save & Load PATRAN
Solver Preference
Preferences...
Screen Capture
Load Script
New Model
Model Memo
Version Info
Quit
2 material properties
1 boundary conditions
*** NASTRAN FILE LOADING COMPLETED.
<<<<<< IMPORTING IGES FILE.
*** IGS FILE LOADING COMPLETED.
CMD:
WHITE
mask mask hid unmask manage grp op group replace mvs mva translate
align new elem ecp split merge emod mc check rchk
solid diagnosis ASSOC normal FINE XTRAN MOVX BTOS ADBRK
CAPR NCON

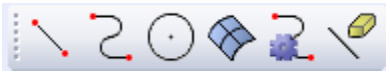
ICON

- 처음 사용자를 위한 Icon

Instant menu / picking



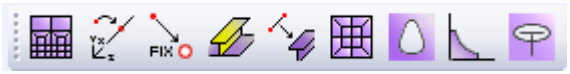
Geo



Mesh

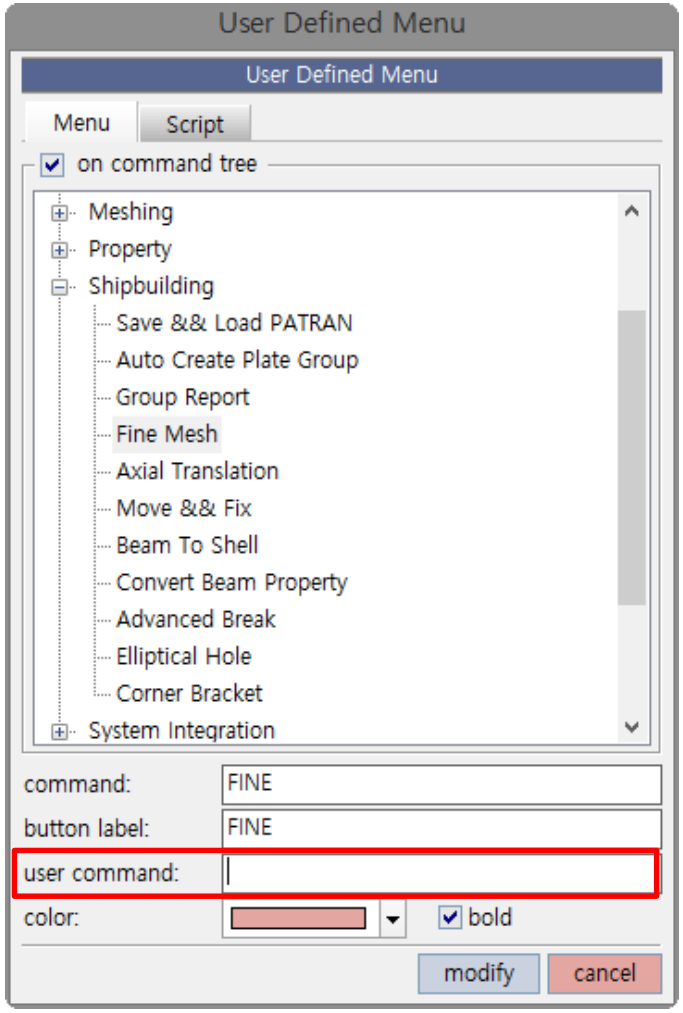
Material, Property

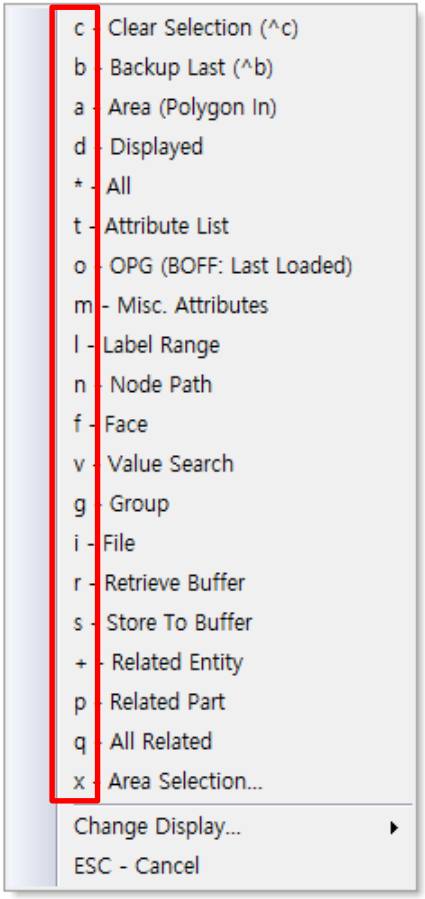
Shipbuilding



HOTKEY

- 대부분의 기능에 Command 및 Hotkey 존재

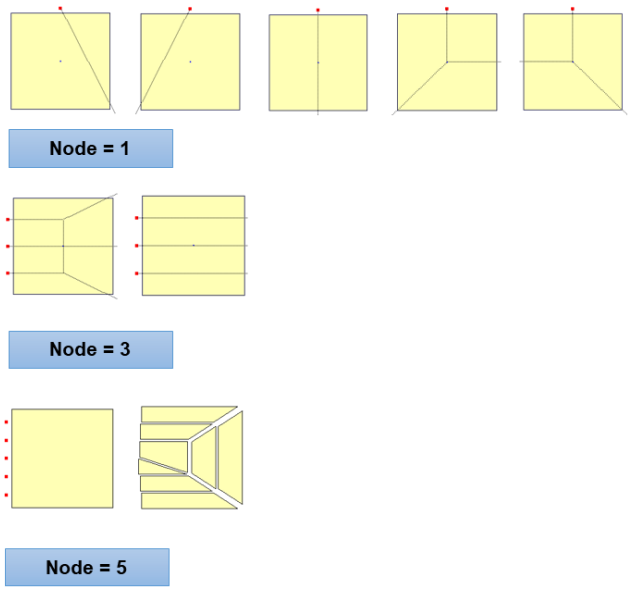


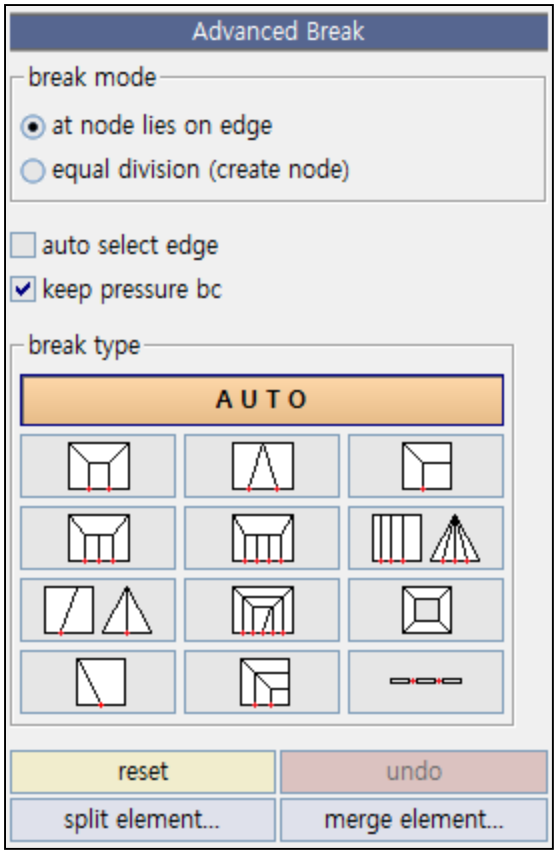


FINE MESH

ADVANCED BREAK (ADBRK)

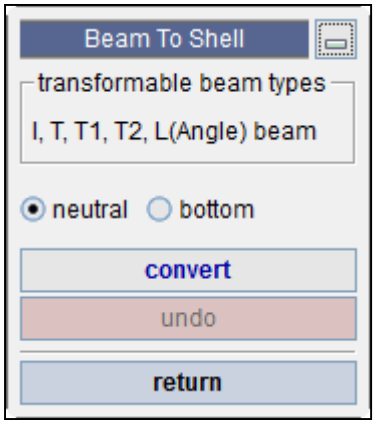
- 자동으로 Node 검색
- 위치와 개수 파악하여 분할

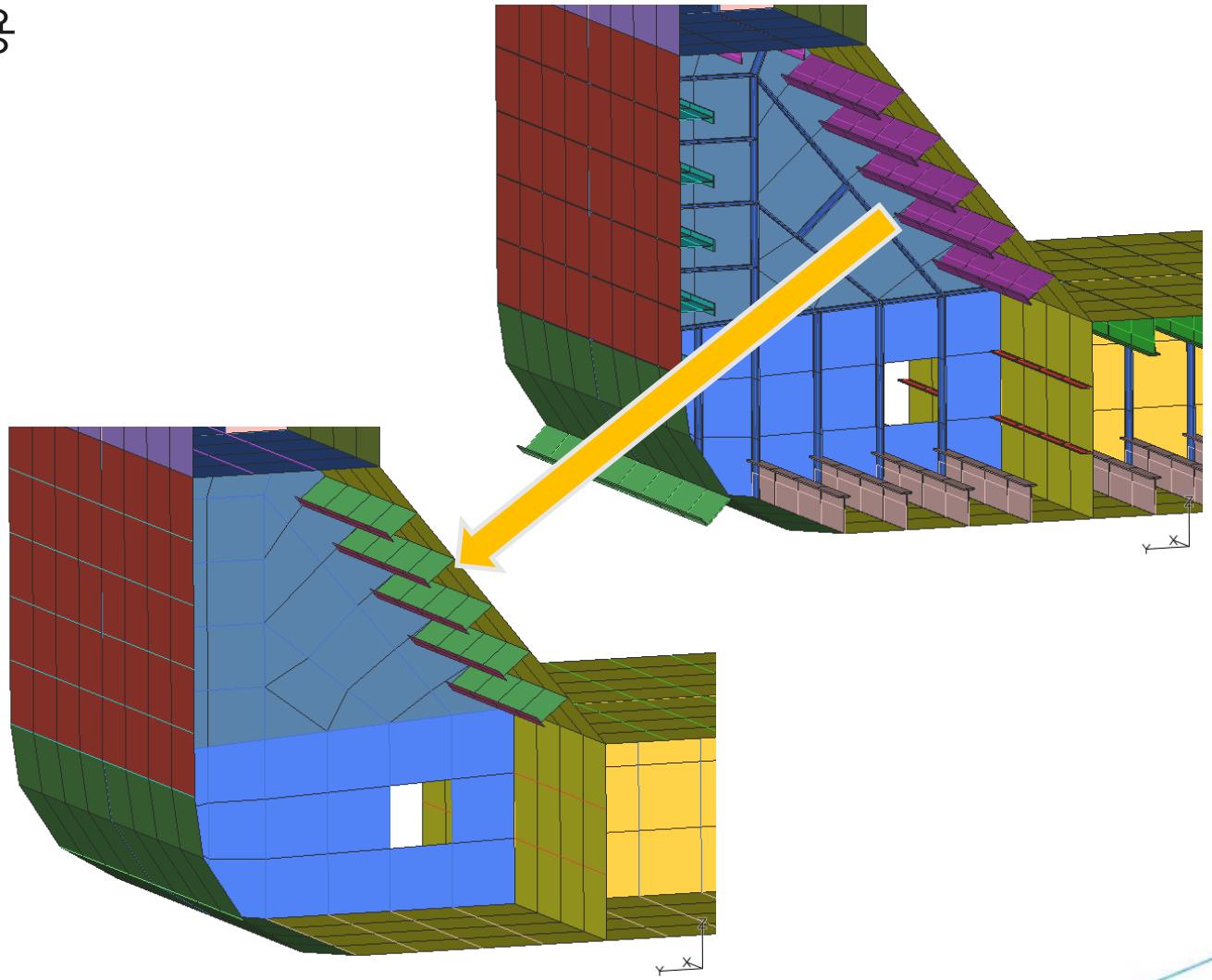




BEAM TO SHELL (BTOS)

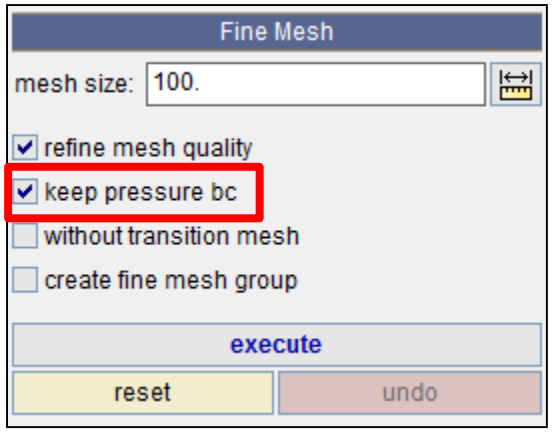
- 1D – 2D 요소 변경
- Property 자동 적용

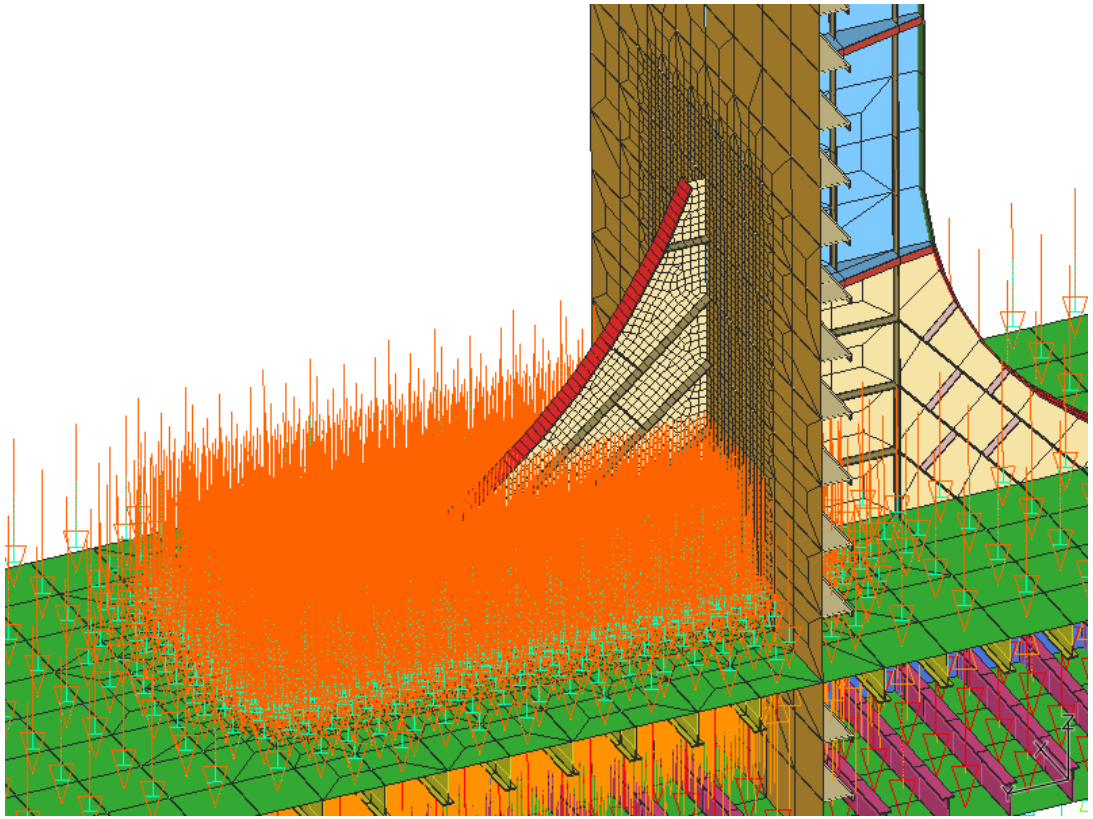




FINE MESH (FINE)

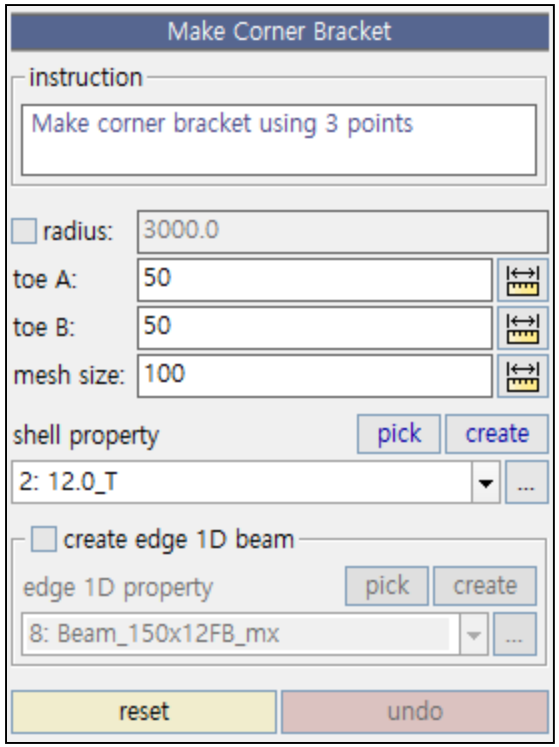
- 사용자 정의 Size로 분할
- Mesh quality 향상

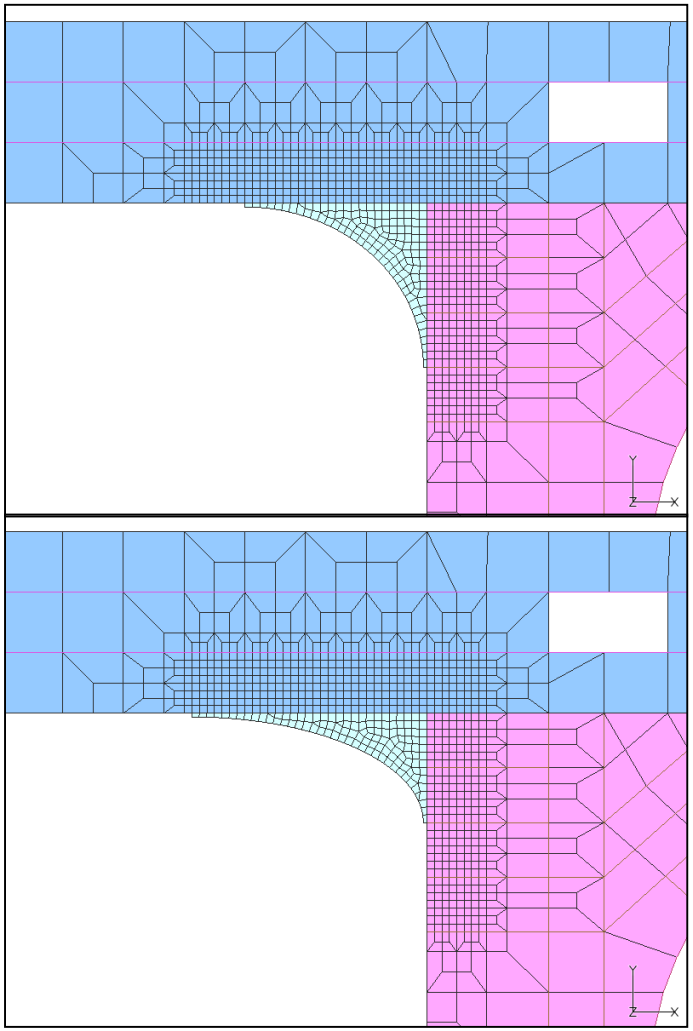




MAKE CORNER BRACKET (COBR)

