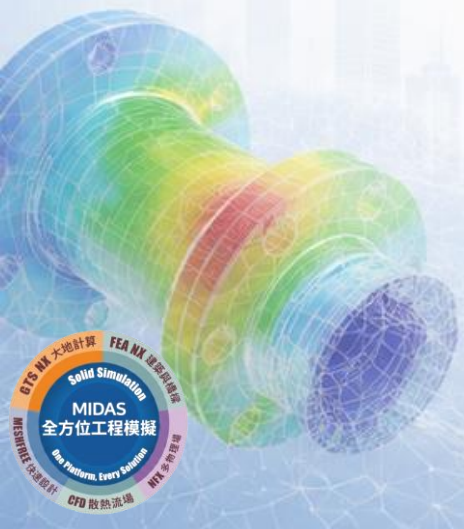
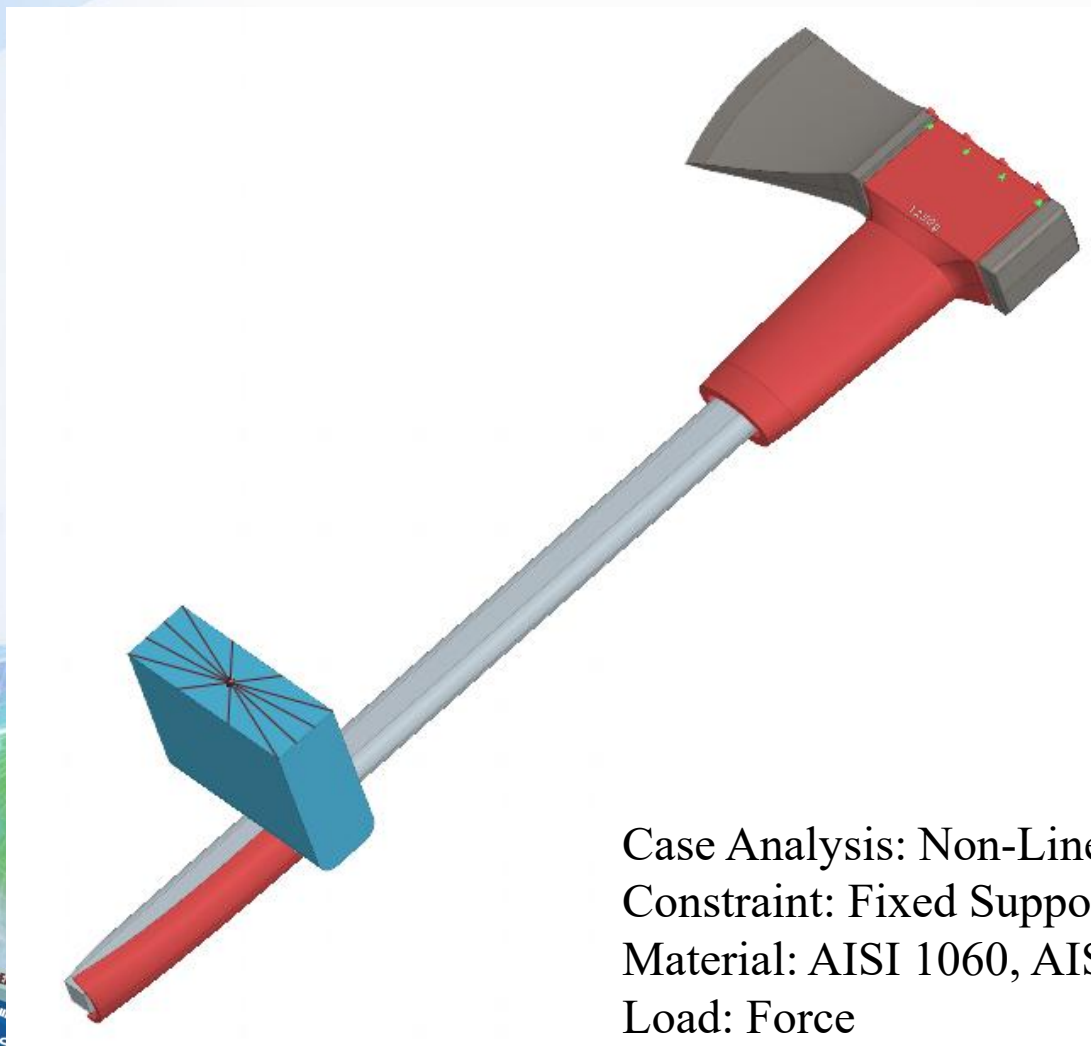