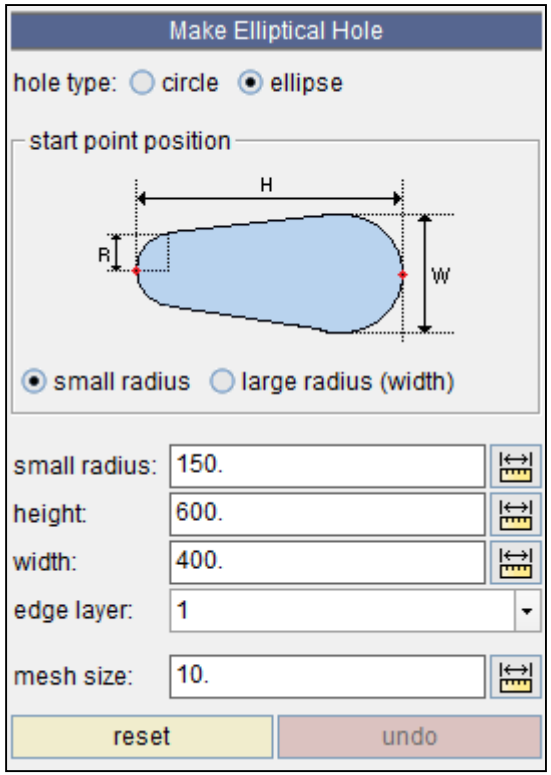
- 3point로 Corner bracket 생성 가능

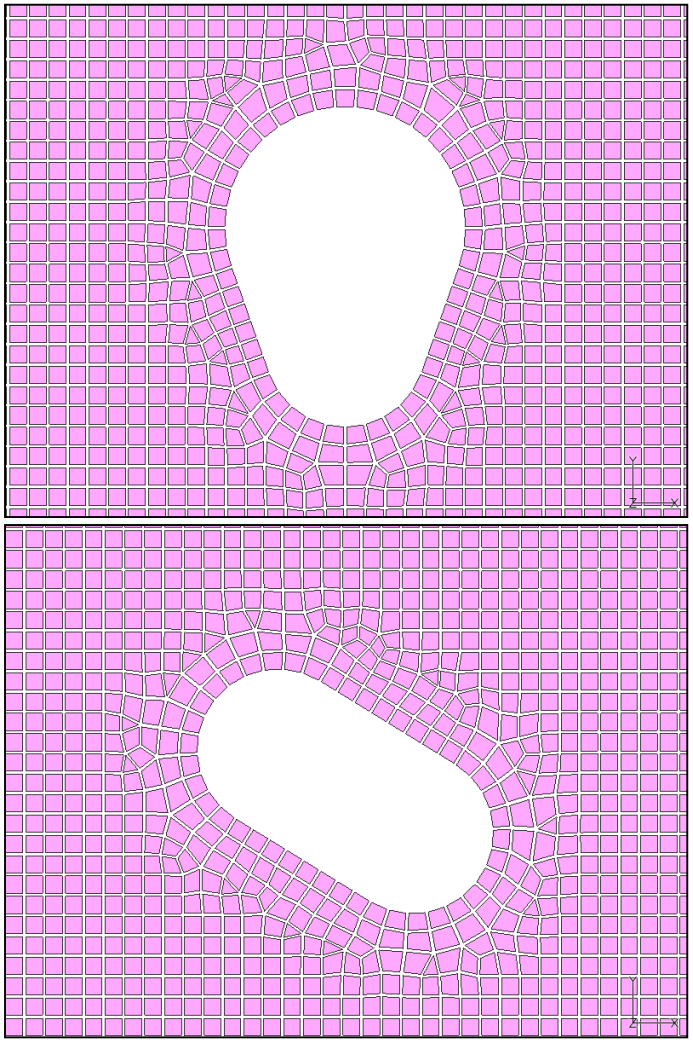




MAKE ELLIPTICAL HOLE (EHOLE)

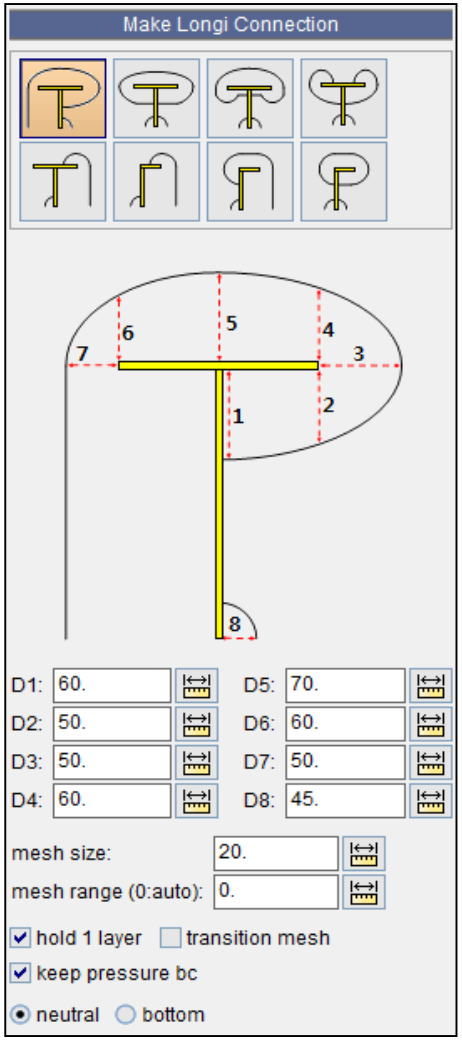
- 3point로 Elliptical hole, circle 생성 가능

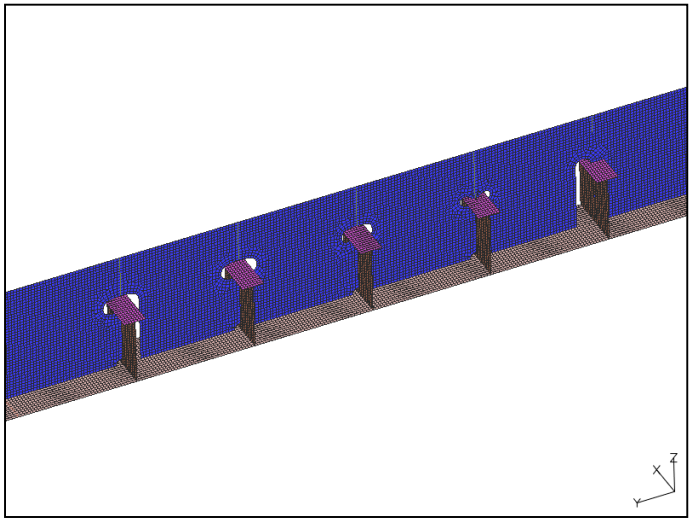


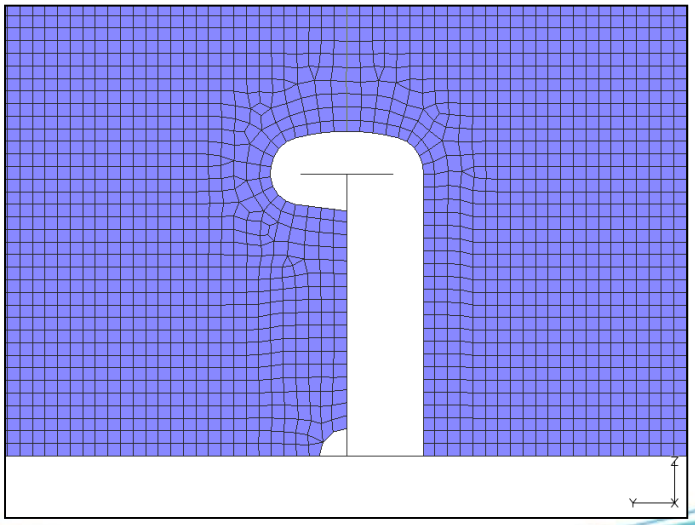


MAKE LONGI CONNECTION (LONGI)

- Longi connection 자동화 기능
- 기존 6~8시간 소요 시간을 획기적으로 감소



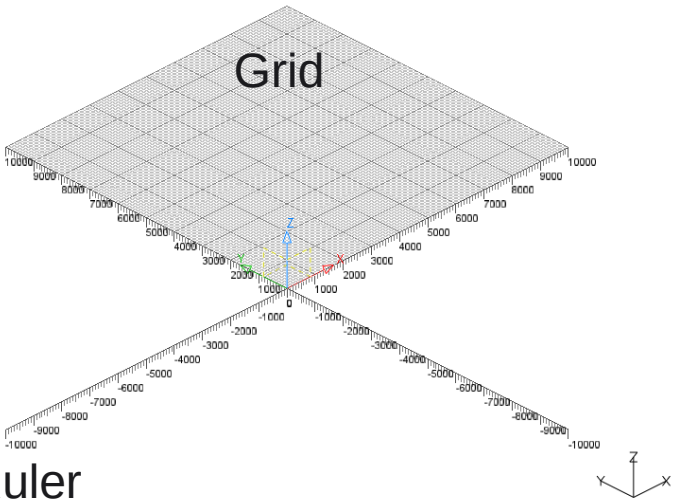




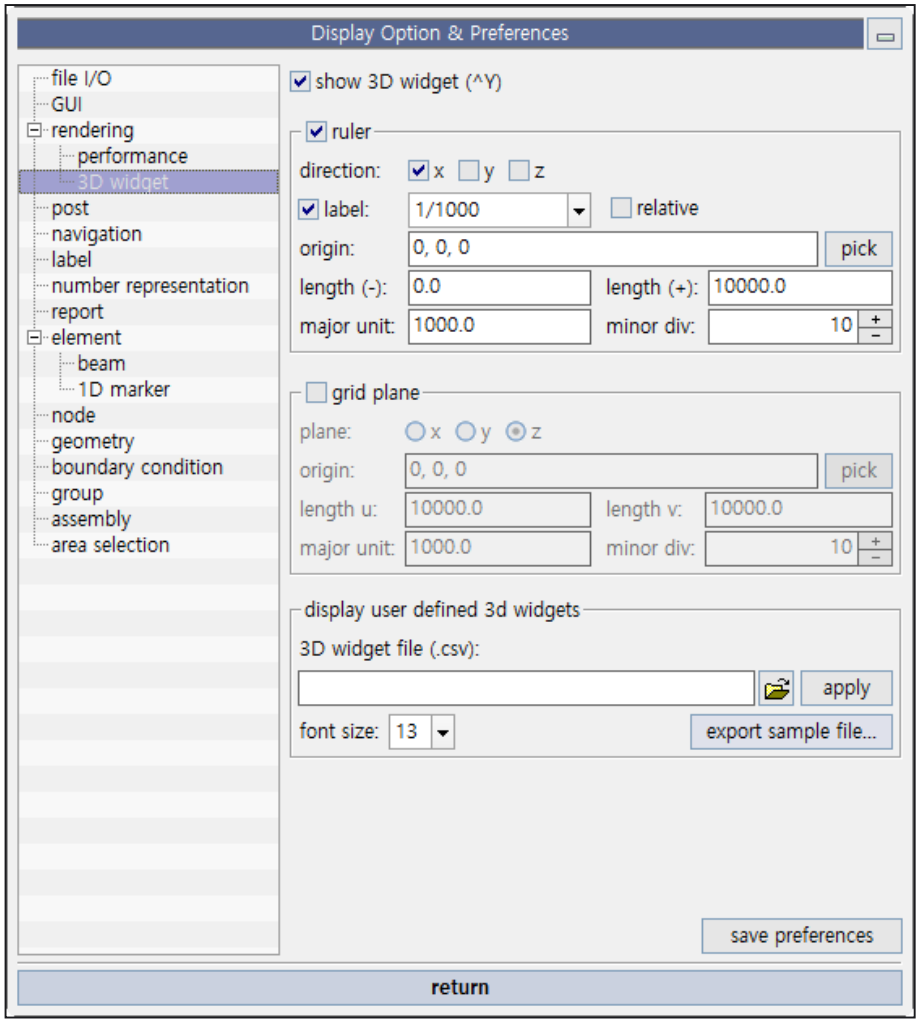
FUNCTIONS

3D WIDGET (^Y)

- 가상의 point로 사용 가능한 Grid, Ruler widget

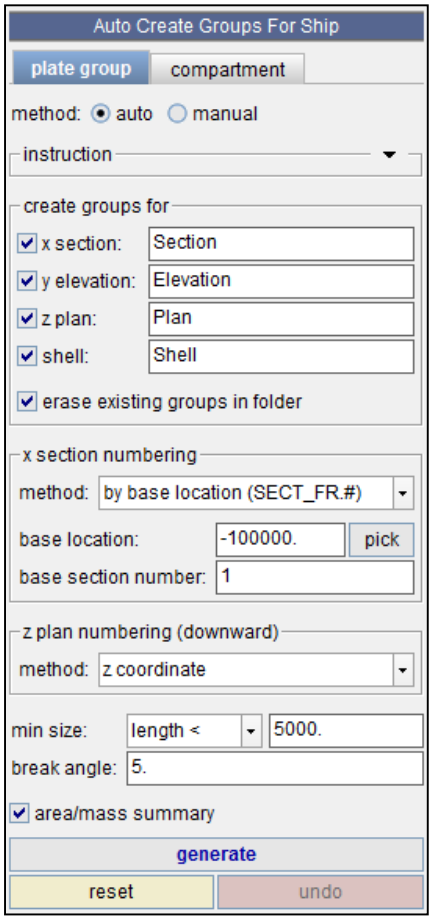


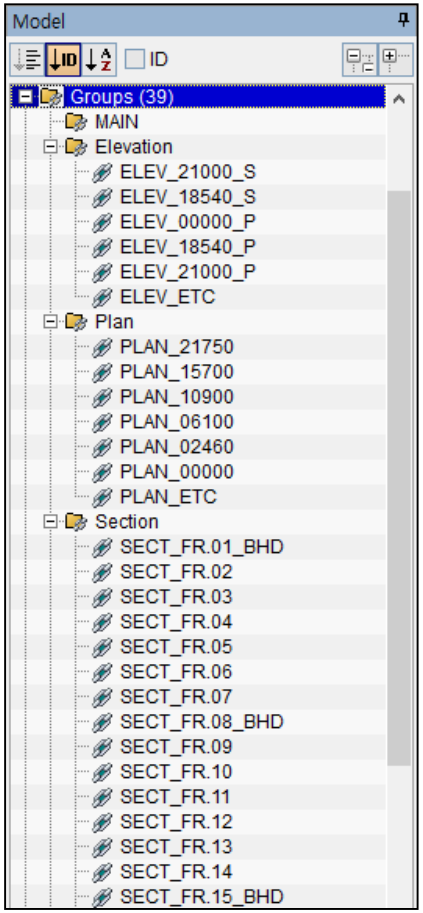
Ruler

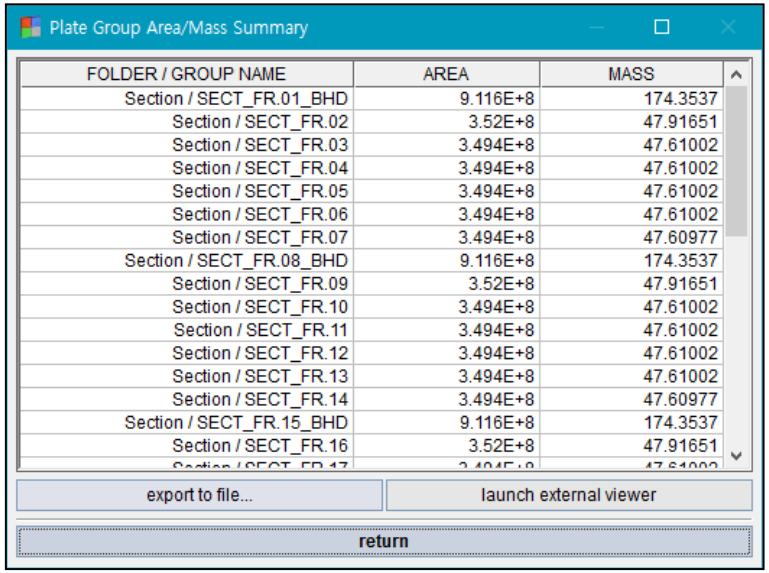


AUTO CREATE PLATE GROUP (AUTOG)

- 각각의 Plane을 찾아 자동 Grouping
- Section number, BHD 구분 및 자동 작성
- 폴더 분류 및 Summary report 출력



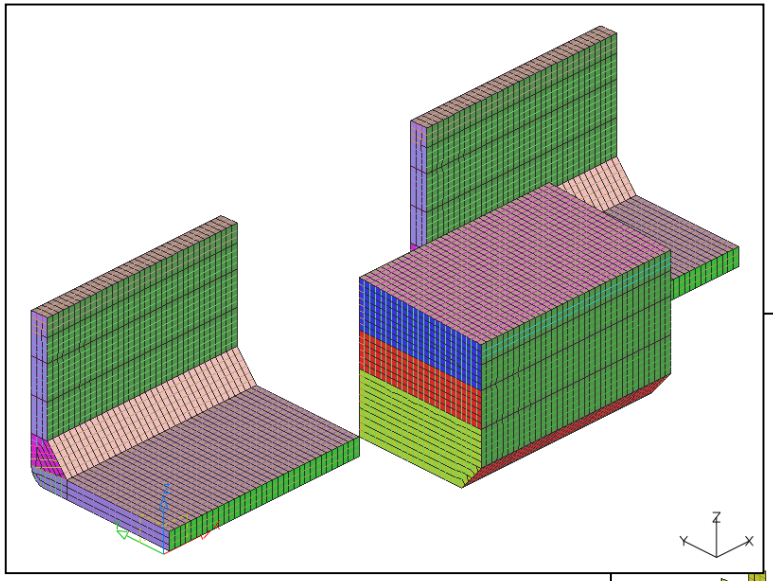




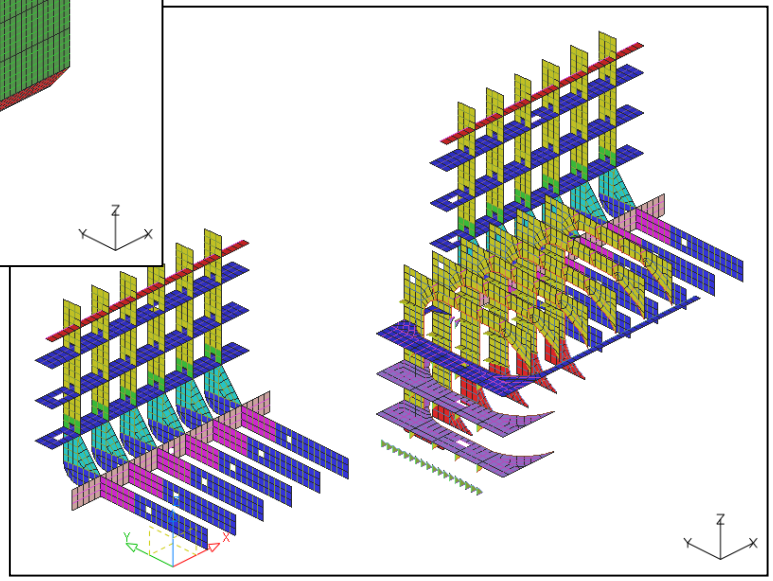
FOLDER / GROUP NAME	AREA	MASS
Section / SECT_FR.01_BHD	9.116E+8	174.3537
Section / SECT_FR.02	3.52E+8	47.91651
Section / SECT_FR.03	3.494E+8	47.61002
Section / SECT_FR.04	3.494E+8	47.61002
Section / SECT_FR.05	3.494E+8	47.61002
Section / SECT_FR.06	3.494E+8	47.61002
Section / SECT_FR.07	3.494E+8	47.60977
Section / SECT_FR.08_BHD	9.116E+8	174.3537
Section / SECT_FR.09	3.52E+8	47.91651
Section / SECT_FR.10	3.494E+8	47.61002
Section / SECT_FR.11	3.494E+8	47.61002
Section / SECT_FR.12	3.494E+8	47.61002
Section / SECT_FR.13	3.494E+8	47.61002
Section / SECT_FR.14	3.494E+8	47.60977
Section / SECT_FR.15_BHD	9.116E+8	174.3537
Section / SECT_FR.16	3.52E+8	47.91651

AUTO CREATE PLATE GROUP (AUTOG)

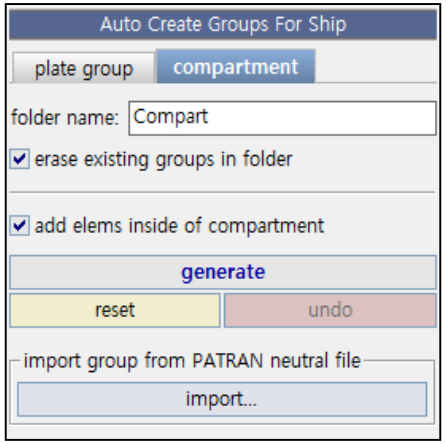
- Compartment 자동 Grouping
- 주부재는 shell 요소만 작성되며, Inner부재는 INR Group으로 따로 작성

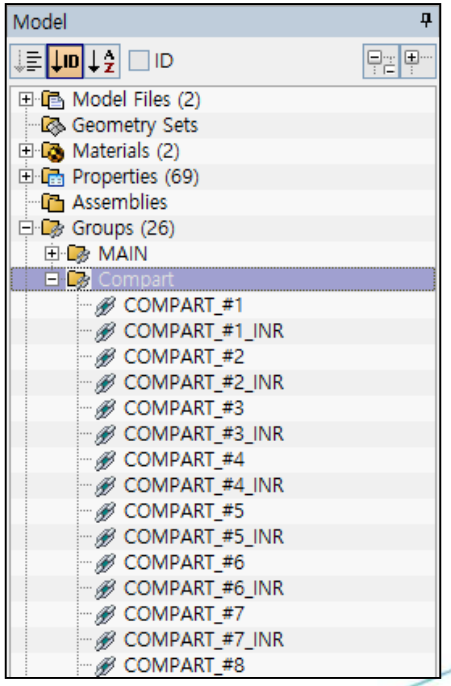


COMPART_#no



COMPART_#no_INR





BEAM OFFSET (BOFF)

- Offset, Orientation 자동화

BOFF

Beam Offset

○ modify offset ◉ attach to face

notification:

Option for attaching beam's top/bottom end to shell face works only for the beam elements defined by beam library, otherwise use 'more offset' to add offset.

method:

◉ align vector & add offset
○ align vector
○ add offset

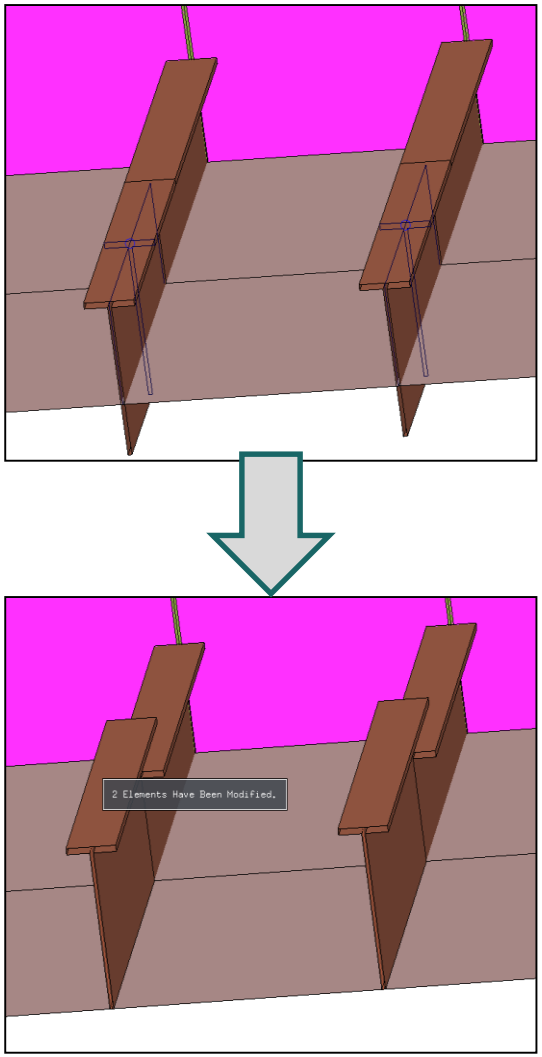
direction: ○ (+) normal ◉ (-) normal
align axis: ◉ y vector ○ z vector
attach to: ◉ bottom ○ top
more offset: 0.