手工具分析 非線性分析



案例概述



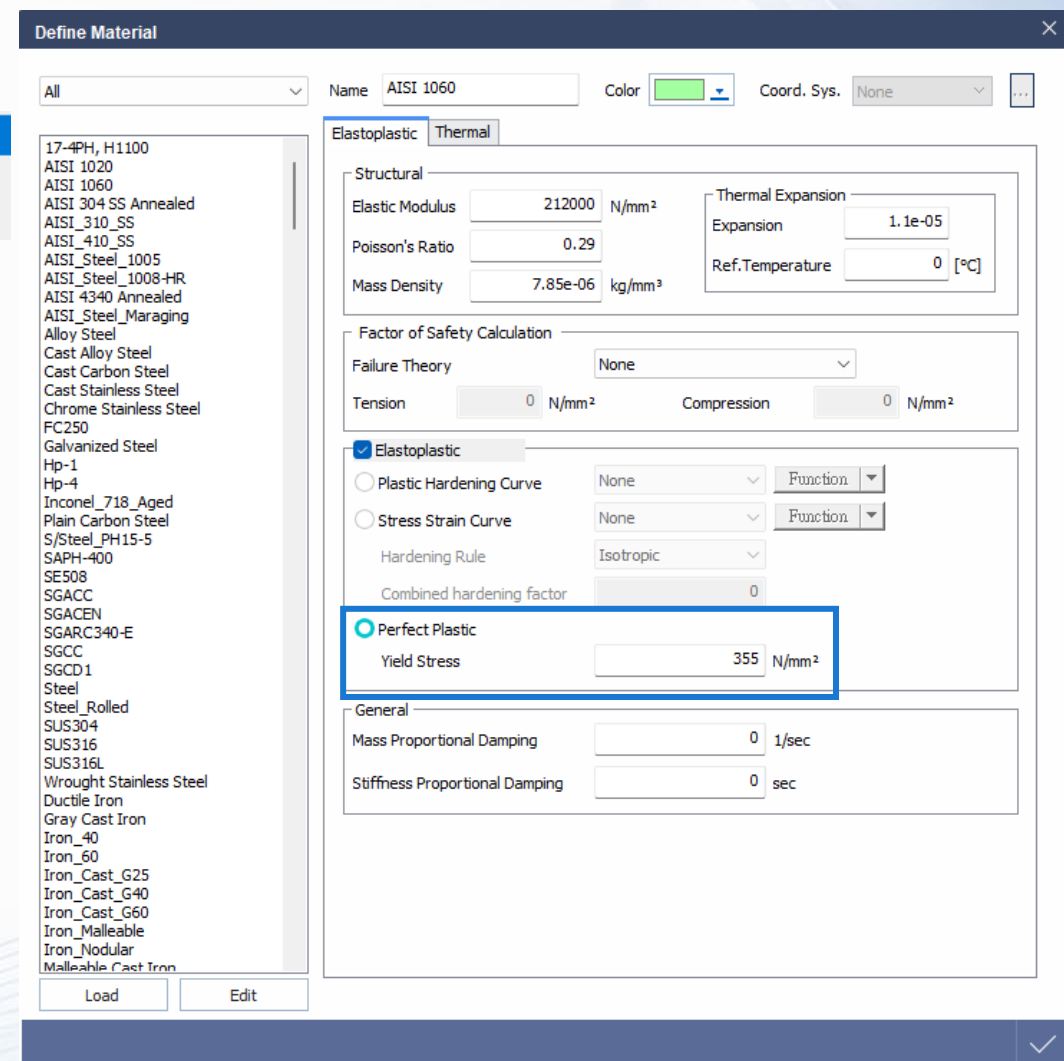
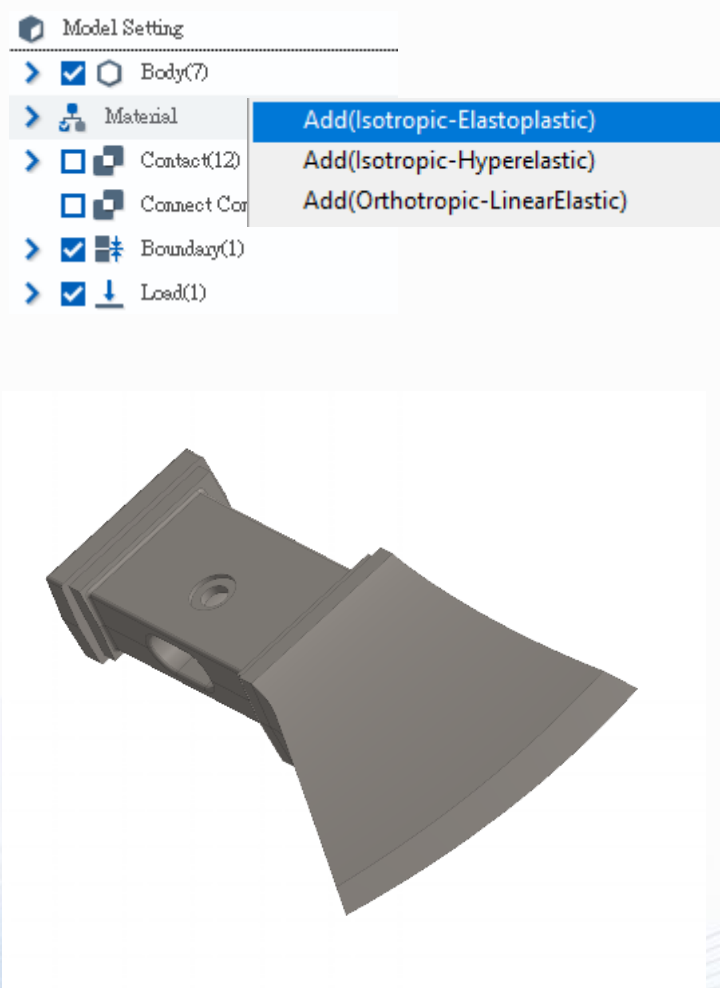
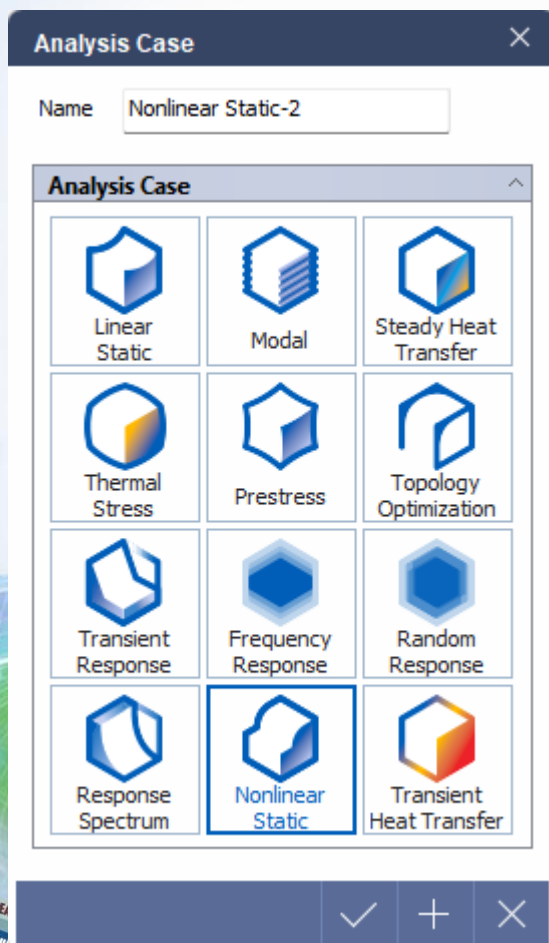
Case Analysis: Non-Linear Analysis

Constraint: Fixed Support, Rigid Link

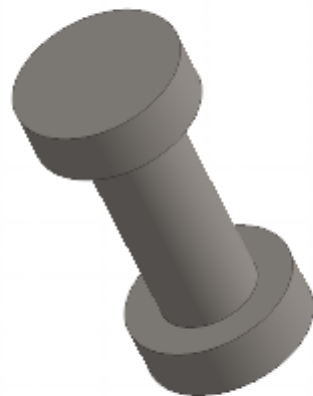
Material: AISI 1060, AISI 304, Polypropylene, FRP, TPR

Load: Force

幾何模型 – 分析案例與材料 (AISI 1060)



幾何模型 – 材料 (AISI 1060)



Define Material

All Name AISI 304 SS Annealed Color Coord. Sys. None

Elastoplastic Thermal

Structural

Elastic Modulus 197000 N/mm²

Poisson's Ratio 0.27

Mass Density 7.955e-06 kg/mm³

Thermal Expansion

Expansion 1.7e-05

Ref. Temperature 0 [°C]

Factor of Safety Calculation

Failure Theory None

Tension 0 N/mm² Compression 0 N/mm²

☒ Elastoplastic

☐ Plastic Hardening Curve None Function

☐ Stress Strain Curve None Function

Hardening Rule Isotropic

Combined hardening factor 0

☒ Perfect Plastic

Yield Stress 215 N/mm²

General

Mass Proportional Damping 0 1/sec

Stiffness Proportional Damping 0 sec

Load Edit

幾何模型 – 材料 (Polypropylene)



Define Material

All Name PP Color Coord. Sys. None

17-4PH, H1100
AISI 1020
AISI 1060
AISI 304 SS Annealed
AISI_310_SS
AISI_410_SS
AISI_Steel_1005
AISI_Steel_1008+HR
AISI 4340 Annealed
AISI_Steel_Maraging
Alloy Steel
Cast Alloy Steel
Cast Carbon Steel
Cast Stainless Steel
Chrome Stainless Steel
FC250
Galvanized Steel
Hp-1
Hp-4
Inconel_718_Aged
Plain Carbon Steel
S/Steel_PH15-5
SAPH-400
SE508
SGACC
SGACEN
SGARC340-E
SGCC
SGCD1
Steel
Steel_Rolled
SUS304
SUS316
SUS316L
Wrought Stainless Steel
Ductile Iron
Gray Cast Iron
Iron_40
Iron_60
Iron_Cast_G25
Iron_Cast_G40
Iron_Cast_G60
Iron_Malleable
Iron_Nodular
Malleable Cast Iron

Load Edit

Elastoplastic Thermal

Structural

Elastic Modulus 1180 N/mm²

Poisson's Ratio 0.402

Mass Density 8.9e-07 kg/mm³

Thermal Expansion

Expansion 0

Ref. Temperature 0 [°C]

Factor of Safety Calculation

Failure Theory None

Tension 0 N/mm² Compression 0 N/mm²

☒ Elastoplastic

☐ Plastic Hardening Curve None Function

☐ Stress Strain Curve None Function

Hardening Rule Isotropic

Combined hardening factor 0

☒ Perfect Plastic

Yield Stress 15 N/mm²

General

Mass Proportional Damping 0 1/sec

Stiffness Proportional Damping 0 sec

幾何模型 – 材料 (FRP)



Define Material

All Name FRP Color Coord. Sys. None

Elastoplastic Thermal

Structural

Elastic Modulus 30000 N/mm²

Poisson's Ratio 0.3

Mass Density 1.5e-06 kg/mm³

Thermal Expansion

Expansion 0

Ref. Temperature 0 [°C]

Factor of Safety Calculation

Failure Theory None

Tension 0 N/mm² Compression 0 N/mm²

☒ Elastoplastic

☐ Plastic Hardening Curve None Function

☐ Stress Strain Curve None Function

Hardening Rule Isotropic

Combined hardening factor 0

☒ Perfect Plastic

Yield Stress 400 N/mm²

General

Mass Proportional Damping 0 1/sec

Stiffness Proportional Damping 0 sec

Load Edit

幾何模型 – 材料 (TPR)