☐ select seed shell to guide beam vector
☑ attach to displayed shell only
☑ treat 'L' beam in reversed manner

undo

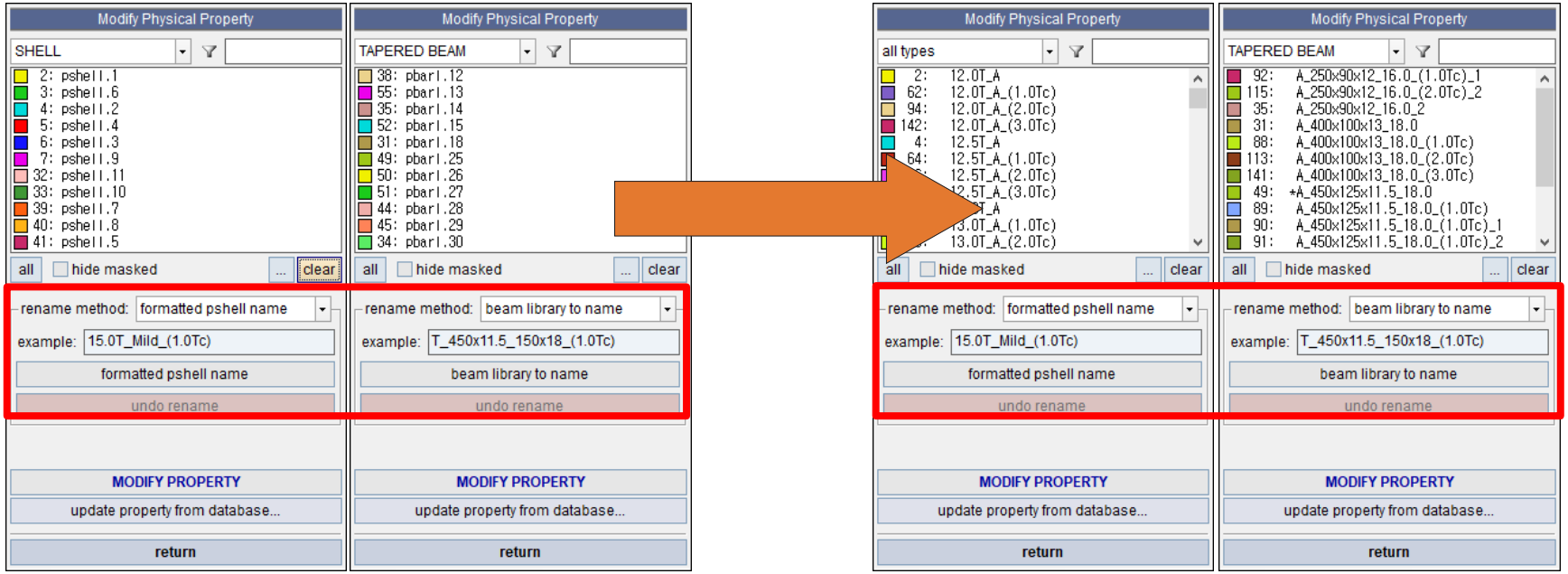
find unattached beams

☐ display beam system



MODIFY PROPERTY NAME (PMOD, VE)

- Dimension을 이용하여 Property name 변경 가능



PROPERTY DATABASE (PDB)

- Bulb flats property는 아래 수식을 이용하여 L-type으로 제공

1.4.1 Stiffener profile with a bulb section

The properties of bulb profile sections are to be determined by direct calculations.

Where direct calculation of properties is not possible, a bulb section may be taken equivalent to a built-up section. The net dimensions of the equivalent built-up section are to be obtained, in mm, from the following formulae.

$$h_w = h'_w - \frac{h'_w}{9.2} + 2$$

$$b_f = \alpha\left(t'_w + \frac{h'_w}{6.7} - 2\right)$$

$$t_f = \frac{h'_w}{9.2} - 2$$

$$t_w = t'_w$$

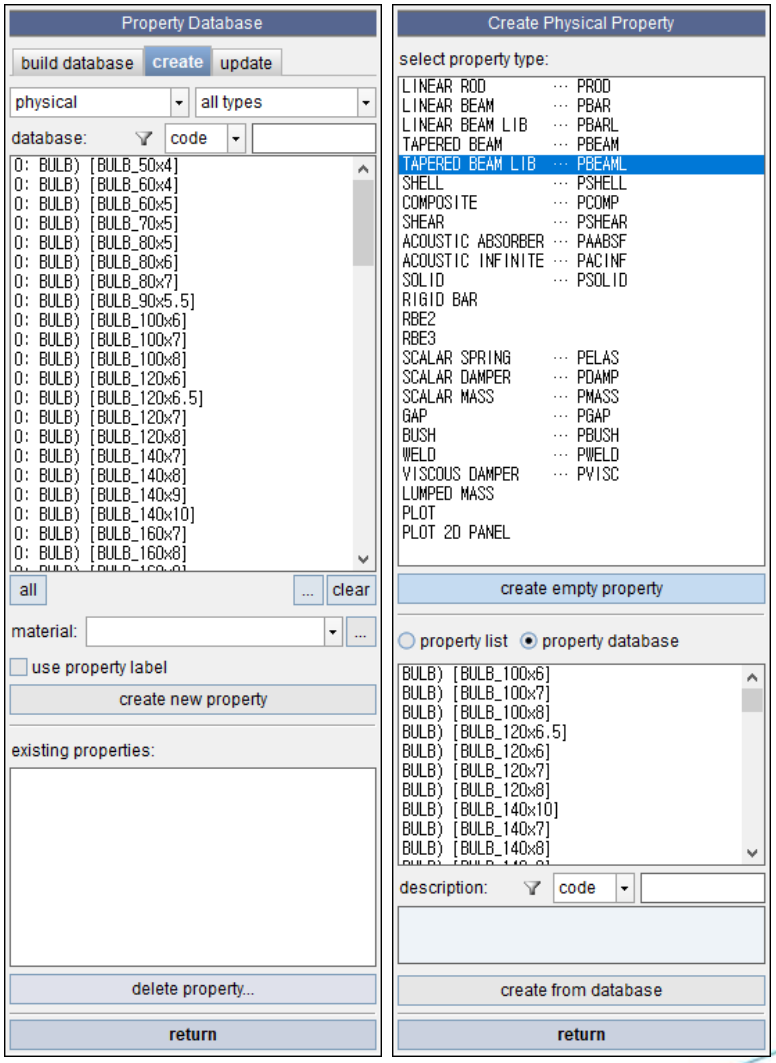
where:

h'_w, t'_w : Net height and thickness of a bulb section, in mm, as shown in Figure 13.

α : Coefficient equal to:

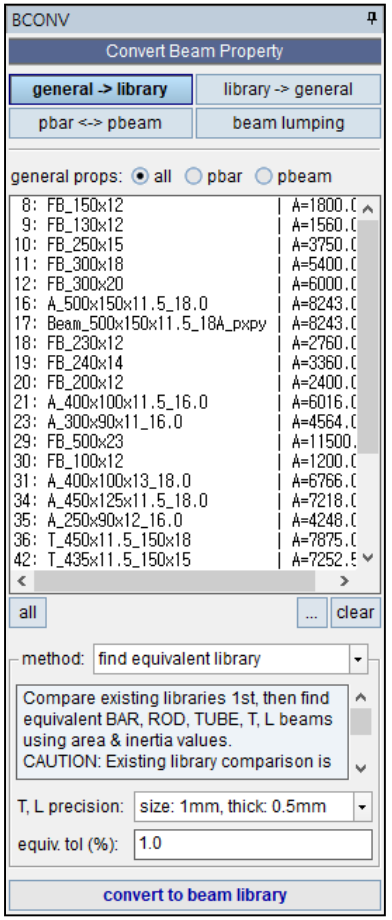
$$\alpha = 1.1 + \frac{(120 - h'_w)^2}{3000} \quad \text{for } h'_w \le 120$$

$$\alpha = 1.0 \quad \text{for } h'_w > 120$$



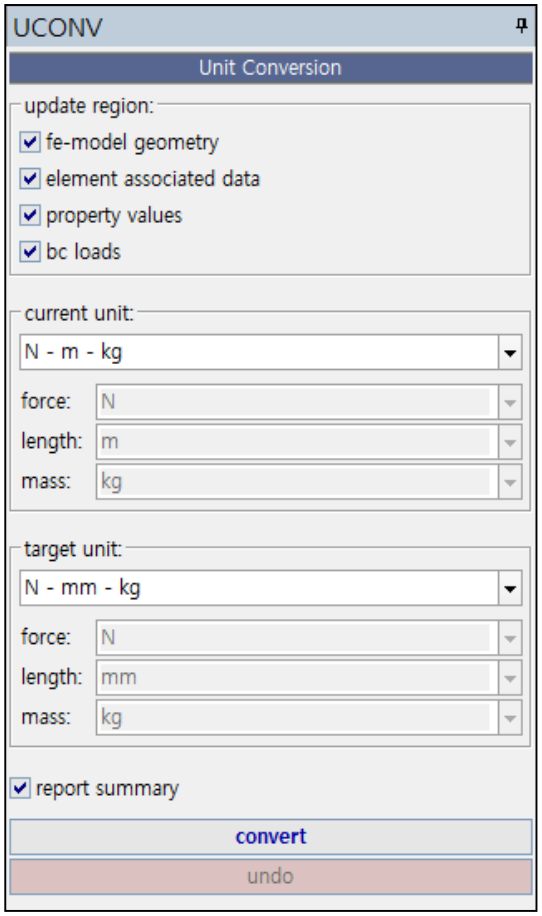
CONVERT BEAM PROPERTY (BCONV)

- Instruction: 기존에 존재하는 property를 먼저 비교 함
  (기존에 사용하는 Property를 PDB에 저장 후 general ←→ library convert 전에
  전체 생성한 후 수행 – 변환 속도 매우 빠름)
- Property가 존재하지 않을 경우 내부적으로 계산하여 library 생성
  (Property가 있는 경우 대비하여 상대적으로 매우 느림)
- 해당 기능의 장점은 Corrosion을 적용한 경우에도 옵션을 0.1~0.05로 설정 시 변환이 가능함. 하지만 변환 시간은 오래 걸림
- Equiv. tol의 경우 2~3% 정도로 수행 시 가장 근사한 값을 찾을 수 있음.
  하지만 가급적 변경하지 않는 것을 추천.
  (%는 dimension 크기에 대한 % 값이며, 초기 1% 값은 1%이하의 크기 차이일 때 변경하는 것을 의미)
- 1mm → 0.5mm → 0.1mm → 0.05mm 네 단계로 검색이 가능함.
  하지만 길이가 작아질수록 많은 시간이 소요될 수 있음
  (ex. 0.05mm 옵션 사용 시 340.75와 같은 값을 찾는 것이 가능하다 한 property를 찾는 데 30초 이상 소요)



UNIT CONVERSION (UCONV)

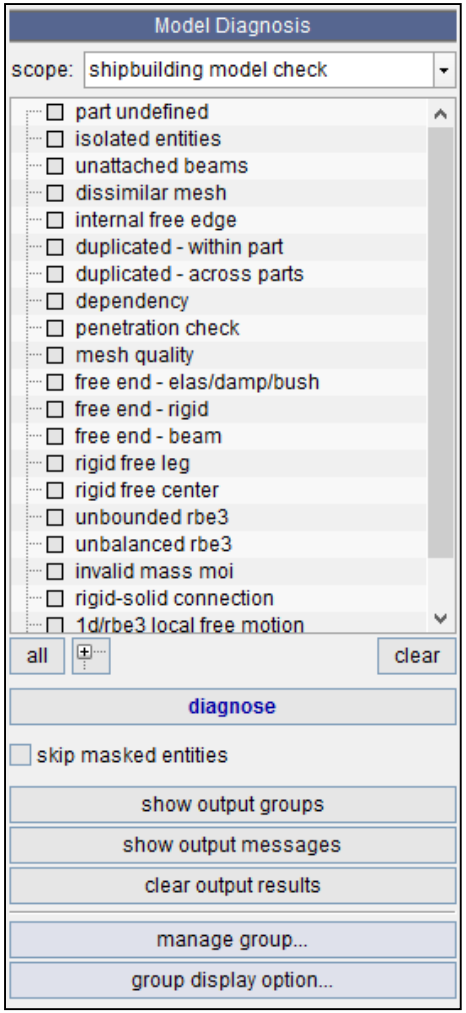
- 완벽한 단위변환

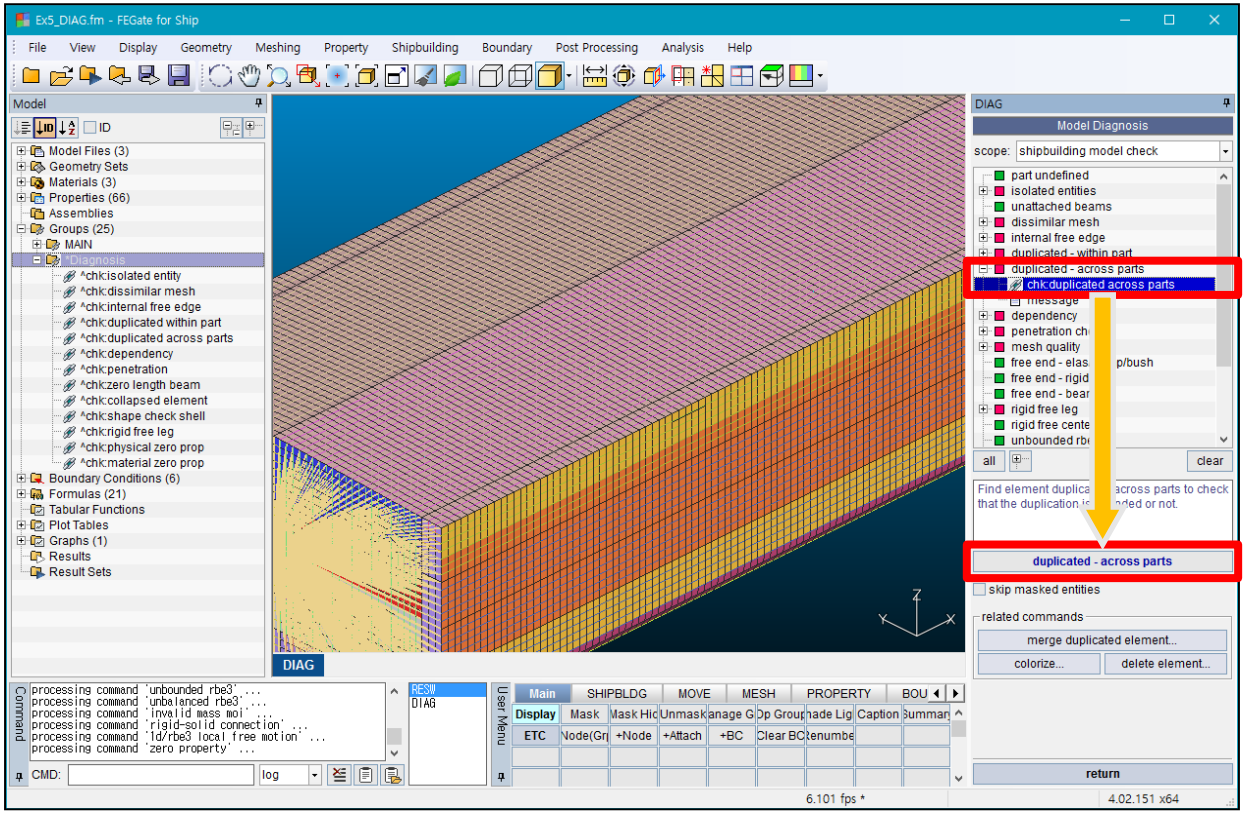



```
< UNIT SYSTEM CONVERSION SUMMARY >

UNIT SYSTEM (BEFORE) : N - mm - kg
UNIT SYSTEM (AFTER)  : N - m - kg

* CONVERSION FACTORS
  FORCE:          1
  LENGTH:         0.001
  VELOCITY:       0.001
  ACCELERATION:   0.001
  MASS:           1
  AREA:           1E-06
  VOLUME:         1E-09
  MOMENT:         0.001
  PRESS/STRESS:   1000000
  MODULUS:        1000000
  MASS DENSITY:   1E+09
  NSM/LENGTH:     1000
  NSM/AREA:       1000000
  AREA MOI:       1E-12
  MASS MOI:       1E-06
  TRANS. K/B:     1000
  ROTAT. K/B:     0.001

* GEOMERTY CONVERSION
    46161 NODE COORDINATES HAVE BEEN SCALED BY 0.001

* ELEMENT ASSOCIATED VALUE CONVERSION

* ELEMENT ASSOCIATED VALUE CONVERSION
    91216 BEAM OFFSET VALUES * 0.001


* MATERIAL PROPERTY VALUE CONVERSION
  MAT       1 - YOUNG'S MODULUS          : 206000.0 ---> 2.06E+11
                MASS DENSITY             :   7.8E-9 --->      7.8
  MAT       2 - YOUNG'S MODULUS          : 206000.0 ---> 2.06E+11
                MASS DENSITY             :   7.8E-9 --->      7.8
```

MODEL DIAGNOSIS (DIAG)

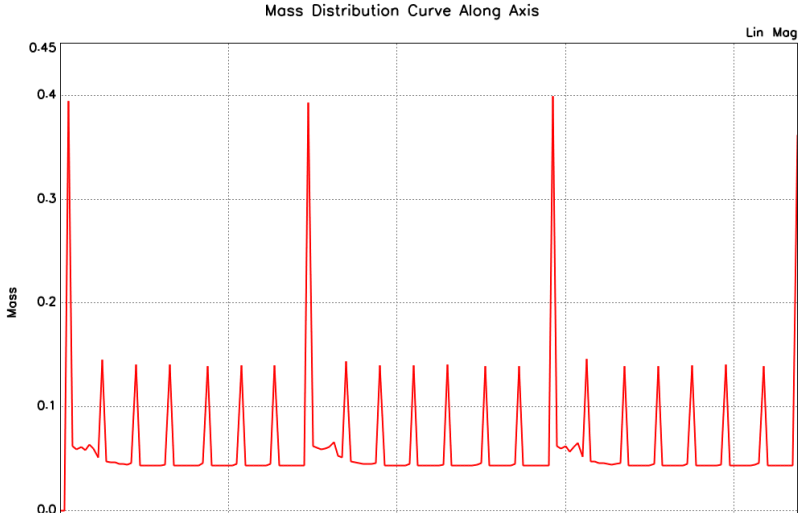
- 강력한 모델 체크 기능 (37개 항목)
- 해당 에러에 대한 수정기능 연동

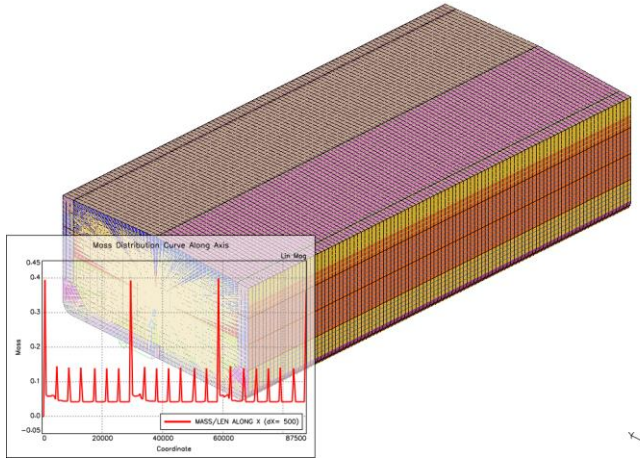


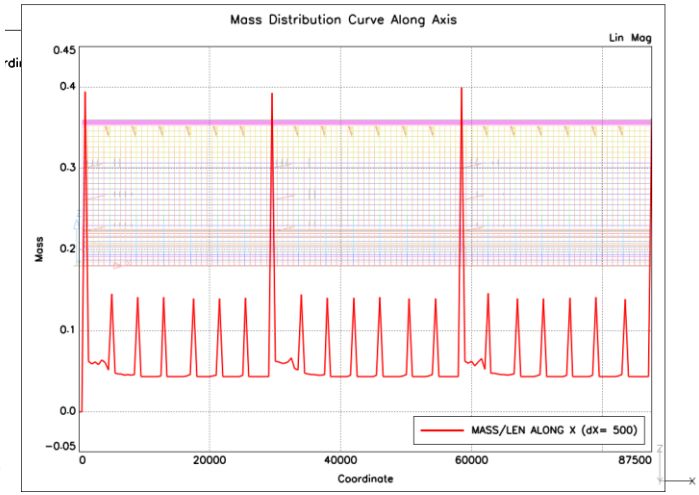


MASS GRAPH (SOLID)

- Mass 분포도 그래프로 작성

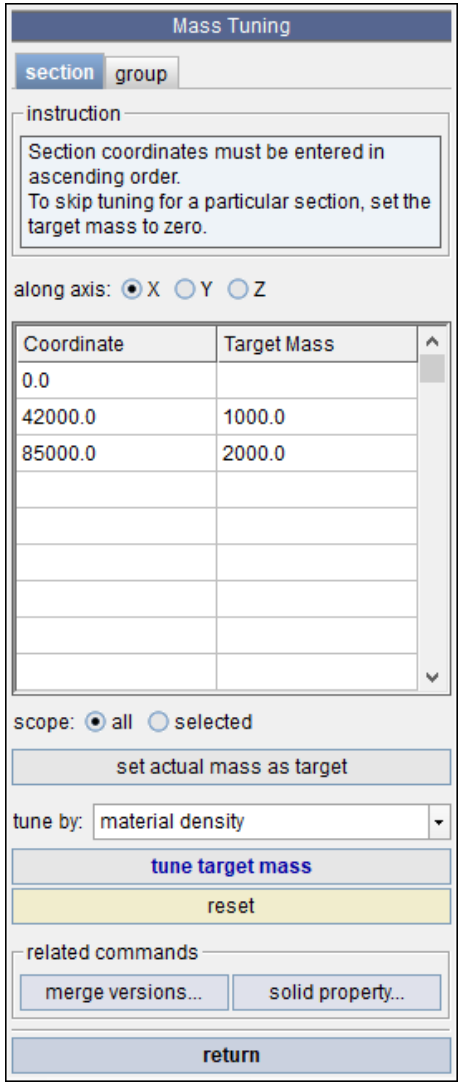


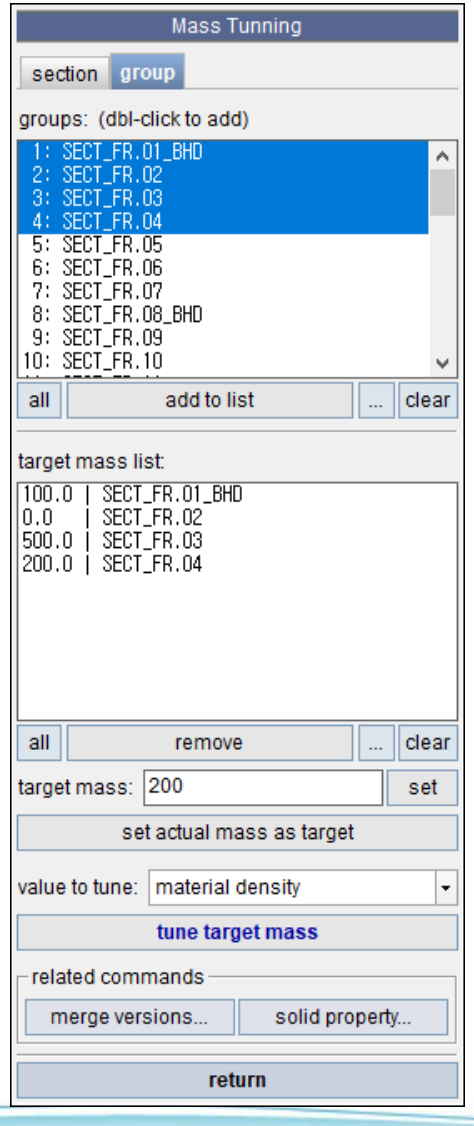


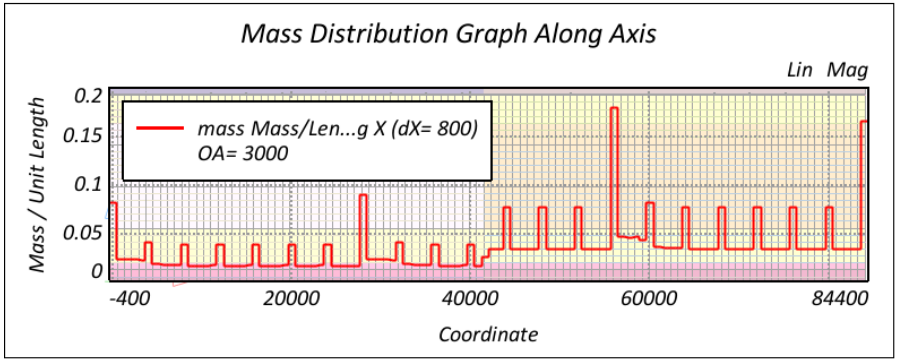


MASS TUNING (MTUNE)

- Section 또는 Group을 이용한 Mass tuning

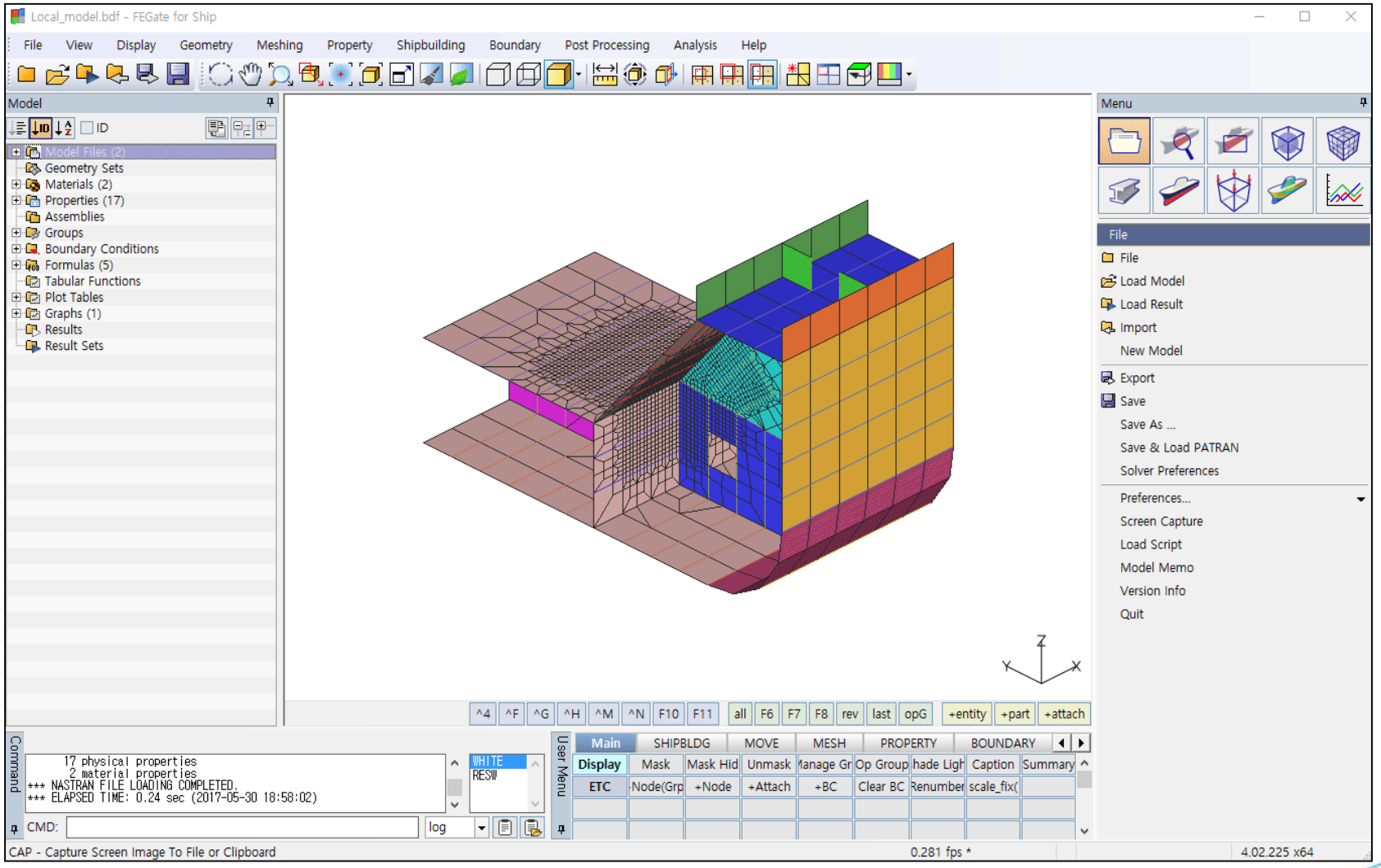






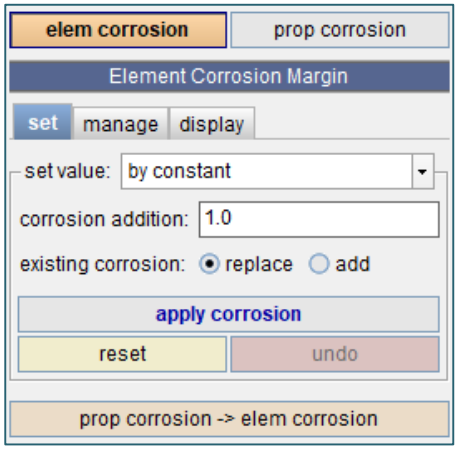
SUB-MODELING (SUBM)

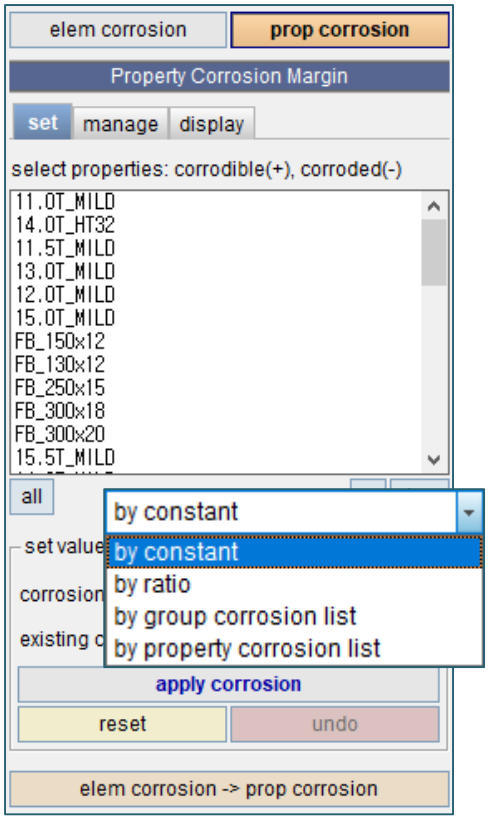
- Sub-modeling 자동화 (gif 참조)



CORROSION MARGIN (CORR)

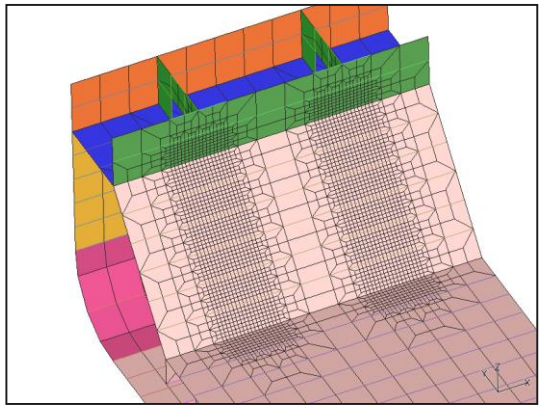
- 부식 여유치 적용 기능 (gif 참조)

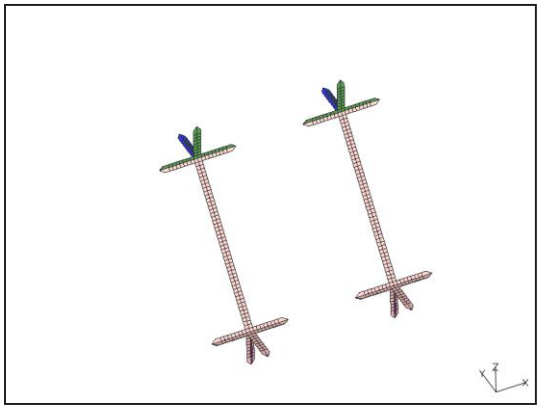


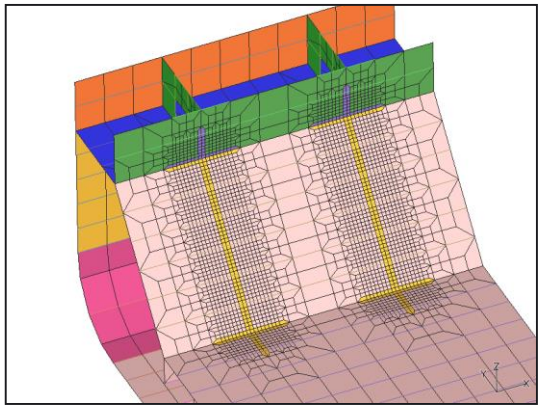


WELDING JOINT PROPERTY (WJOIN)

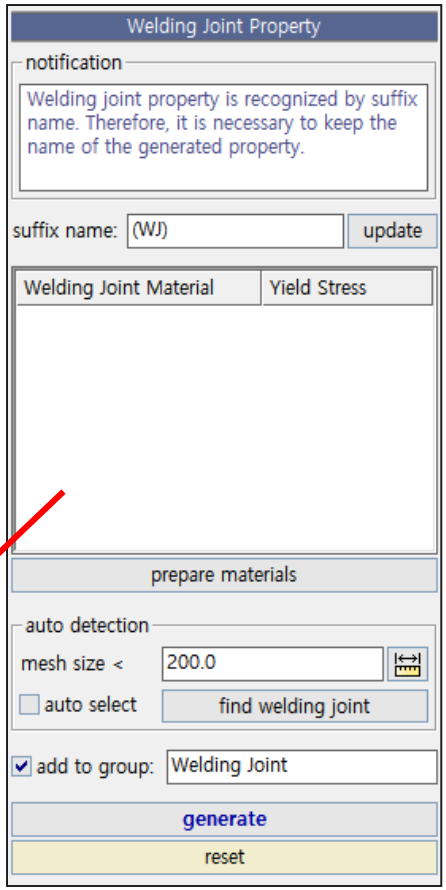
- Welding Joint를 구분함과 동시에 별도의 Yield stress를 적용
- 사용자 지정 Mesh size 범위 내에 T-Connection을 자동으로 검색하고 material을 분리, 별도의 Yield stress를 지정하여 Welding Joint에 대한 평가에 편의를 제공





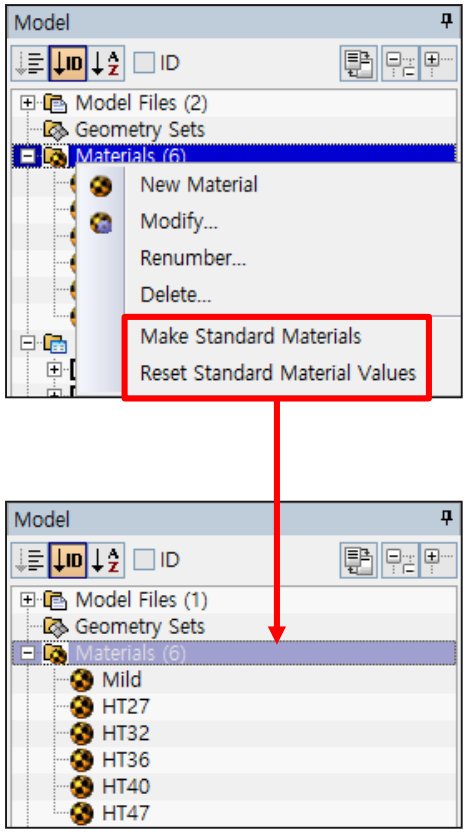


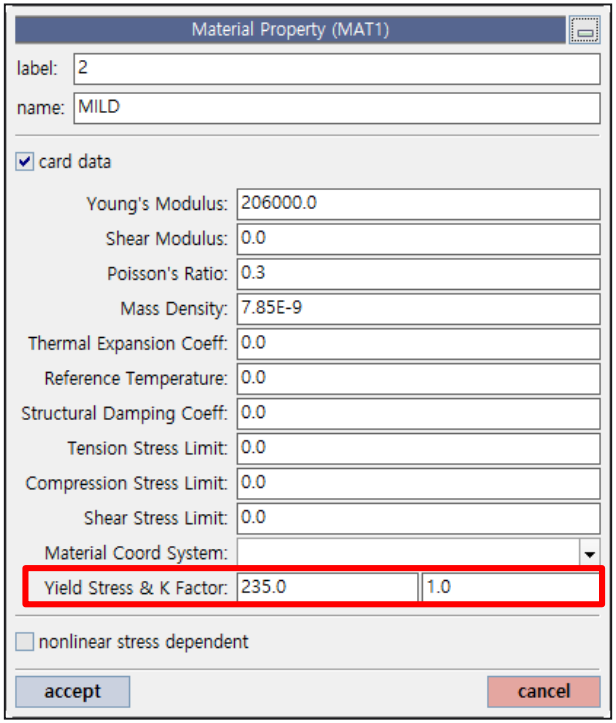
Welding Joint Material	Yield Stress
Mild (WJ)	235
HT32 (WJ)	315