Define Material

All Name TPR Color Coord. Sys. None

Elastoplastic Thermal

Structural

Elastic Modulus 10 N/mm²

Poisson's Ratio 0.49

Mass Density 8.9e-07 kg/mm³

Thermal Expansion

Expansion 0

Ref. Temperature 0 [°C]

Factor of Safety Calculation

Failure Theory None

Tension 0 N/mm² Compression 0 N/mm²

☐ Elastoplastic

☐ Plastic Hardening Curve None Function

☐ Stress Strain Curve None Function

Hardening Rule Isotropic

Combined hardening factor 0

☐ Perfect Plastic

Yield Stress 0 N/mm²

General

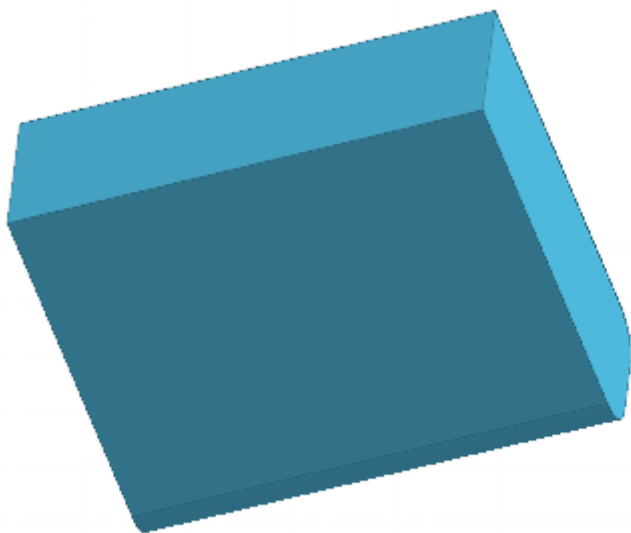
Mass Proportional Damping 0 1/sec

Stiffness Proportional Damping 0 sec

17-4PH, H1100
AISI 1020
AISI 1060
AISI 304 SS Annealed
AISI_310_SS
AISI_410_SS
AISI_Steel_1005
AISI_Steel_1008-HR
AISI 4340 Annealed
AISI_Steel_Maraging
Alloy Steel
Cast Alloy Steel
Cast Carbon Steel
Cast Stainless Steel
Chrome Stainless Steel
FC250
Galvanized Steel
Hp-1
Hp-4
Inconel_718_Aged
Plain Carbon Steel
S/Steel_PH15-5
SAPH-400
SE508
SGACC
SGACEN
SGARC340-E
SGCC
SGCD1
Steel
Steel_Rolled
SUS304
SUS316
SUS316L
Wrought Stainless Steel
Ductile Iron
Gray Cast Iron
Iron_40
Iron_60
Iron_Cast_G25
Iron_Cast_G40
Iron_Cast_G60
Iron_Malleable
Iron_Nodular
Malleable Cast Iron

Load Edit

幾何模型 – 材料 (Alloy Steel)



Define Material

All Name Alloy Steel Color Coord. Sys. None

17-4PH, H1100
AISI 1020
AISI 1060
AISI 304 SS Annealed
AISI_310_SS
AISI_410_SS
AISI_Steel_1005
AISI_Steel_1008-HR
AISI 4340 Annealed
AISI_Steel_Maraging
Alloy Steel
Cast Alloy Steel
Cast Carbon Steel
Cast Stainless Steel
Chrome Stainless Steel
FC250
Galvanized Steel
Hp-1
Hp-4
Inconel_718_Aged
Plain Carbon Steel
S/Steel_PH15-5
SAPH-400
SE508
SGACC
SGACEN
SGARC340-E
SGCC
SGCD1
Steel
Steel_Rolled
SUS304
SUS316
SUS316L
Wrought Stainless Steel
Ductile Iron
Gray Cast Iron
Iron_40
Iron_60
Iron_Cast_G25
Iron_Cast_G40
Iron_Cast_G60
Iron_Malleable
Iron_Nodular
Malleable Cast Iron

Elastoplastic Thermal

Structural

Elastic Modulus 210000 N/mm²

Poisson's Ratio 0.28

Mass Density 7.7e-06 kg/mm³

Thermal Expansion

Expansion 1.3e-05

Ref. Temperature 0 [°C]

Factor of Safety Calculation

Failure Theory None

Tension 0 N/mm² Compression 0 N/mm²

Elastoplastic

Plastic Hardening Curve None Function

Stress Strain Curve None Function

Hardening Rule Isotropic

Combined hardening factor 0

Perfect Plastic

Yield Stress 0 N/mm²

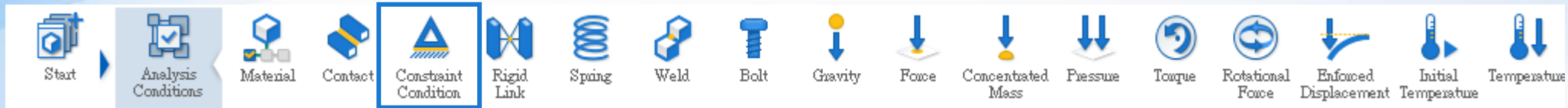
General

Mass Proportional Damping 0 1/sec

Stiffness Proportional Damping 0 sec

Load Edit

分析工況 | 約束條件



Define Boundary Condition [X]



Name:

Select [^]
Face:

Reference Object [^]
Type:

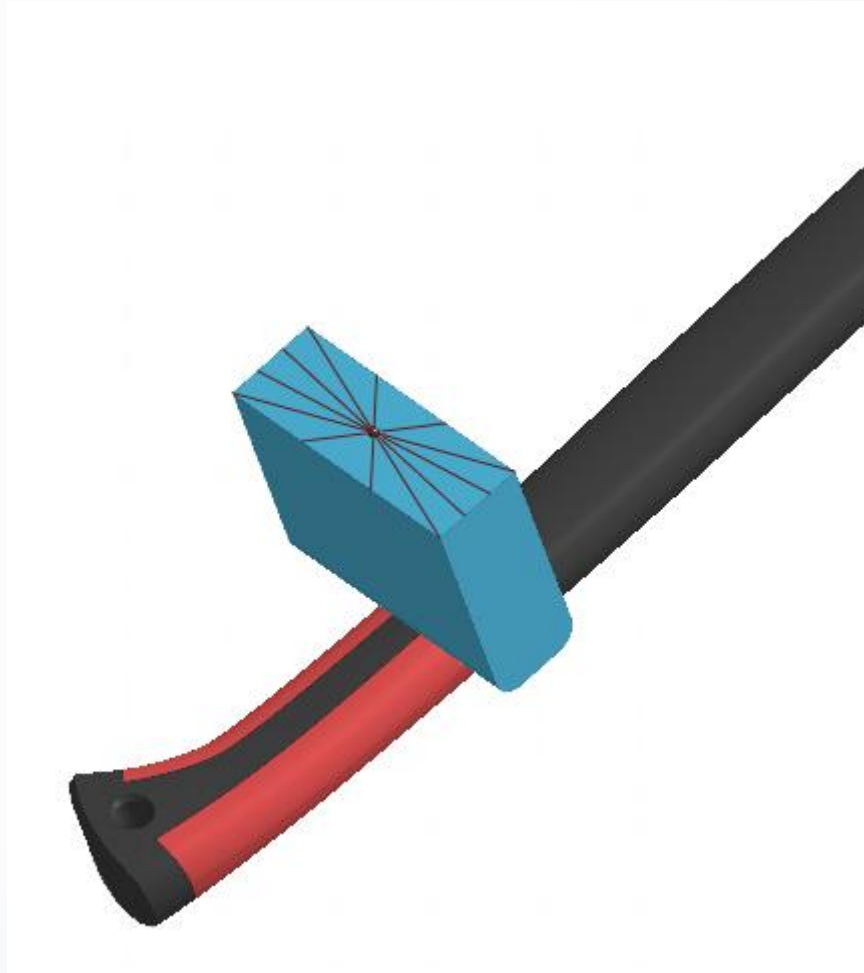
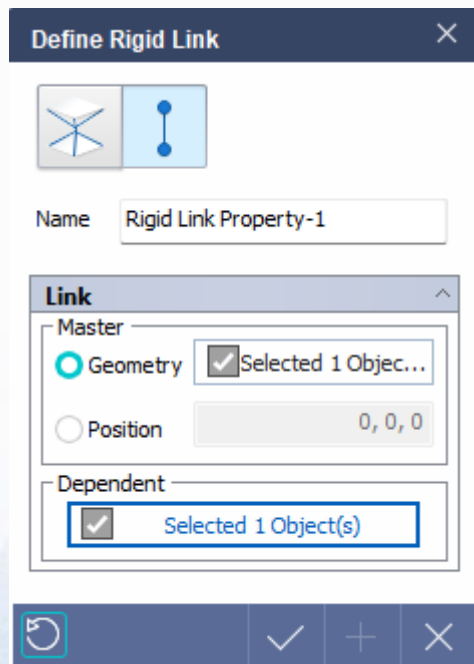
Symmetry Condition [v]

DOF [^]
☒ Tx ☒ Ty ☒ Tz

[Reset] [OK] [Add] [Cancel]



分析工況 | 剛性連桿



分析工況 | 強制位移



Define Enforced Displacement

Name

Displacement-1

➔

Selected 1 Object(s)

Reference Object

TypeGlobal Coordinate System

Direction

☐ Tx

0

mm

☐ Rx

0

☐ Ty

0

mm

☐ Ry

0

☒ Tz

-200

mm

☐ Rz

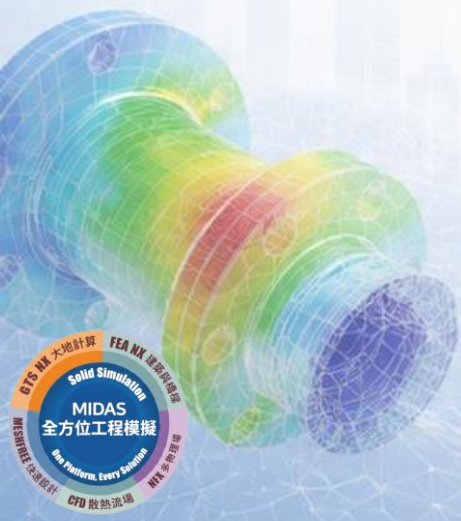
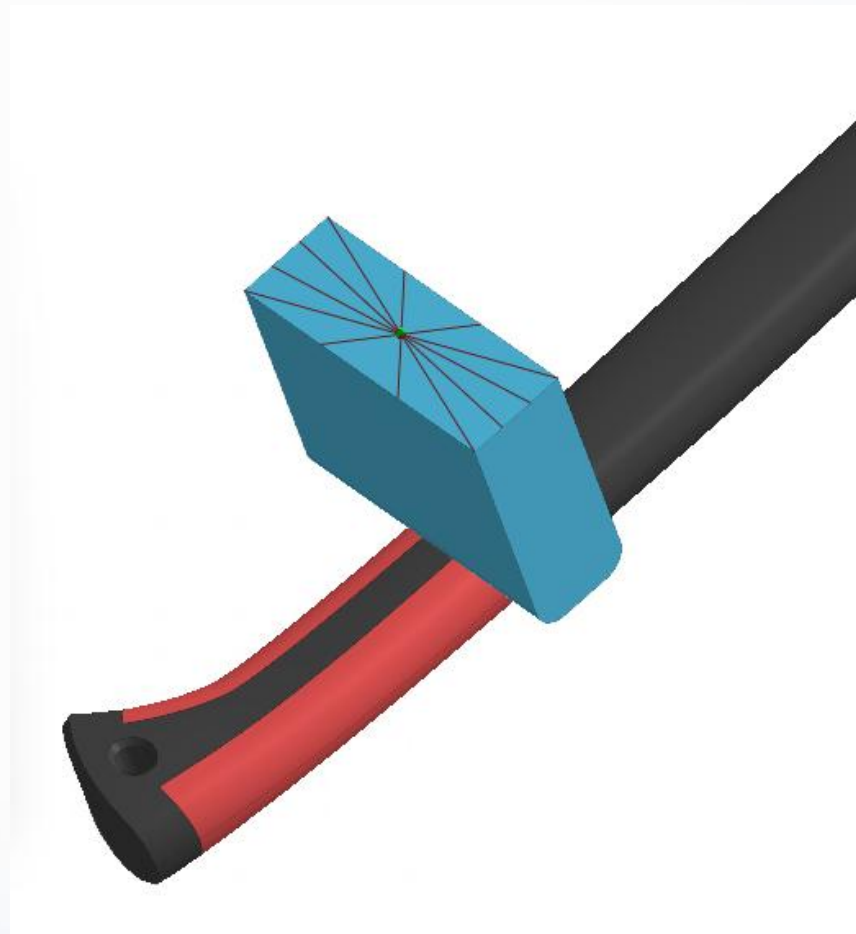
0

↺

✓

+

✕



分析工況 | 接觸



Define Contact

Name

Select

Selected 7 Object(s)