CREATE MATERIAL PROPERTY

- Default property 자동 생성
- Yield stress & K Factor는 Post에서 사용

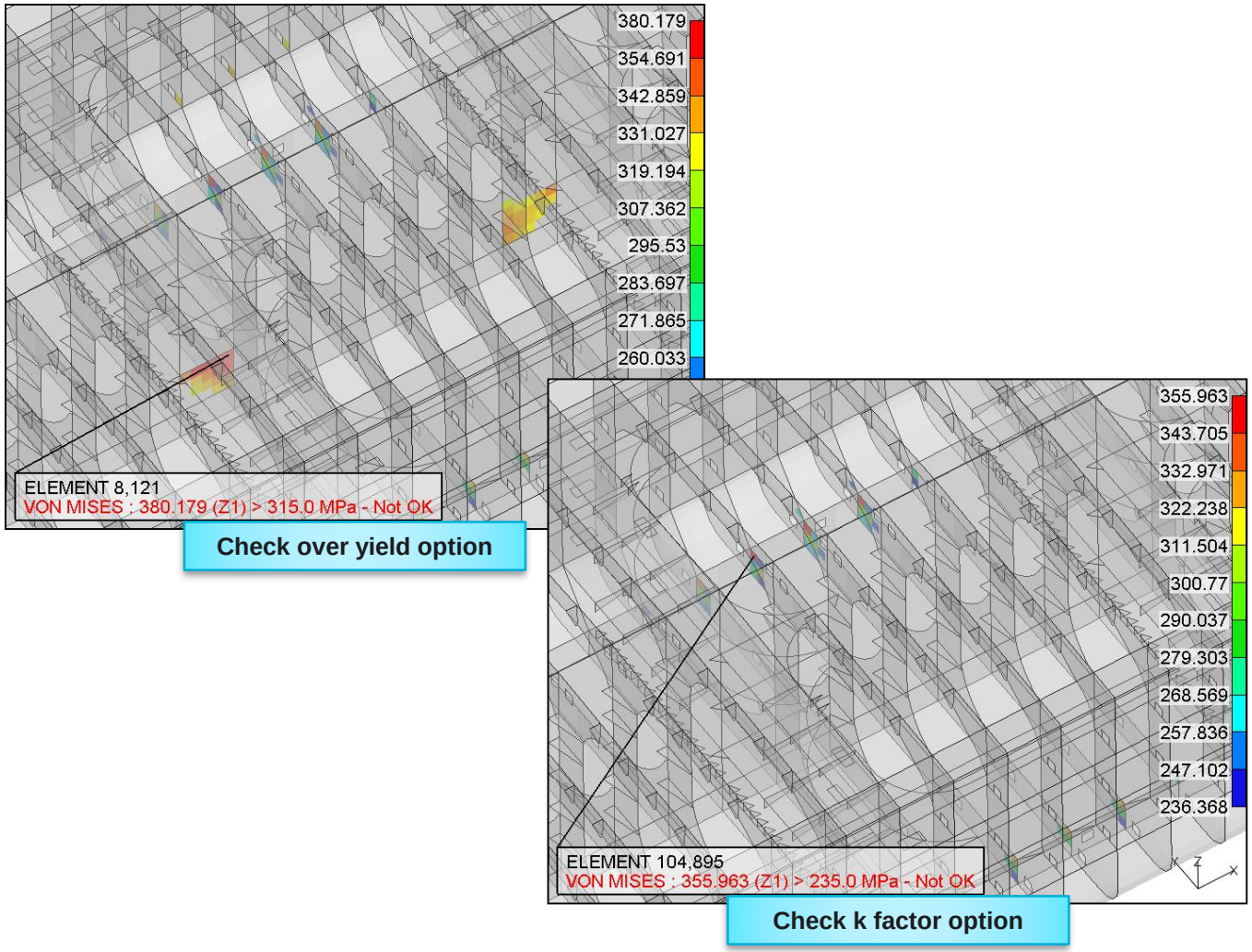


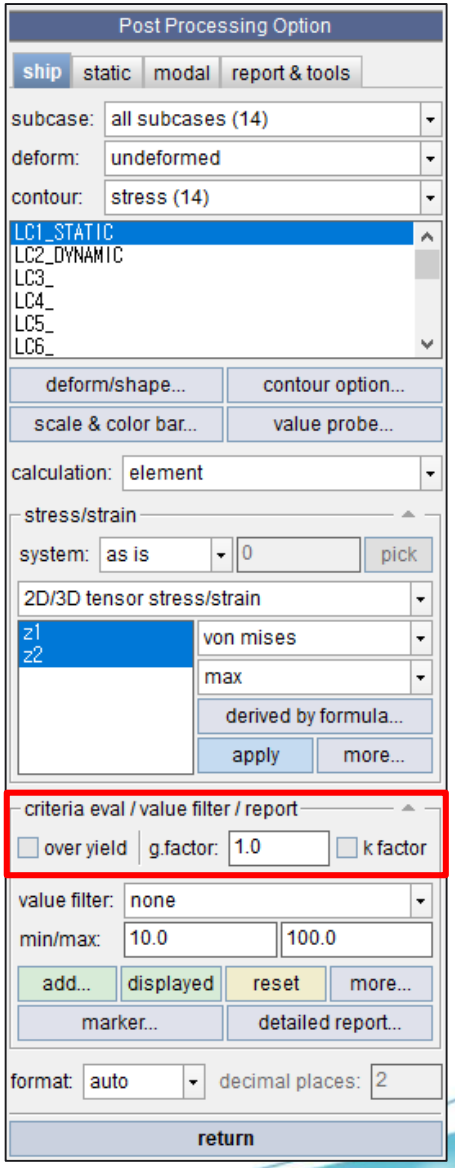


Material Name	Specified minimum yield stress in N/mm^2	K factor
MILD	235	1.0
HT27	265	0.92
HT32	315	0.78
HT36	355	0.72
HT40	390	0.68
HT47	460	0.62

CREATE MATERIAL PROPERTY

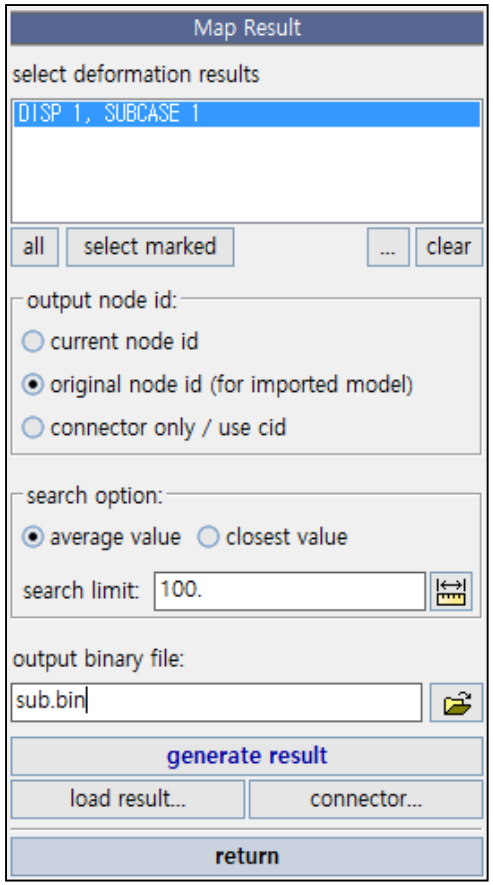
- Yield stress & K Factor는 Post에서 사용 예

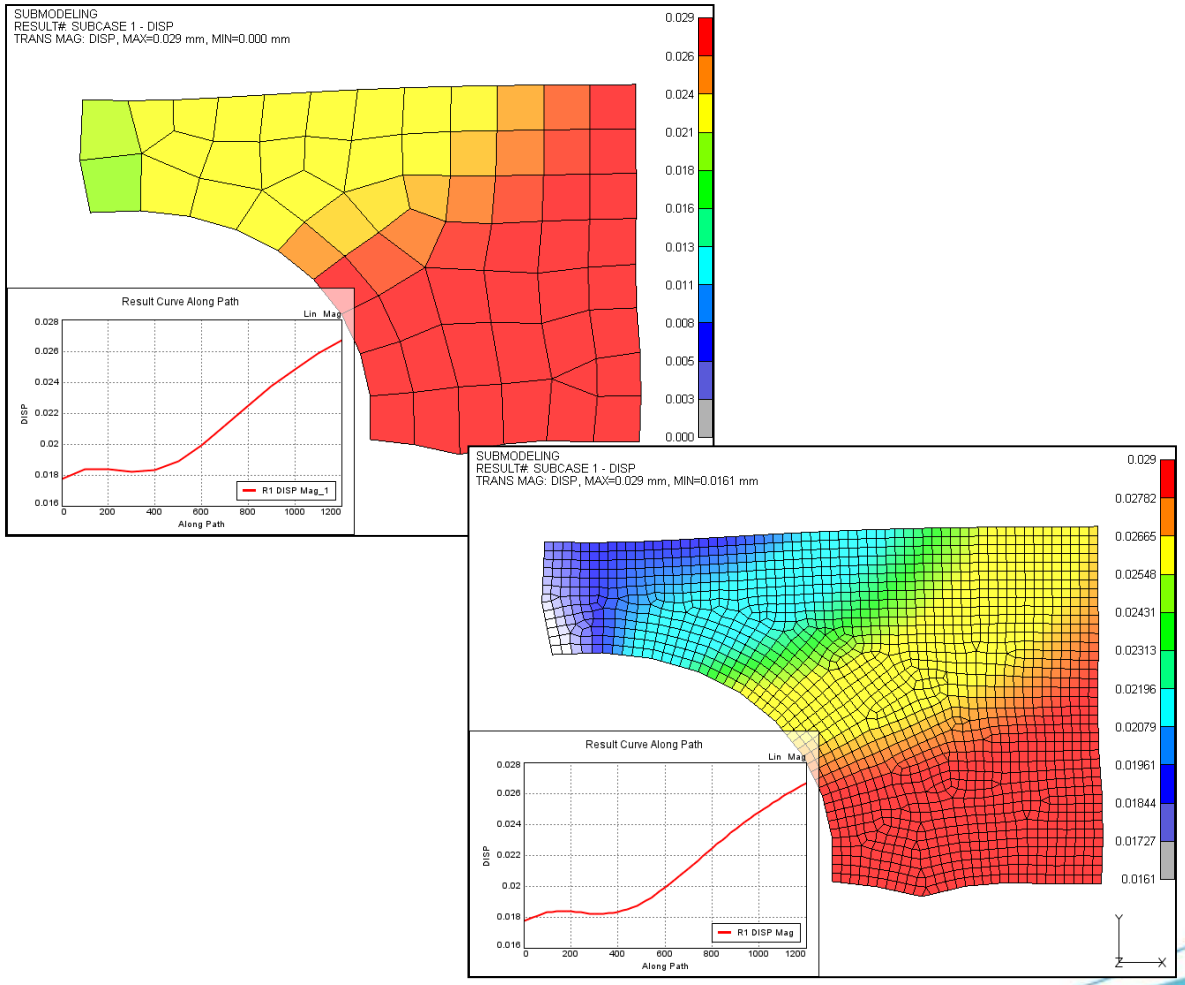




MAP RESULT (MAPR)

- Global model의 결과를 Submodel로 Mapping 가능
- 모든 Result case(disp)에 대해 일괄 생성 가능





SCRIPT를 이용한 하중 생성

SCRIPT를 이용한 하중 생성

Excel

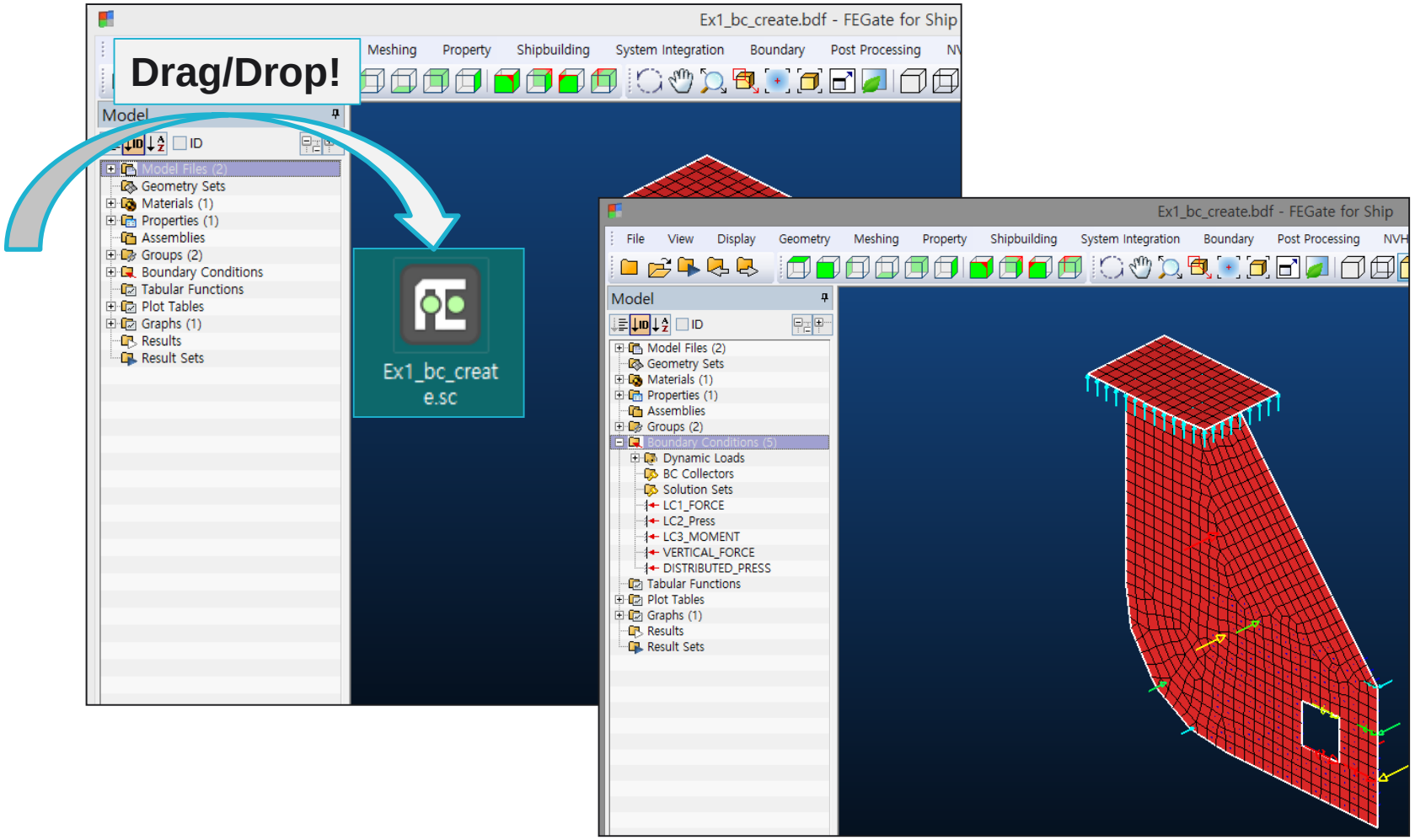
	1	2	3	4	5
1	LC Name	Entity ID	X	Y	Z
2	LC1_FORCE	10001	-100	0	0
3	LC1_FORCE	10002	-200	0	0
4	LC1_FORCE	10003	-300	0	0
5	LC1_FORCE	10004	-400	0	0
6	LC1_FORCE	10005	-500	0	0
7	LC1_FORCE	10006	-600	0	0
8	LC1_FORCE	10007	-700	0	0
9					
10	LC Name	Entity ID	Shell	Value	
11	LC2_Press	10001	1	100	
12	LC2_Press	10002	1	200	
13	LC2_Press	10003	1	300	
14	LC2_Press	10004	1	400	
15	LC2_Press	10005	1	500	
16	LC2_Press	10006	1	600	
17	LC2_Press	10007	1	700	
18					
19	LC Name	Entity ID	X	Y	Z
20	LC3_MOMENT	10001	0	-100	0
21	LC3_MOMENT	10002	0	-200	0
22	LC3_MOMENT	10003	0	-300	0
23	LC3_MOMENT	10004	0	-400	0
24	LC3_MOMENT	10005	0	-500	0

Ctrl + C
Ctrl + V

.sc (Text file)

```
1  *LOG
2
3  *FORCE( FORMAT=(CSV,5), LIST=(
4  LC1_FORCE,10001,-100,0,0
5  LC1_FORCE,10002,-200,0,0
6  LC1_FORCE,10003,-300,0,0
7  LC1_FORCE,10004,-400,0,0
8  LC1_FORCE,10005,-500,0,0
9  ))
10
11 *PRESS( FORMAT=(TAB,4), LIST=(
12 LC2_Press 10001 1 100
13 LC2_Press 10002 1 200
14 LC2_Press 10003 1 300
15 LC2_Press 10004 1 400
16 LC2_Press 10005 1 500
17 ))
18
19 *MOMENT( FORMAT=(TAB,5), LIST=(
20 LC3_MOMENT 10001 0 -100 0
21 LC3_MOMENT 10002 0 -200 0
22 LC3_MOMENT 10003 0 -300 0
23 LC3_MOMENT 10004 0 -400 0
24 LC3_MOMENT 10005 0 -400 0
25 ))
```

SCRIPT를 이용한 하중 생성



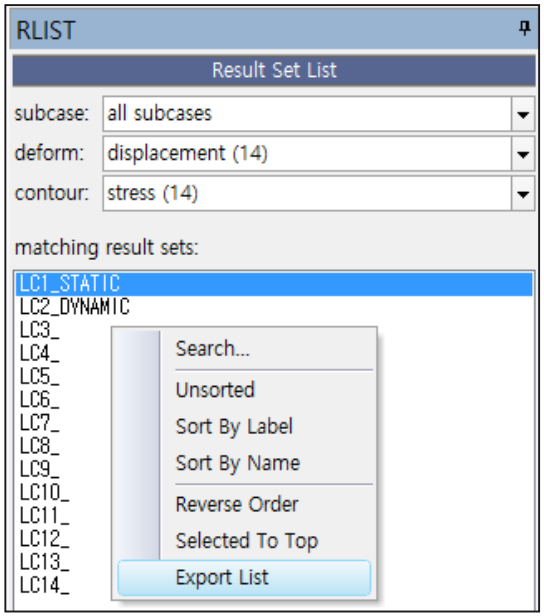
SCRIPT를 이용한 RESULT COMBINE

SCRIPT를 이용한 RESULT COMBINE

CSV

	1	2	3
1	Subcase	Subcase	New Name
2	LC1_Static	LC2_Dynamic	LC1+LC2
3	LC2_	LC3_	LC2+LC3
4	LC4_	LC5_	LC4+LC5
5	LC6_	LC7_	LC6+LC7
6	LC8_	LC9_	LC8+LC9
7	LC10_	LC11_	LC10+LC11
8	LC12_	LC13_	LC12+LC13
9	LC14_	LC1_Static	LC1+LC14

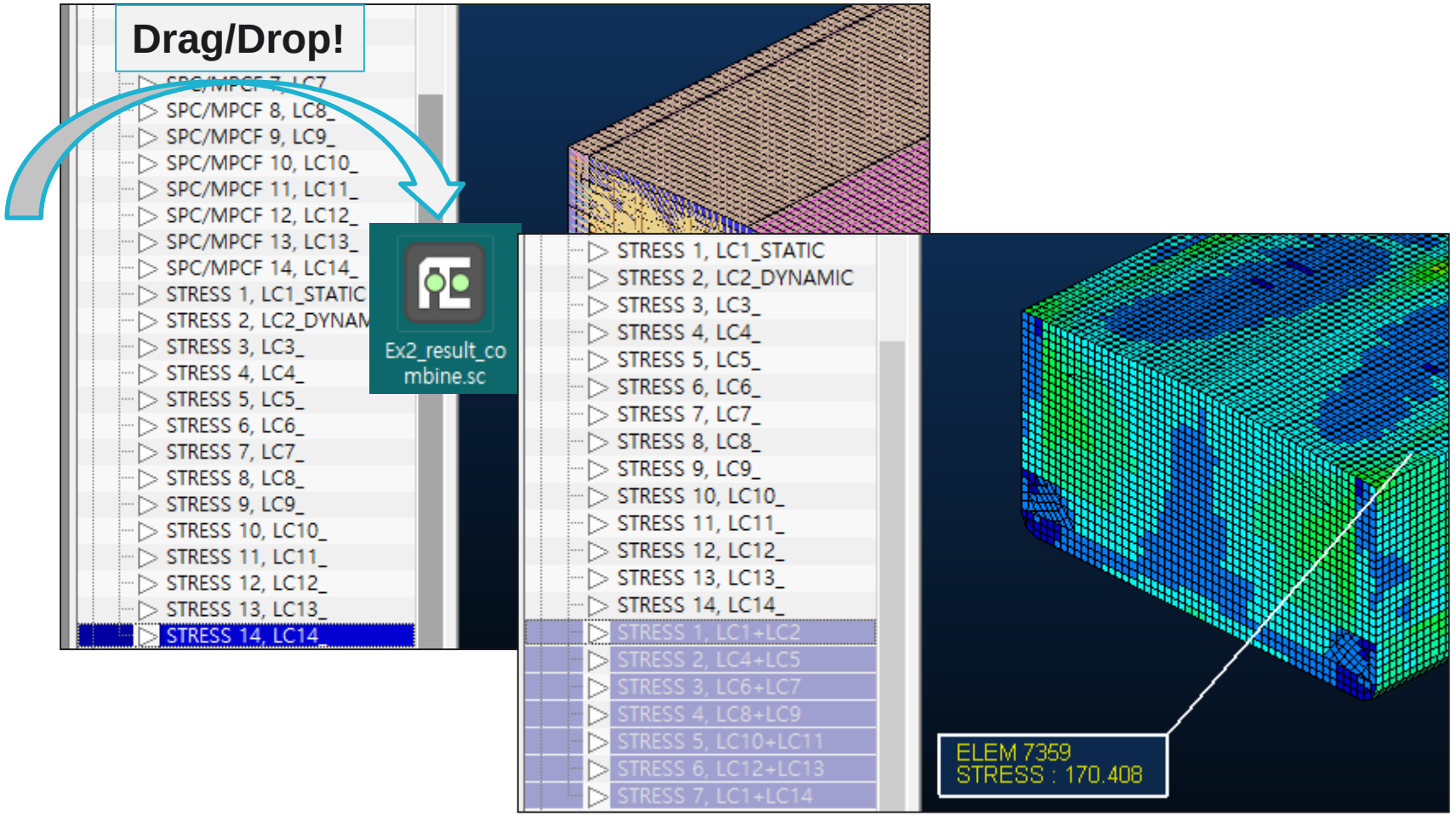
Ctrl + C
Ctrl + V



.sc (Text file)