Type

Welded Contact

Coefficient of friction0

Normal Stiffness factor0.1

Tangential Stiffness factor0.01

Search Range

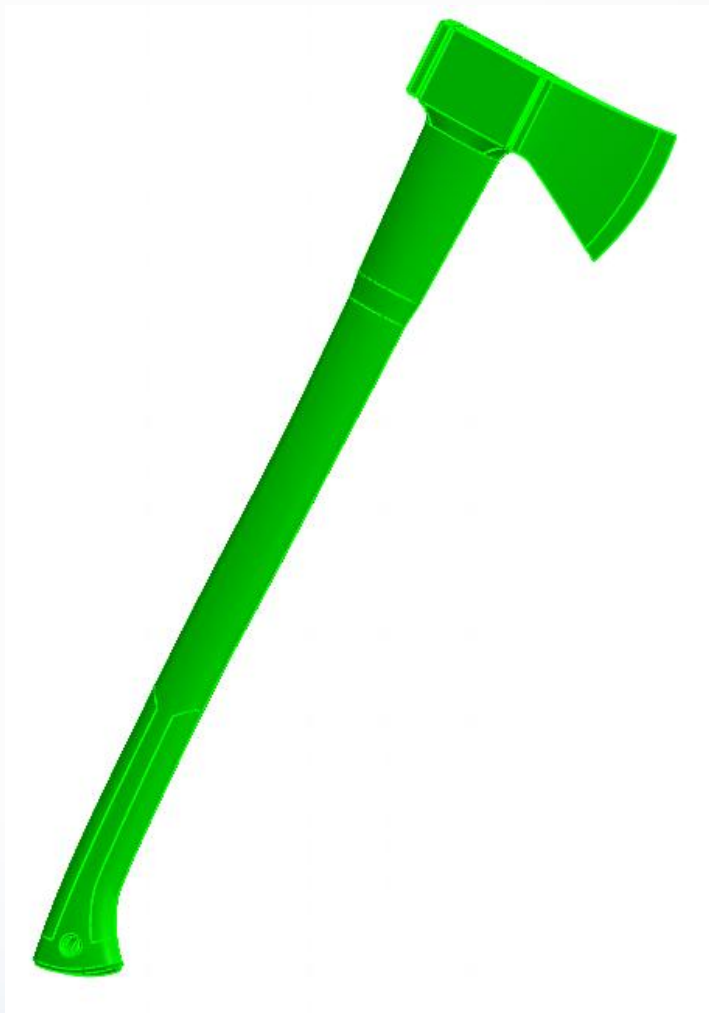
☒ Auto

0.745906 mm

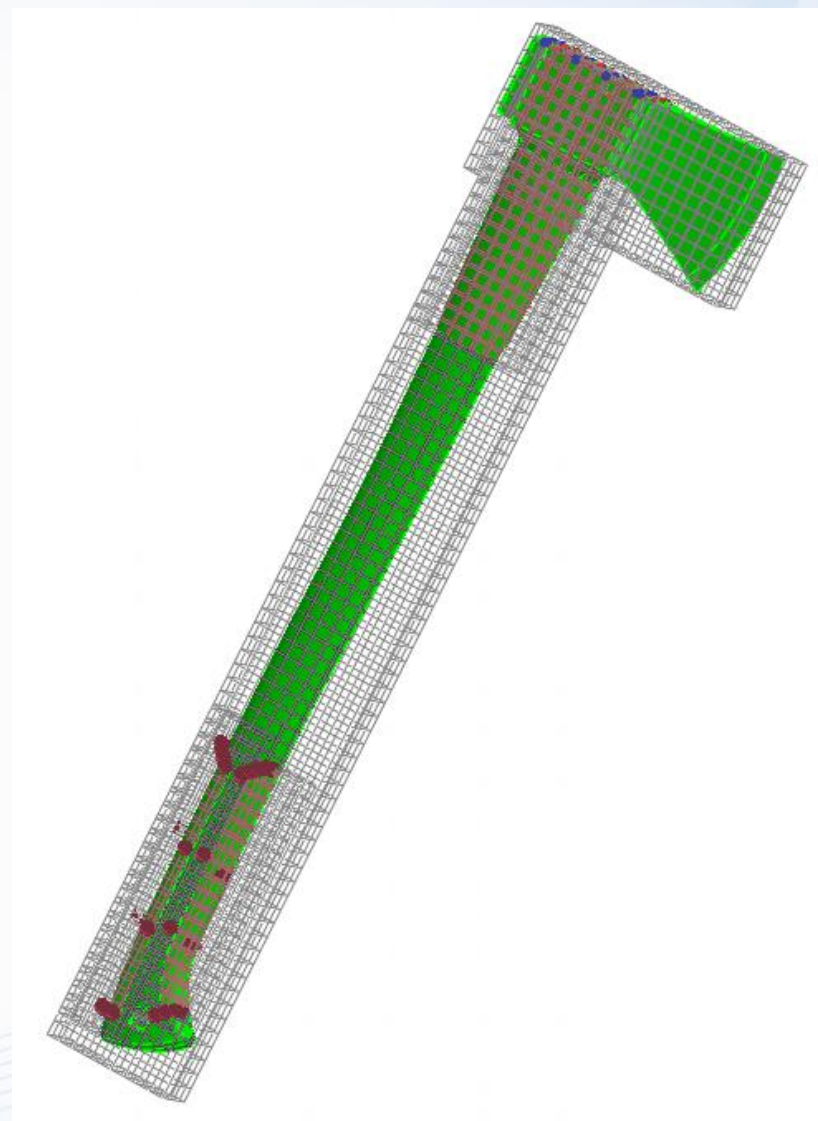
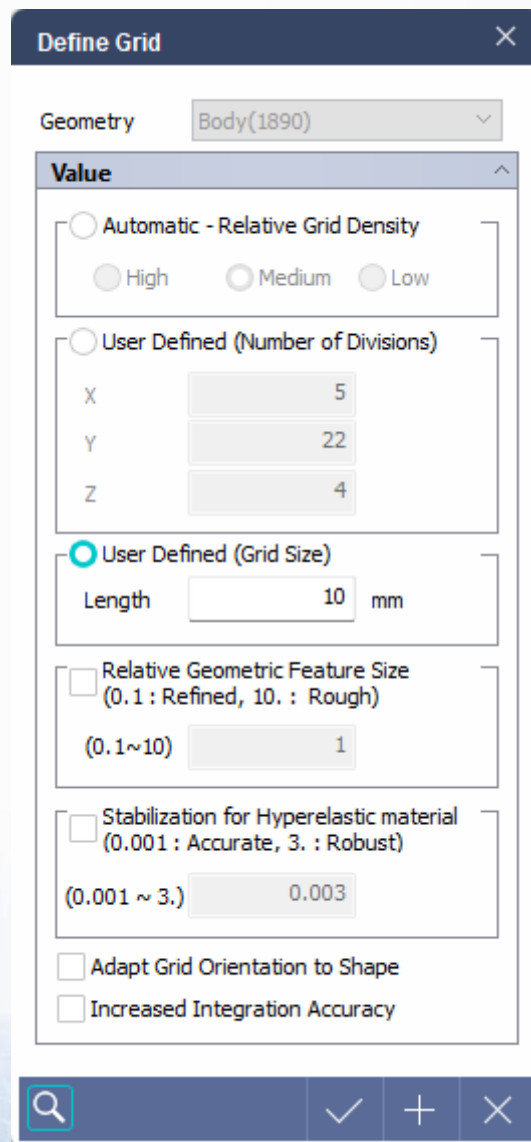
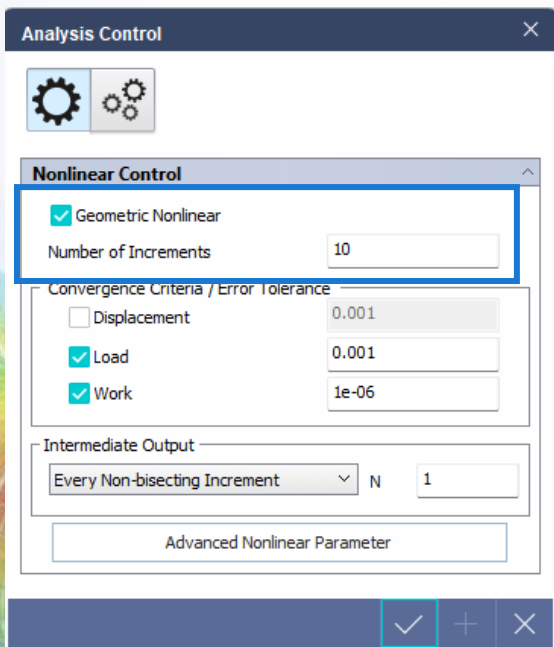
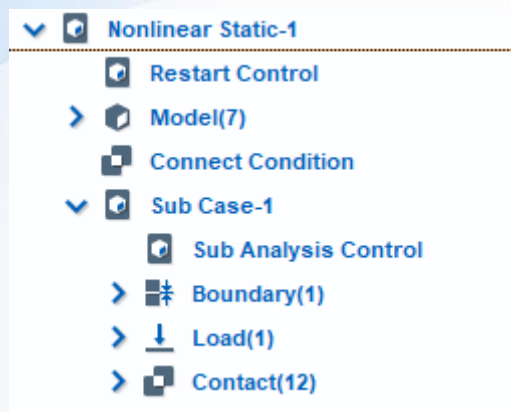
✓