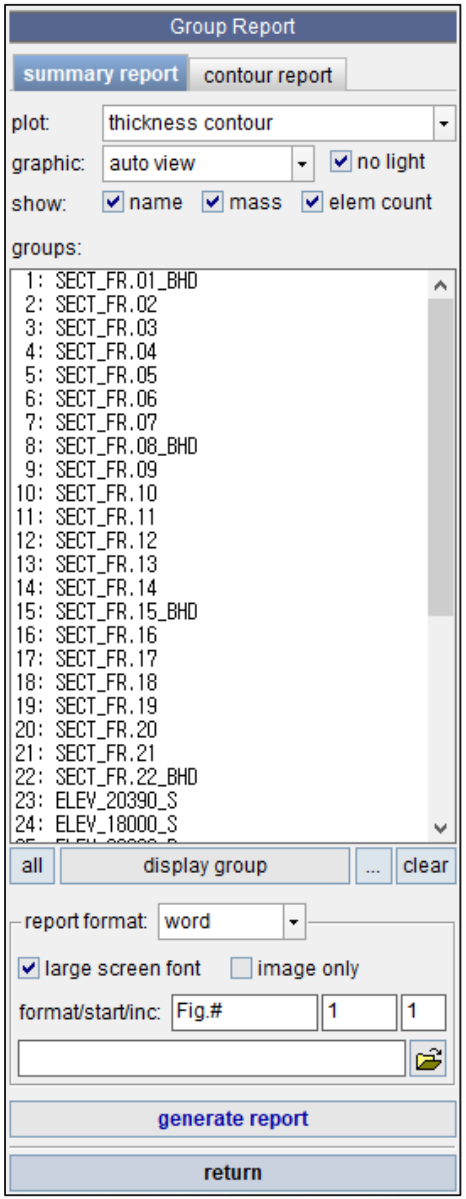
```
1  *LOG
2
   *COMB  (
     METHOD=(PAIR, SUM, REAL), CASE=1, ID=1,
     FILE="Ex6_LC.bin",
     NAME=OFF
     FORMAT=(STRESS, COM1),
     PAIR=(
9      LC1_Static,LC2_Dynamic,LC1+LC2
10     LC2_,    LC3_,        LC2+LC3
11     LC4_,    LC5_,        LC4+LC5
12     LC6_,    LC7_,        LC6+LC7
13     LC8_,    LC9_,        LC8+LC9
14     LC10_,   LC11_,       LC10+LC11
15     LC12_,   LC13_,       LC12+LC13
16     LC14_,   LC1_Static,  LC1+LC14
17   ))
```

SCRIPT를 이용한 RESULT COMBINE



보고서

THICKNESS PLOT 자동화



Report mass : Mass 출력
Report elem count : Element 개수 출력
Auto view : 최적의 View 자동 검색
Disable light : Light source on/off

SHELL THICKNESS PLOT
GROUP: SECT_Fr.68_BHD
ELEMS: 1386 QUAD, 32 TRIA, 661 BAR, 697 BEAM
MASS: 174.3537

Figure number 자동 입력

THICKNESS PLOT 자동화

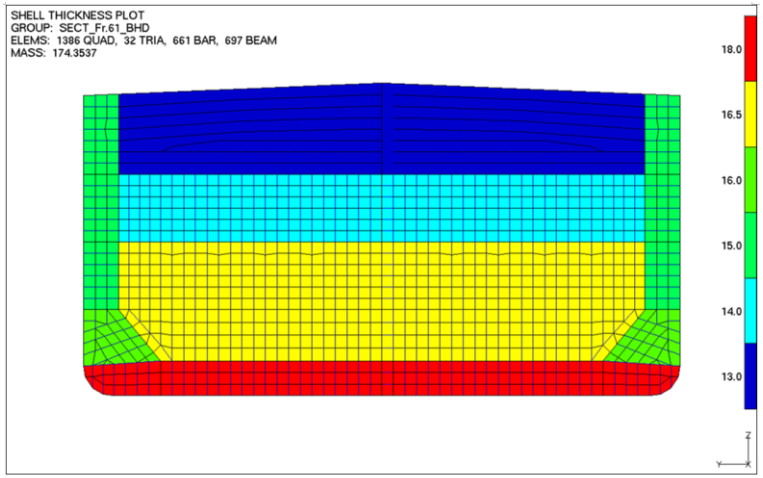


Fig.1.9. Group: SECT_Fr.61_BHD

Group에 존재하는 Thickness 만 표시

Figure number 및 Group name 자동 작성

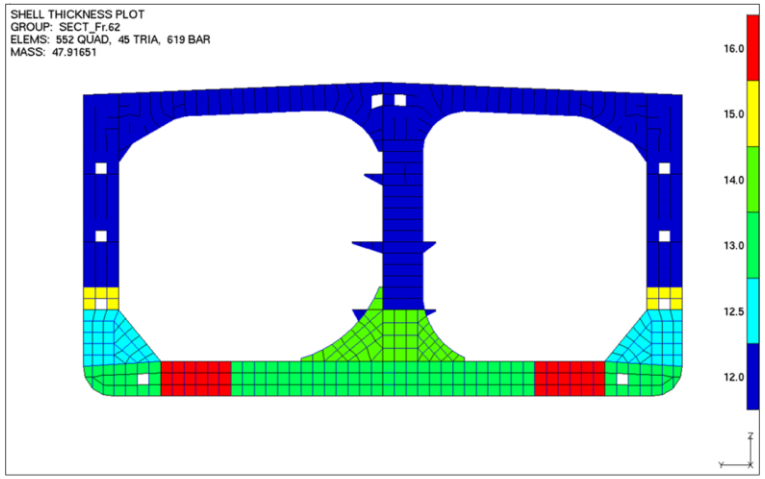
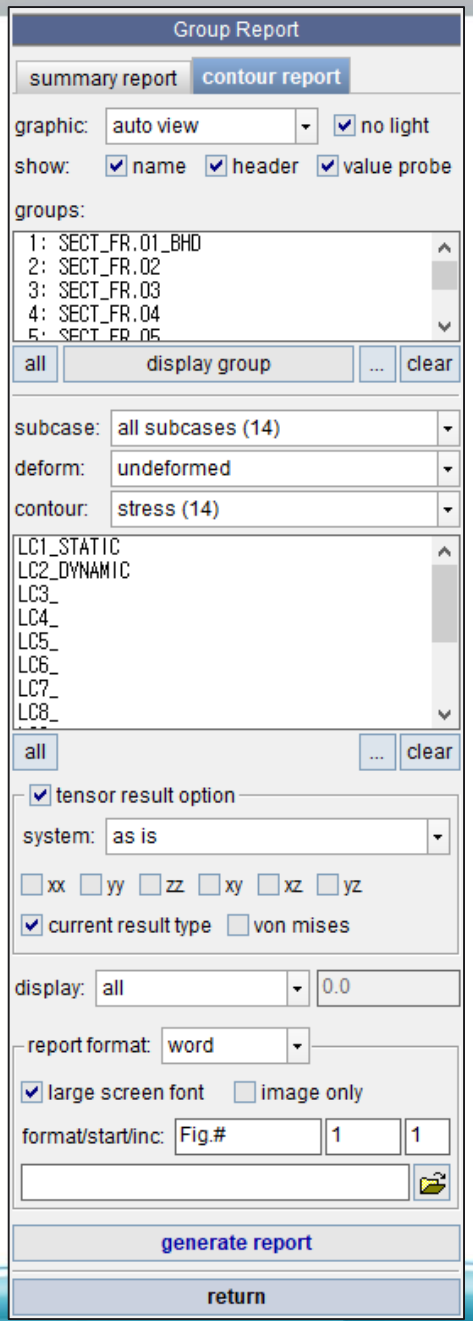


Fig.1.10. Group: SECT_Fr.62

최적의 View 자동 검색

RESULT PLOT 자동화



Group 및 Subcase 선택

Tensor result 선택

Figure number 자동 입력

RESULT PLOT 자동화

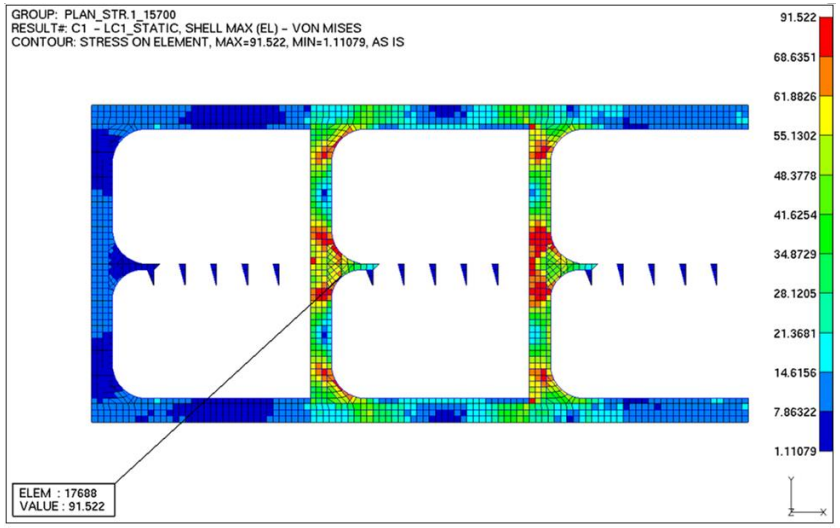


Fig.2.1. C1 - LC1_STATIC, SHELL MAX (EL) - VON MISES at PLAN_STR.1_15700

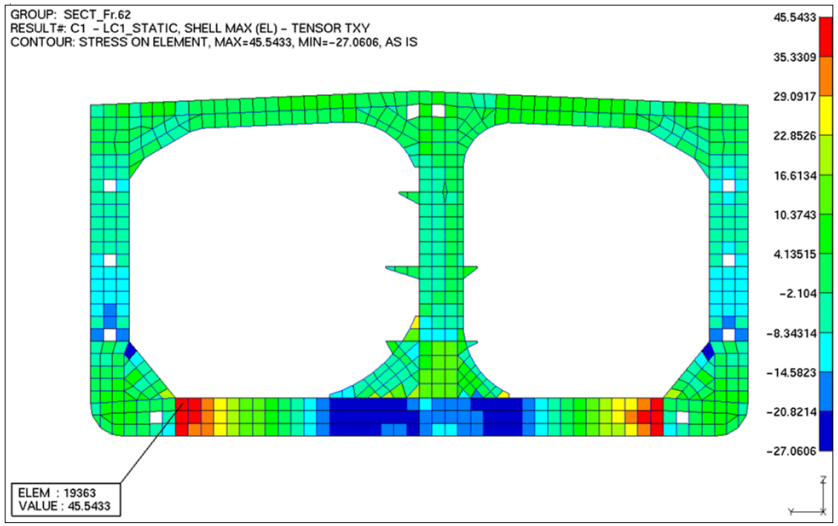


Fig.2.12. C1 - LC1_STATIC, SHELL MAX (EL) - TENSOR TXY at SECT_Fr.62

최적의 View 자동 검색

Fig number, Subcase name, Stress, Group name 자동 작성

CONTOUR REPORT – GROUP (CREP)

- Report 자동화의 Result plot 기능과 비슷함
- 다른 점은 결과 한 장, 전체 모델에서의 위치 한 장이 출력 됨

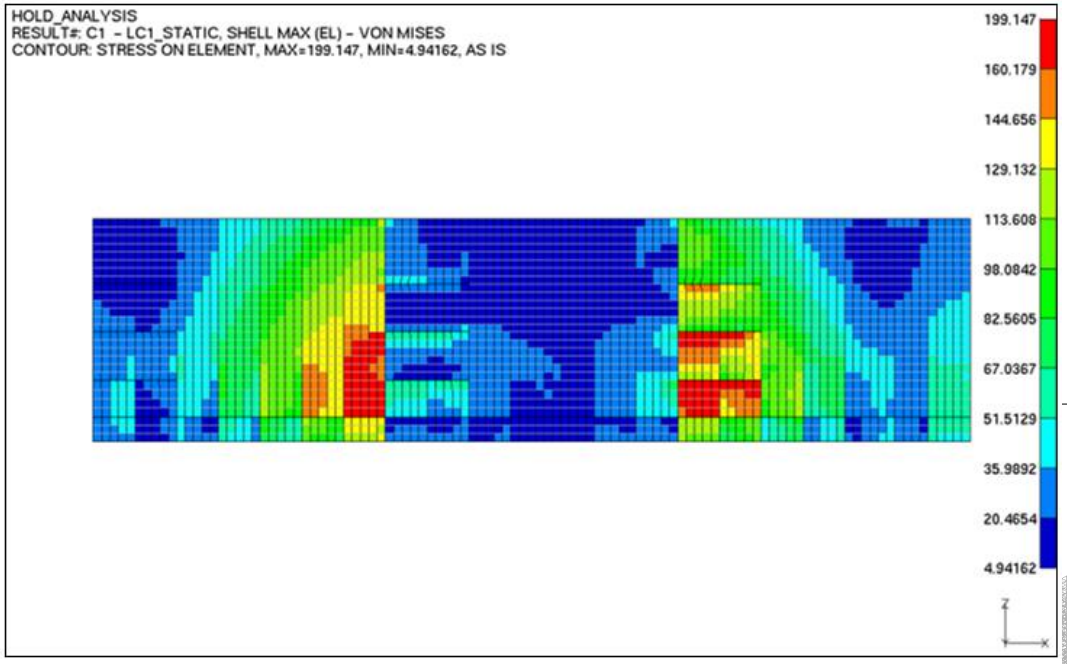
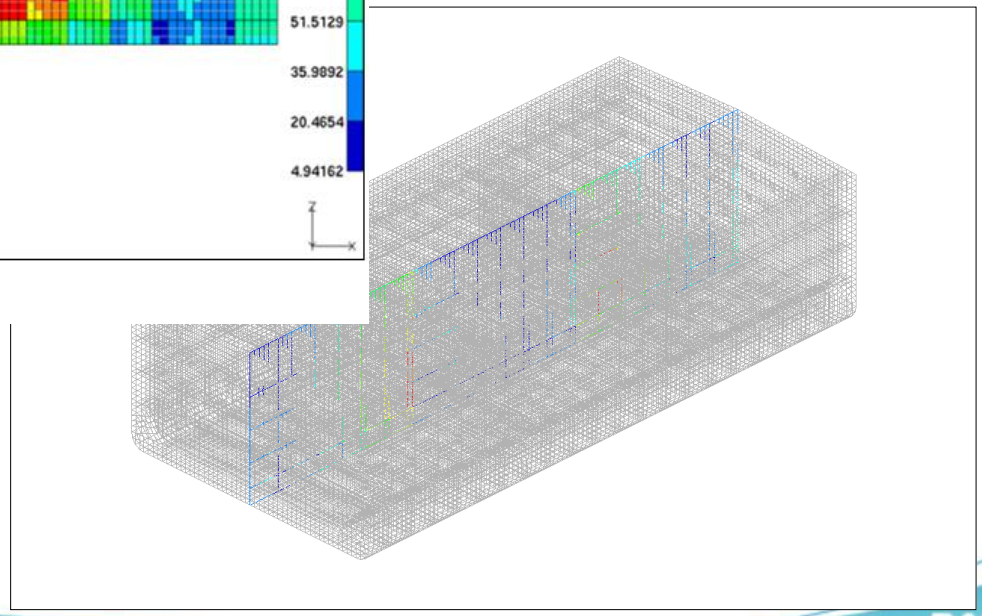


Fig.1. C1 - LC1_STATIC, SHELL MAX (EL) - VON MISES at ELEV_CL



CONTOUR REPORT – PART (CREP)

- Report 자동화의 Thickness plot 기능과 비슷함
- 다른 점은 결과 한 장, 전체 모델에서의 위치 한 장이 출력 됨

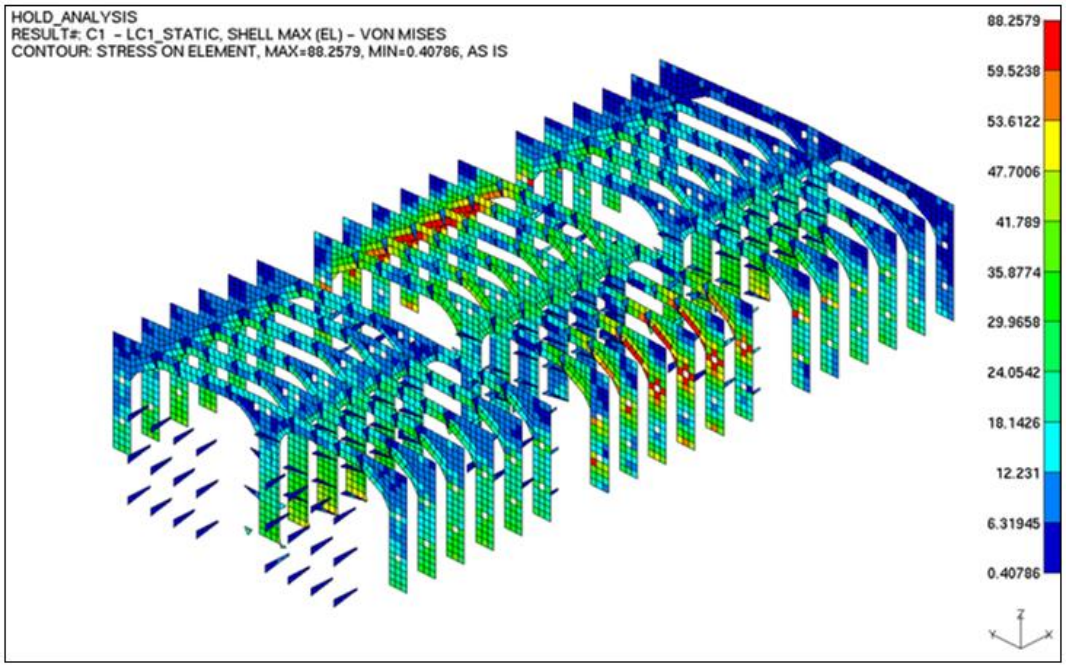
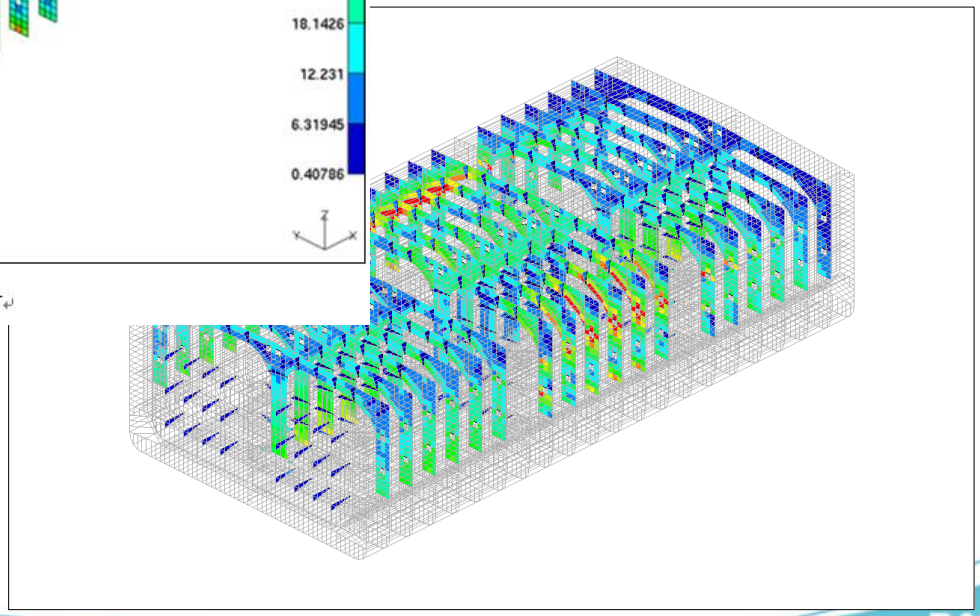
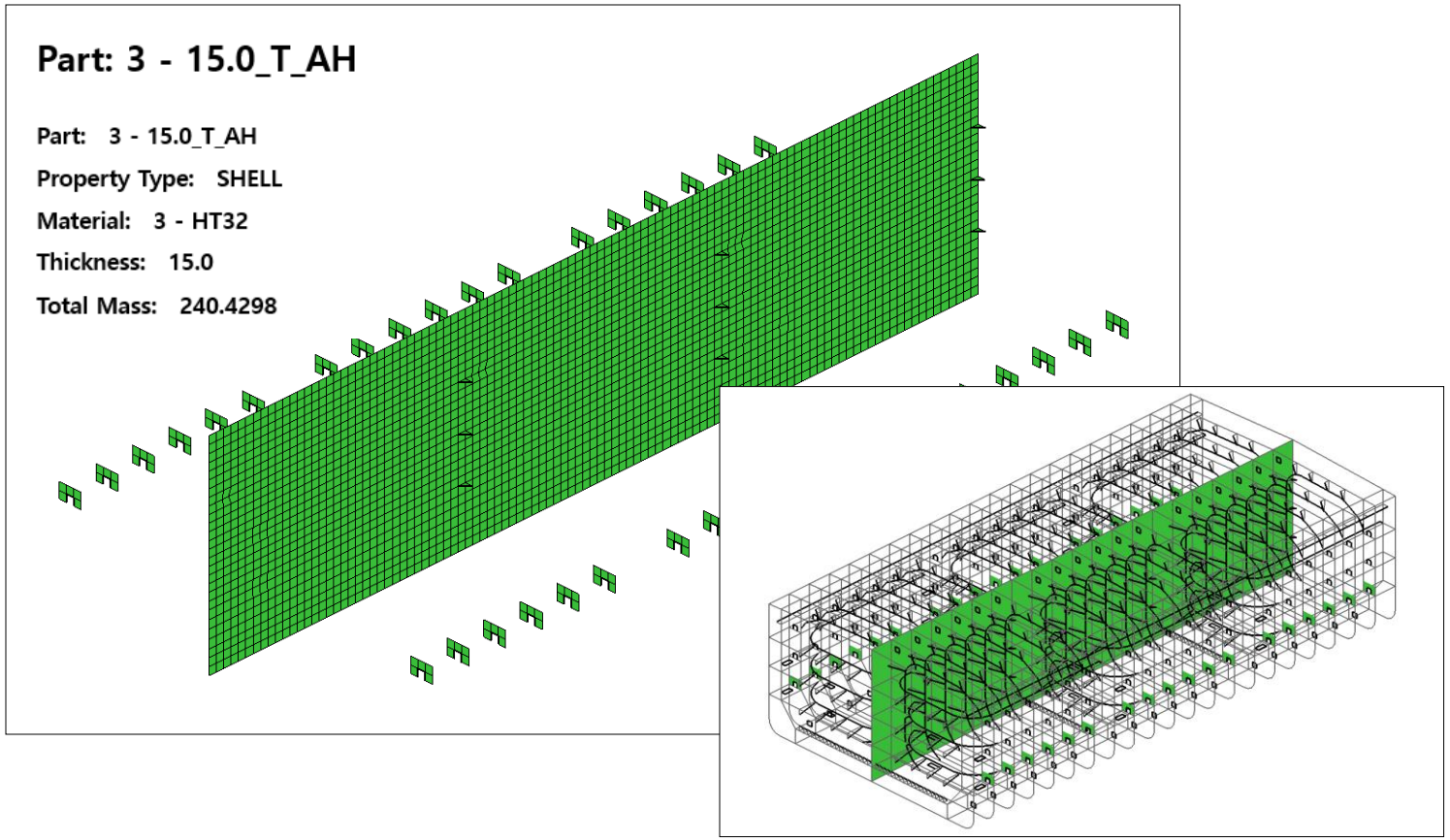


Fig.1.1. C1 - LC1_STATIC, SHELL MAX (EL) - VON MISES at P2 - 12.0_T



PART SUMMARY (PSUM)

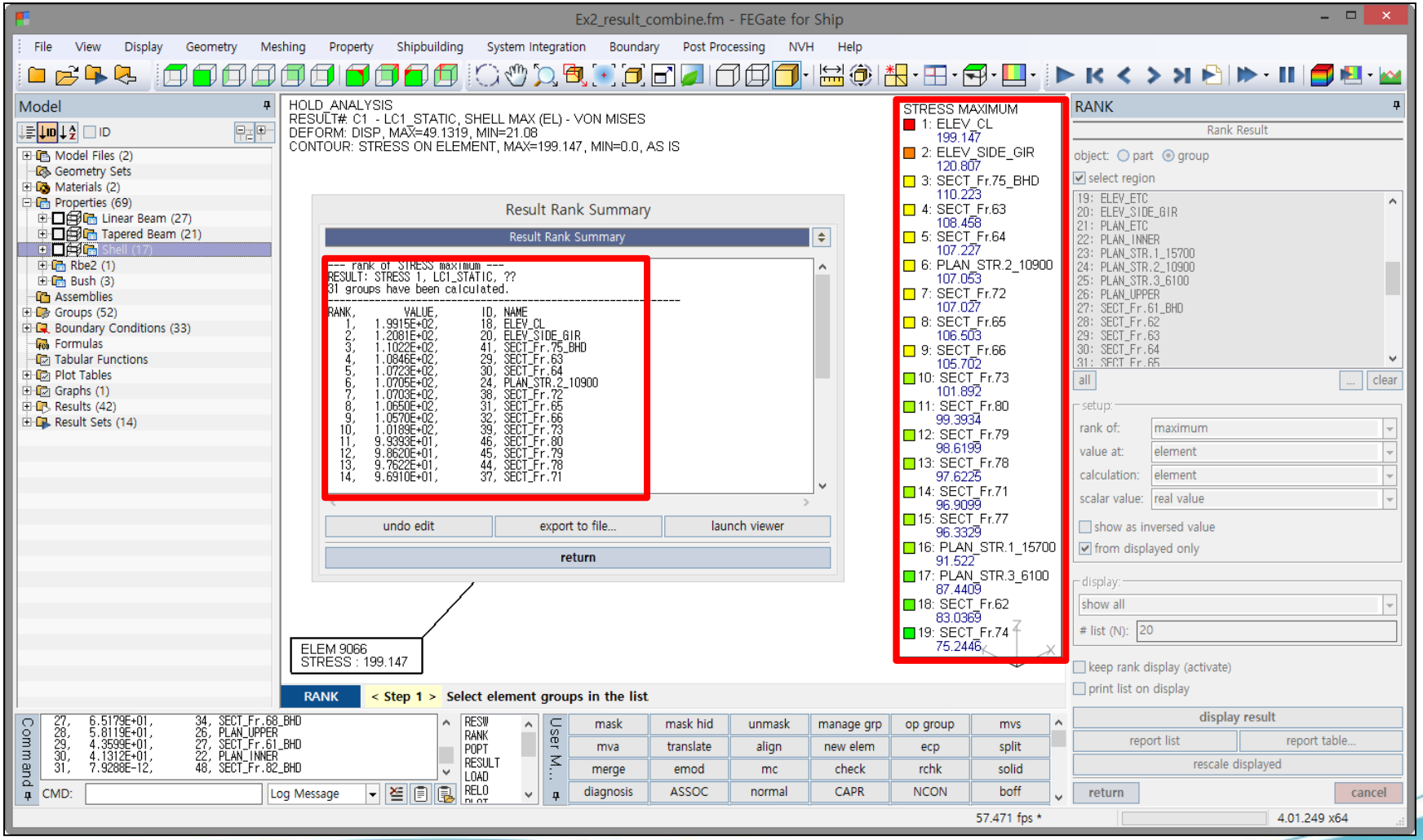
- Thickness plot 기능 보다 더 자세한 정보를 출력
- 해당 Property의 모든 부재와 그 부재의 위치 파악 용이



POST

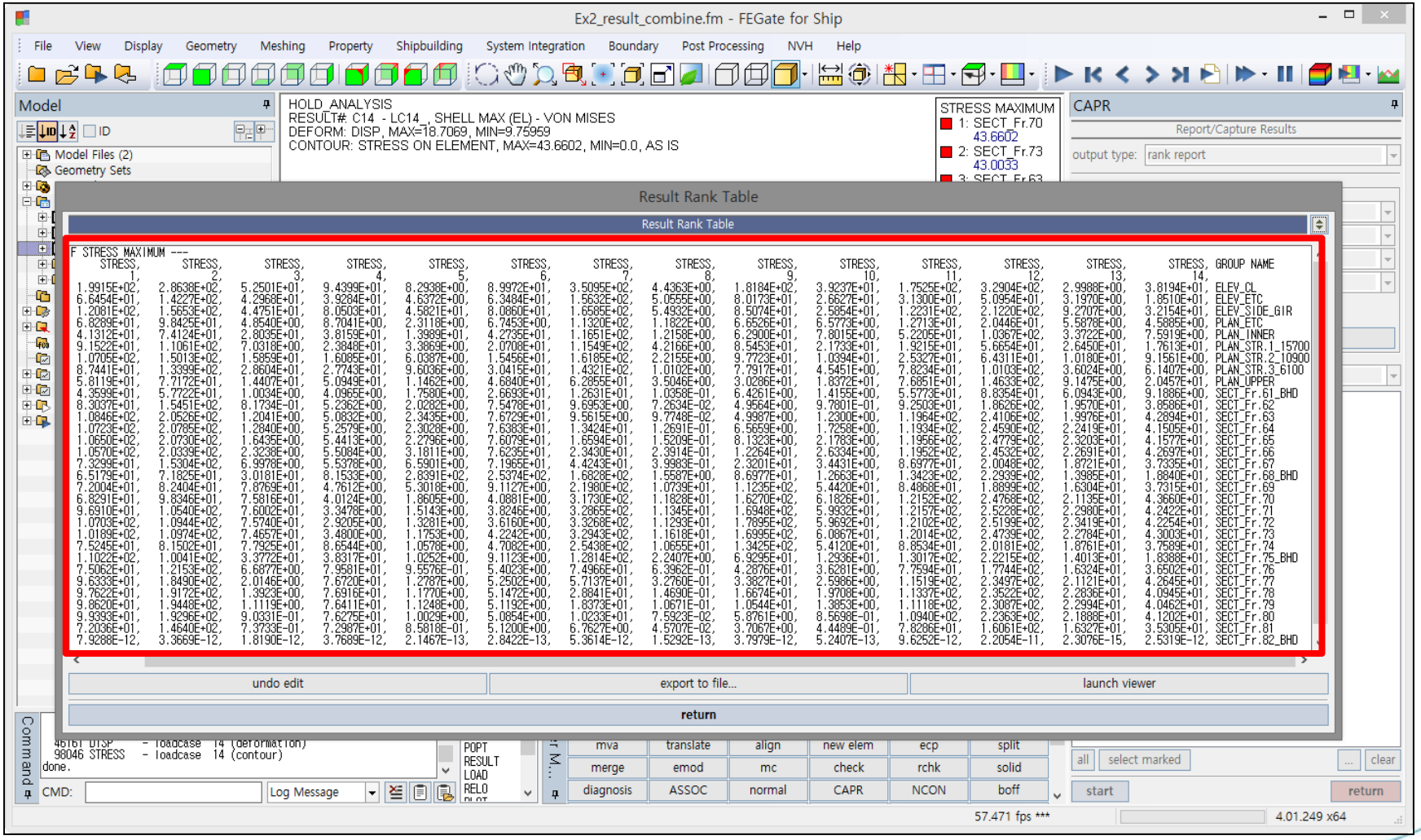
RANK REPORT (RANK)

- 해석 결과를 각 부재, 또는 Group 별로 통계적 계산을 수행
- 값의 순위를 매김



RANK REPORT - TABLE

- 하나의 Subcase가 아닌 전체 Subcase에서의 결과 확인 가능

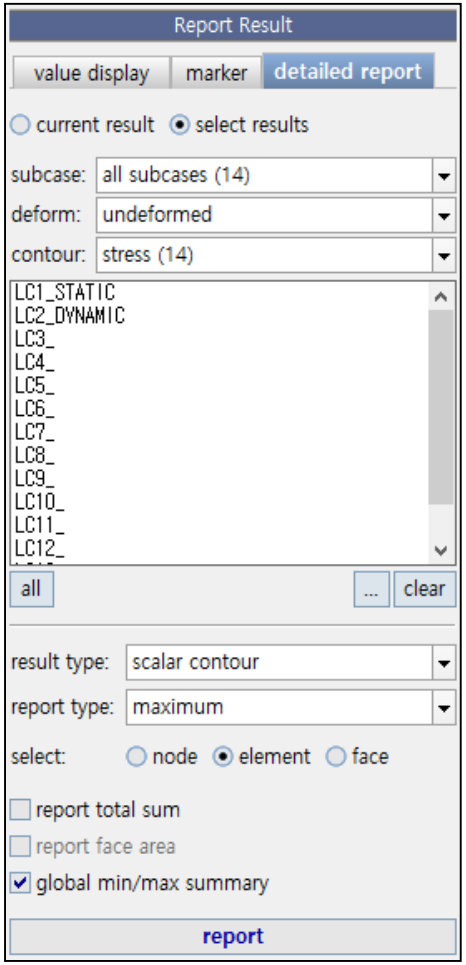


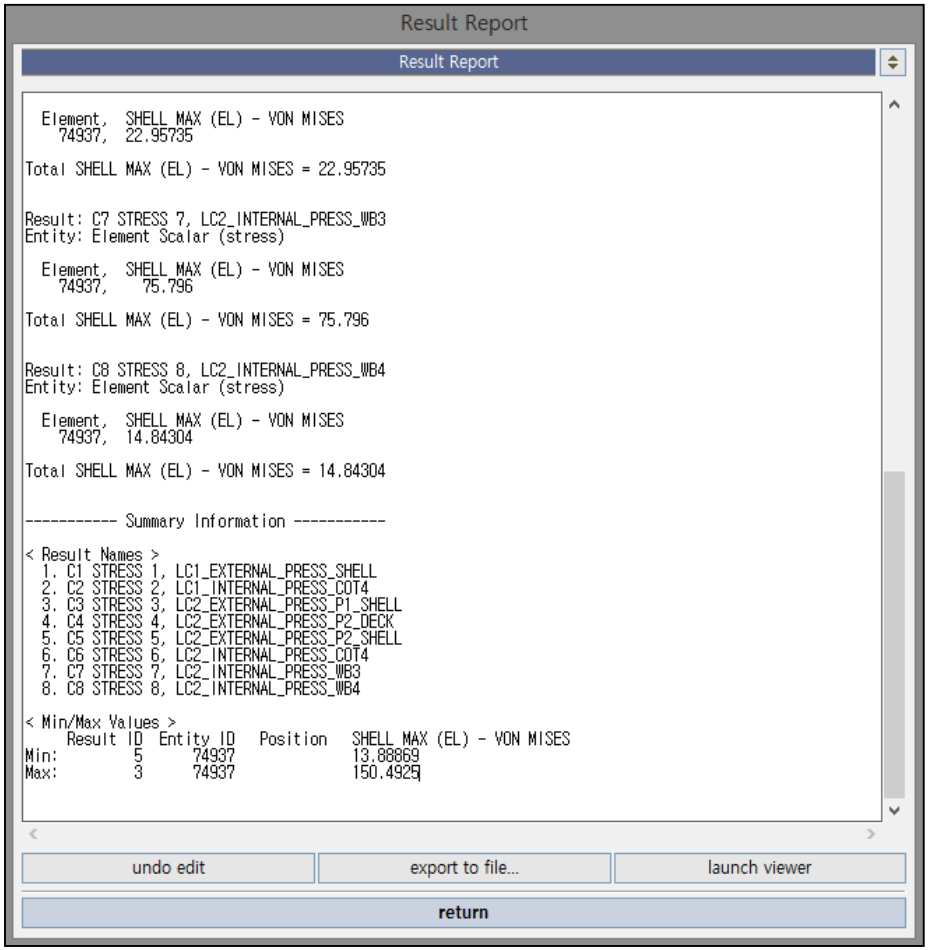
F STRESS MAXIMUM ---

STRESS, 1,	STRESS, 2,	STRESS, 3,	STRESS, 4,	STRESS, 5,	STRESS, 6,	STRESS, 7,	STRESS, 8,	STRESS, 9,	STRESS, 10,	STRESS, 11,	STRESS, 12,	STRESS, 13,	STRESS, 14,	GROUP NAME
1.9915E+02,	2.8638E+02,	5.2501E+01,	9.4399E+01,	8.2938E+00,	8.9972E+01,	3.5095E+02,	4.4363E+00,	1.8184E+02,	3.9237E+01,	1.7525E+02,	3.2904E+02,	2.9988E+00,	3.8194E+01,	ELEV_CL
6.6454E+01,	1.4227E+02,	4.2968E+01,	3.9284E+01,	4.6372E+00,	6.3484E+01,	1.5632E+02,	5.0555E+00,	8.0173E+01,	2.6627E+01,	3.1300E+01,	5.0954E+01,	3.1970E+00,	1.8510E+01,	ELEV_ETC
1.2081E+02,	1.5653E+02,	4.4751E+01,	8.0503E+01,	4.5821E+01,	8.0860E+01,	1.6585E+02,	5.4932E+00,	8.5074E+01,	2.5854E+01,	1.2231E+02,	2.1220E+02,	9.2707E+00,	3.2154E+01,	ELEV_SIDE_GIR
6.8289E+01,	9.8425E+01,	4.8540E+00,	8.7041E+00,	2.3118E+00,	6.7453E+00,	1.1320E+02,	1.1822E+00,	6.6526E+01,	6.5773E+00,	1.2713E+01,	2.0446E+01,	5.5878E+00,	4.5885E+00,	PLAN_ETC
4.1312E+01,	7.4124E+01,	2.8035E+01,	3.8159E+01,	1.3989E+01,	4.2735E+01,	1.1651E+02,	1.2158E+00,	6.2900E+01,	7.8015E+00,	5.2205E+01,	1.0367E+02,	3.3722E+00,	7.5919E+00,	PLAN_INNER
9.1522E+01,	1.1061E+02,	7.0318E+00,	2.3848E+01,	3.3869E+00,	2.0708E+01,	1.1549E+02,	4.2166E+00,	8.5453E+01,	2.1733E+01,	1.9215E+01,	5.6654E+01,	2.6450E+01,	1.7613E+01,	PLAN_STR.1_15700
1.0705E+02,	1.5013E+02,	1.5859E+01,	1.6085E+01,	6.0387E+00,	1.5456E+01,	1.6185E+02,	2.2155E+00,	9.7723E+01,	1.0394E+01,	2.5327E+01,	6.4311E+01,	1.0180E+01,	9.1561E+00,	PLAN_STR.2_10900
8.7441E+01,	1.3399E+02,	2.8604E+01,	2.7743E+01,	9.6036E+00,	3.0415E+01,	1.4321E+02,	1.0102E+00,	7.7917E+01,	4.5451E+00,	7.8234E+01,	1.0103E+02,	3.6024E+00,	6.1407E+00,	PLAN_STR.3_6100
5.8119E+01,	7.7172E+01,	1.4407E+01,	5.0949E+01,	1.1462E+00,	4.6840E+01,	6.2855E+01,	3.5046E+00,	3.0286E+01,	1.8372E+01,	7.6851E+01,	1.4633E+02,	9.1475E+00,	2.0457E+01,	PLAN_UPPER
4.3599E+01,	5.7722E+01,	1.0034E+00,	4.0965E+00,	1.7580E+00,	2.6693E+01,	1.2631E+01,	1.0358E-01,	6.4261E+00,	1.4155E+00,	5.5773E+01,	8.8354E+01,	6.0943E+00,	9.1886E+00,	SECT_Fr.61_BHD
8.3037E+01,	1.5451E+02,	8.1734E-01,	5.2362E+00,	2.0282E+00,	7.5478E+01,	9.6953E+00,	7.2634E-02,	4.9564E+00,	9.7801E-01,	9.2503E+01,	1.8626E+02,	1.9570E+01,	3.8586E+01,	SECT_Fr.62
1.0846E+02,	2.0526E+02,	1.2041E+00,	5.0832E+00,	2.3435E+00,	7.6729E+01,	9.5615E+00,	9.7748E-02,	4.9987E+00,	1.2300E+00,	1.1964E+02,	2.4106E+02,	1.9976E+01,	4.2894E+01,	SECT_Fr.63
1.0723E+02,	2.0785E+02,	1.2840E+00,	5.2579E+00,	2.3028E+00,	7.6383E+01,	1.3424E+01,	1.2691E-01,	6.5659E+00,	1.7258E+00,	1.1934E+02,	2.4590E+02,	2.2419E+01,	4.1505E+01,	SECT_Fr.64
1.0650E+02,	2.0730E+02,	1.6435E+00,	5.4413E+00,	2.2796E+00,	7.6079E+01,	1.6594E+01,	1.5209E-01,	8.1323E+00,	2.1783E+00,	1.1956E+02,	2.4779E+02,	2.3203E+01,	4.1577E+01,	SECT_Fr.65
1.0570E+02,	2.0339E+02,	2.3238E+00,	5.5084E+00,	3.1811E+00,	7.6235E+01,	2.3430E+01,	2.3914E-01,	1.2264E+01,	2.6334E+00,	1.1952E+02,	2.4532E+02,	2.2691E+01,	4.2697E+01,	SECT_Fr.66
7.3299E+01,	1.5304E+02,	6.9978E+00,	5.5378E+00,	6.5901E+00,	7.1965E+01,	4.4243E+01,	3.9983E-01,	2.3201E+01,	3.4431E+00,	8.6977E+01,	2.0048E+02,	1.8721E+01,	3.7335E+01,	SECT_Fr.67
6.5179E+01,	7.1825E+01,	3.0181E+01,	8.1533E+00,	2.8391E+02,	2.5374E+02,	1.6828E+02,	1.5587E+00,	8.6977E+01,	1.2663E+01,	1.3423E+02,	2.2939E+02,	1.3985E+01,	1.8840E+01,	SECT_Fr.68_BHD
7.2004E+01,	8.2404E+01,	7.8769E+01,	4.7612E+00,	5.3018E+00,	9.1127E+00,	2.1980E+02,	1.0739E+01,	1.1235E+02,	5.4420E+01,	8.4868E+01,	1.8899E+02,	1.6304E+01,	3.7315E+01,	SECT_Fr.69
6.8291E+01,	9.8346E+01,	7.5816E+01,	4.0124E+00,	1.8605E+00,	4.0881E+00,	3.1730E+02,	1.1828E+01,	1.6270E+02,	6.1826E+01,	1.2152E+02,	2.4768E+02,	2.1135E+01,	4.3660E+01,	SECT_Fr.70
9.6910E+01,	1.0540E+02,	7.6002E+01,	3.3478E+00,	1.5143E+00,	3.8246E+00,	3.2865E+02,	1.1345E+01,	1.6948E+02,	5.9932E+01,	1.2157E+02,	2.5228E+02,	2.2980E+01,	4.2422E+01,	SECT_Fr.71
1.0703E+02,	1.0944E+02,	7.5740E+01,	2.9205E+00,	1.3281E+00,	3.6160E+00,	3.3268E+02,	1.1293E+01,	1.7895E+02,	5.9692E+01,	1.2102E+02,	2.5199E+02,	2.3419E+01,	4.2254E+01,	SECT_Fr.72
1.0189E+02,	1.0974E+02,	7.4657E+01,	3.4800E+00,	1.1753E+00,	4.2242E+00,	3.2943E+02,	1.1618E+01,	1.6995E+02,	6.0867E+01,	1.2014E+02,	2.4739E+02,	2.2784E+01,	4.3003E+01,	SECT_Fr.73
7.5245E+01,	8.1502E+01,	7.7925E+01,	8.6544E+00,	1.0578E+00,	4.7082E+00,	2.5438E+02,	1.0655E+01,	1.3425E+02,	5.4120E+01,	8.8534E+01,	2.0181E+02,	1.8761E+01,	3.7589E+01,	SECT_Fr.74
1.1022E+02,	1.0041E+02,	3.3772E+01,	3.8317E+01,	1.0252E+00,	9.1123E+00,	1.2814E+02,	2.2407E+00,	6.9295E+01,	1.2936E+01,	1.3017E+02,	2.2215E+02,	1.4013E+01,	1.8388E+01,	SECT_Fr.75_BHD
7.5062E+01,	1.2153E+02,	6.6877E+00,	7.9581E+01,	9.5576E-01,	5.4023E+00,	7.4966E+01,	6.3962E-01,	4.2876E+01,	3.6281E+00,	7.7594E+01,	1.7744E+02,	1.6324E+01,	3.6502E+01,	SECT_Fr.76
9.6333E+01,	1.8490E+02,	2.0146E+00,	7.6720E+01,	1.2787E+00,	5.2502E+00,	5.7137E+01,	3.2760E-01,	3.3827E+01,	2.5986E+00,	1.1519E+02,	2.3497E+02,	2.1121E+01,	4.2645E+01,	SECT_Fr.77
9.7622E+01,	1.9172E+02,	1.3923E+00,	7.6916E+01,	1.1770E+00,	5.1472E+00,	2.8841E+01,	1.4690E-01,	1.6674E+01,	1.9708E+00,	1.1337E+02,	2.3522E+02,	2.2836E+01,	4.0945E+01,	SECT_Fr.78
9.8620E+01,	1.9448E+02,	1.1119E+00,	7.6411E+01,	1.1248E+00,	5.1192E+00,	1.8373E+01,	1.0671E-01,	1.0544E+01,	1.3853E+00,	1.1118E+02,	2.3087E+02,	2.2994E+01,	4.0462E+01,	SECT_Fr.79
9.9393E+01,	1.9296E+02,	9.0331E-01,	7.6275E+01,	1.0029E+00,	5.0854E+00,	1.0233E+01,	7.5923E-02,	5.8761E+00,	8.5698E-01,	1.0940E+02,	2.2363E+02,	2.1888E+01,	4.1202E+01,	SECT_Fr.80
7.2036E+01,	1.4640E+02,	7.3733E-01,	7.2987E+01,	8.5818E-01,	5.1200E+00,	6.7627E+00,	4.5707E-02,	3.7067E+00,	4.4489E-01,	7.8286E+01,	1.6061E+02,	1.6327E+01,	3.5305E+01,	SECT_Fr.81
7.9288E-12,	3.3669E-12,	1.8190E-12,	3.7689E-12,	2.1467E-13,	2.8422E-13,	5.3614E-12,	1.5292E-13,	3.7979E-12,	5.2407E-13,	9.6252E-12,	2.2054E-11,	2.3076E-15,	2.5319E-12,	SECT_Fr.82_BHD

DETAILED REPORT (REPORT)

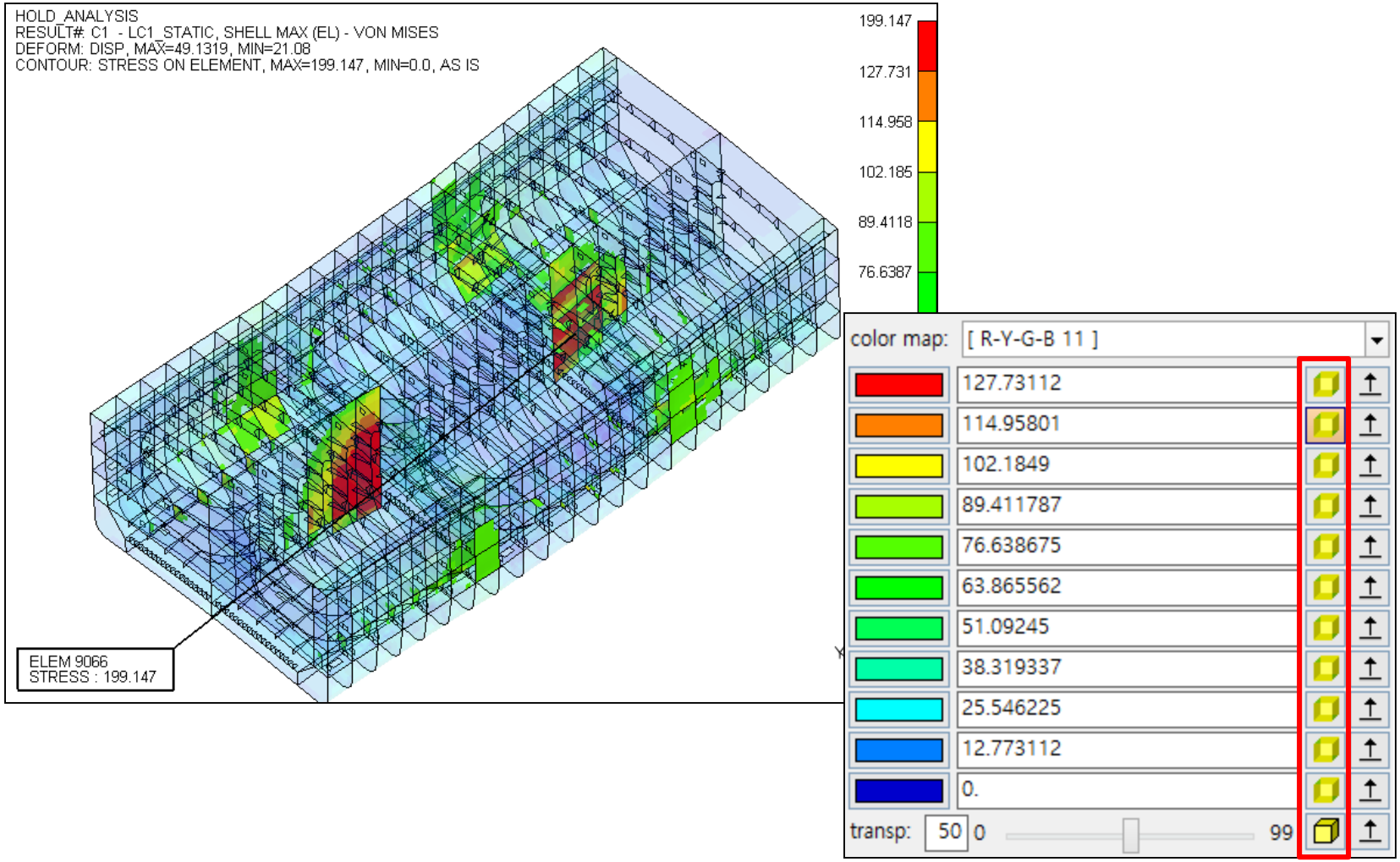
- 지정한 Element와 선택한 Subcase 결과를 Text로 확인 가능
- Max/Min/AVG 출력 가능





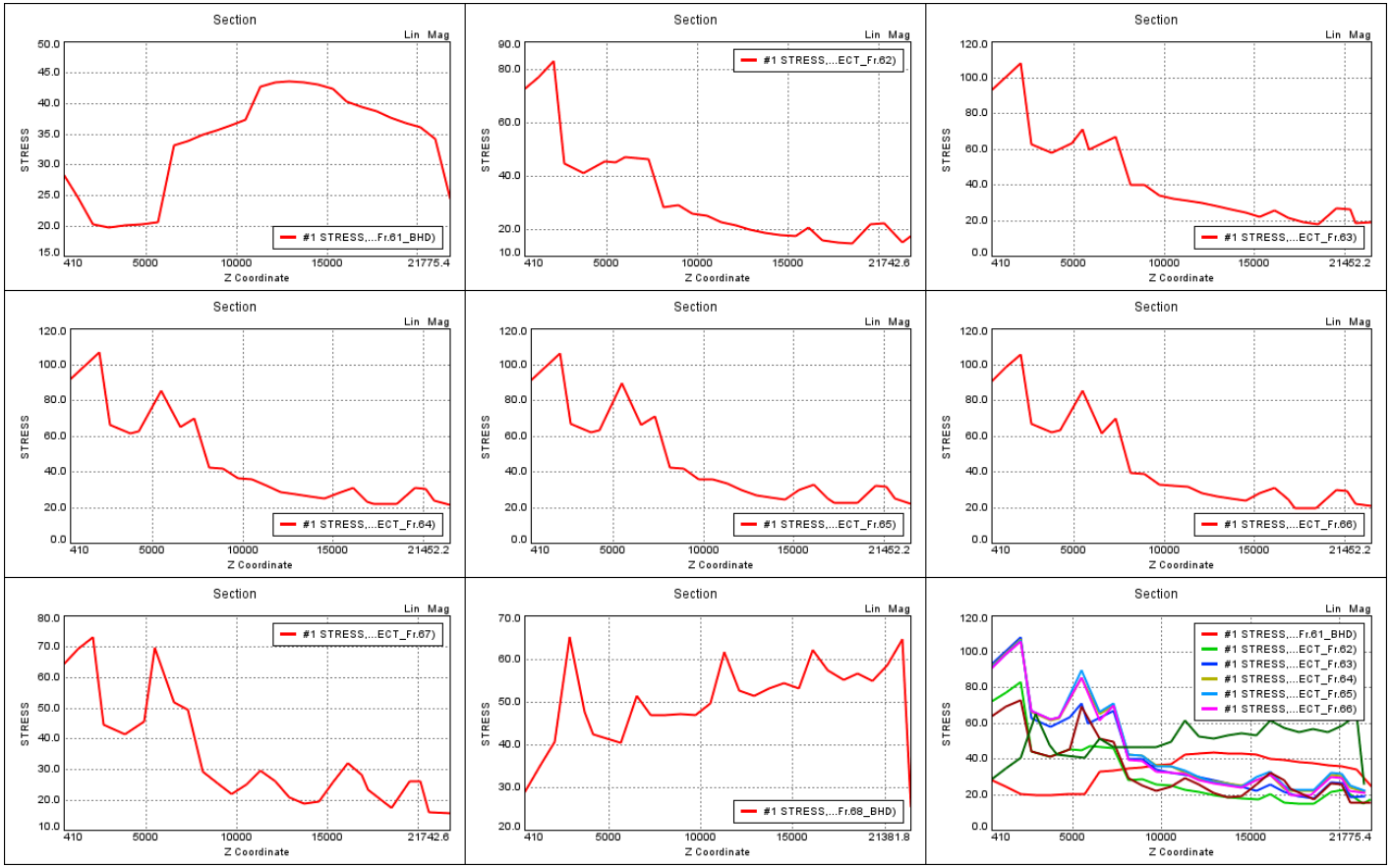
TRANSPARENCY (TPNC)

- 특정 Stress 값 보다 작은 요소의 투명도 조절 가능



GRAPH (PLOT)

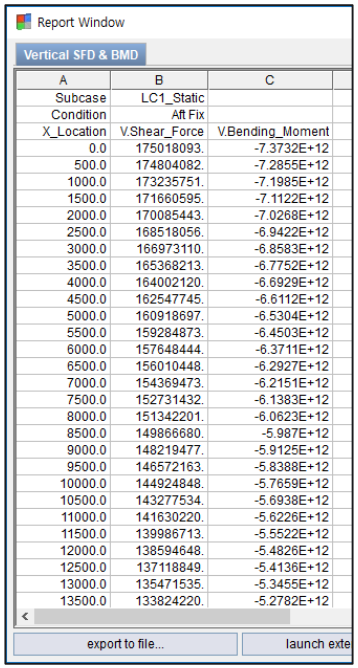
- 여러 개의 Viewport를 이용하여 그래프 작성 가능
- 그래프 정보만 파일로 관리 가능



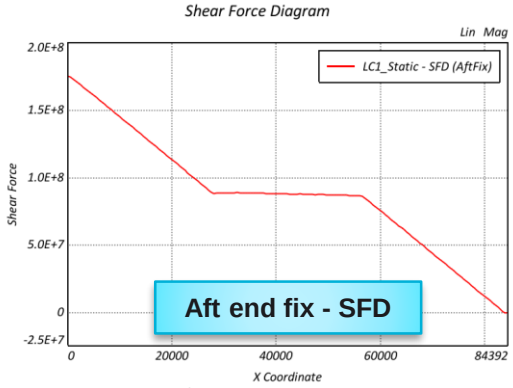
graph.gpf

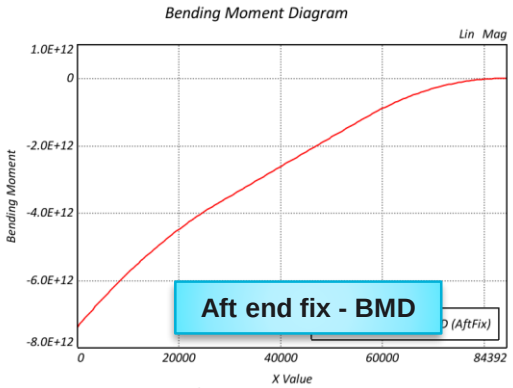
BOUNDARY REPORT (BREP)

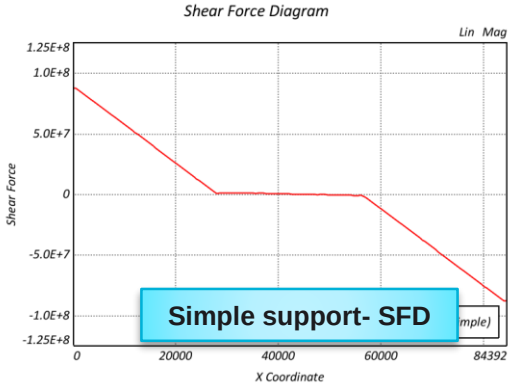
- Shear force & Bending moment diagram 작성 기능
- Aft end, Fore end, Simple support 지원
- Text report 출력 가능

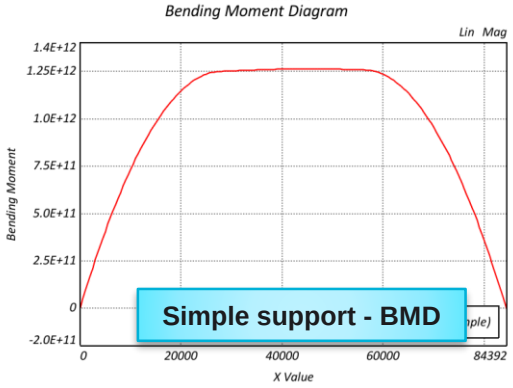


A	B	C
Subcase	LC1_Static	
Condition	Aft Fix	
X_Location	V.Shear_Force	V.Bending_Moment
0.0	175018093.	-7.3732E+12
500.0	174804082.	-7.2855E+12
1000.0	173235751.	-7.1985E+12
1500.0	171660595.	-7.1122E+12
2000.0	170085443.	-7.0268E+12
2500.0	168518056.	-6.9422E+12
3000.0	166973110.	-6.8583E+12
3500.0	165368213.	-6.7752E+12
4000.0	164002120.	-6.6929E+12
4500.0	162547745.	-6.6112E+12
5000.0	160918697.	-6.5304E+12
5500.0	159284873.	-6.4503E+12
6000.0	157648444.	-6.3711E+12
6500.0	156010448.	-6.2927E+12
7000.0	154369473.	-6.2151E+12
7500.0	152731432.	-6.1383E+12
8000.0	151342201.	-6.0623E+12
8500.0	149866680.	-5.987E+12
9000.0	148219477.	-5.9125E+12
9500.0	146572163.	-5.8388E+12
10000.0	144924848.	-5.7659E+12
10500.0	143277534.	-5.6938E+12
11000.0	141630220.	-5.6226E+12
11500.0	139986713.	-5.5522E+12
12000.0	138594648.	-5.4826E+12
12500.0	137118849.	-5.4136E+12
13000.0	135471535.	-5.3455E+12
13500.0	133824220.	-5.2782E+12



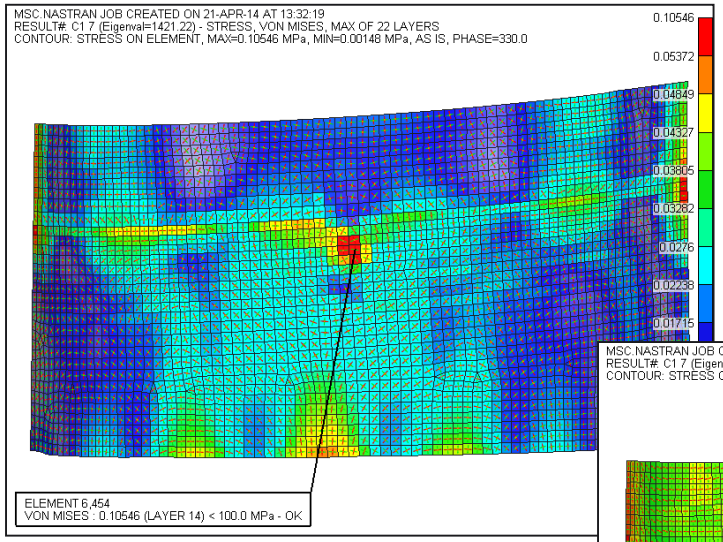


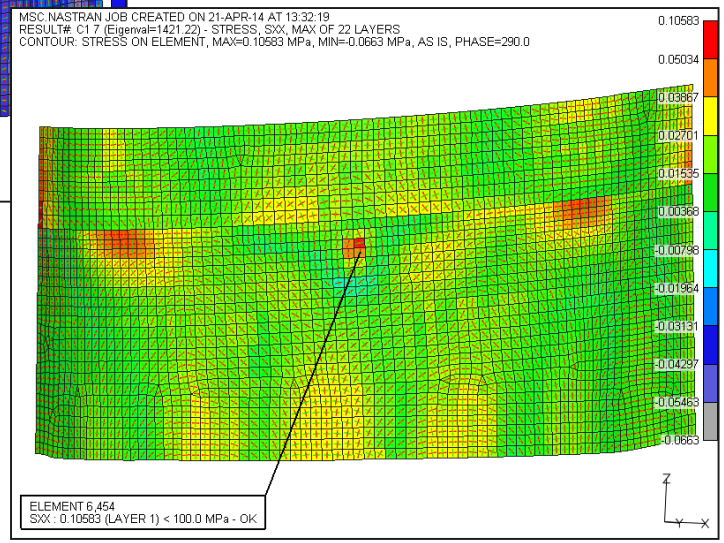


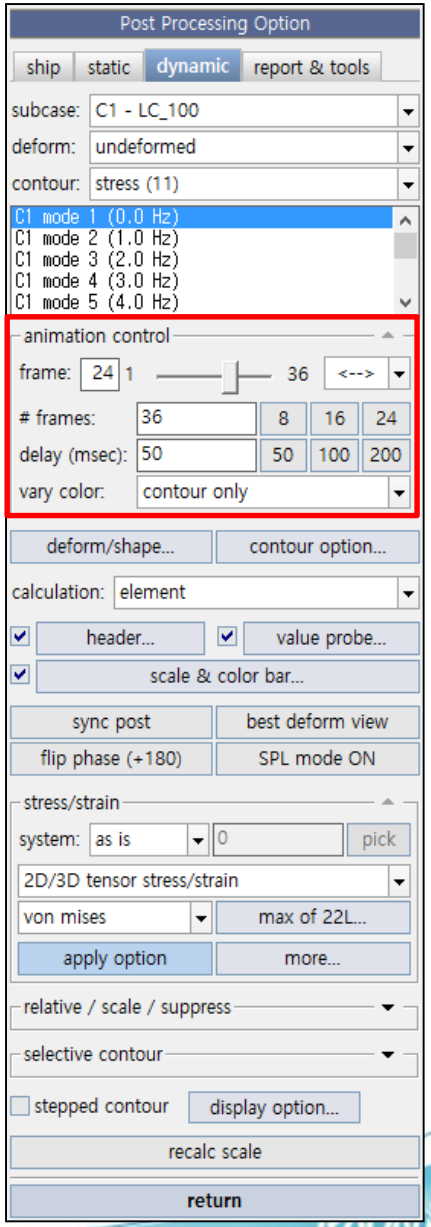


POST PROCESSING OPTION (POPT) – ANIMATION CONTROL

- Complex stress/strain 결과를 지원
- Animation 수행 시 value text와 marker가 실시간으로 반영된다. (Complex_Von.gif 참조)







BUCKLING ANALYSIS (BUCK)

- Lloyd's Resister, CSRH 계산 지원
- Buckling panel 자동 생성
- Buckling report 자동화
- 뛰어난 계산 속도