+

×



分析工況



分析結果 | 變形



Deformations

DISPLACEMENT-XYZ

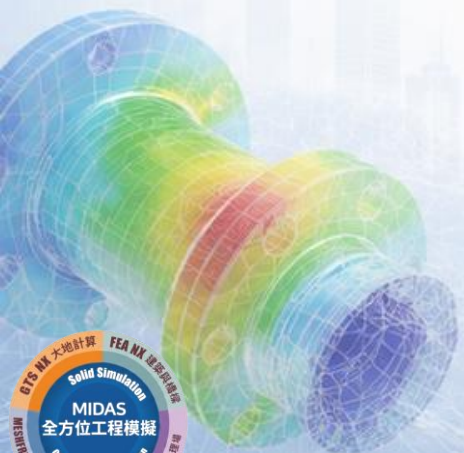
	+286.62756
3.9%	
	+262.74194
5.4%	
	+238.85630
2.9%	
	+214.97068
5.6%	
	+191.08506
6.3%	
	+167.19942
1.8%	
	+143.31380
0.9%	
	+119.42817
1.0%	
	+95.54254
0.9%	
	+71.65691
1.0%	
	+47.77129
1.5%	
	+23.88566
68.8%	
	+0.00003

Nonlinear Static-1

Sub Case-1

INCR=50 (LOAD=1.000)

Unit : mm

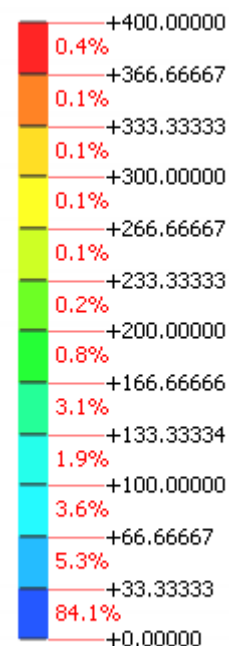


分析結果 | STRESS VON MISES



Stress

STRESS VON MISES



Nonlinear Static-1

Sub Case-1

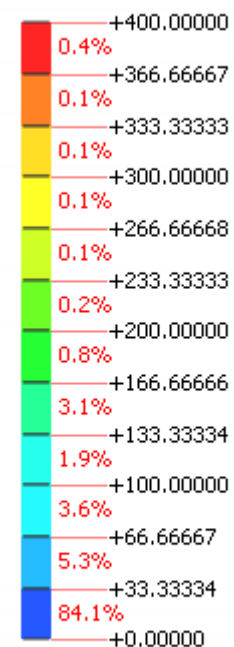
INCR=50 (LOAD=1.000)

Unit : N/mm²



Stress

STRESS VON MISES



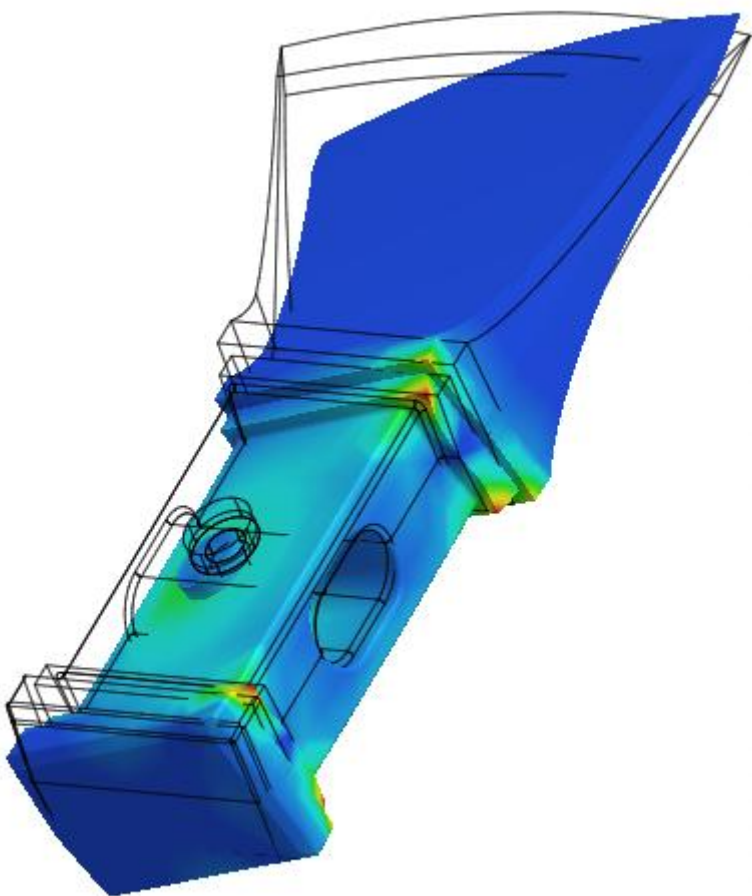
Nonlinear Static-1

Sub Case-1

INCR=50 (LOAD=1.000)

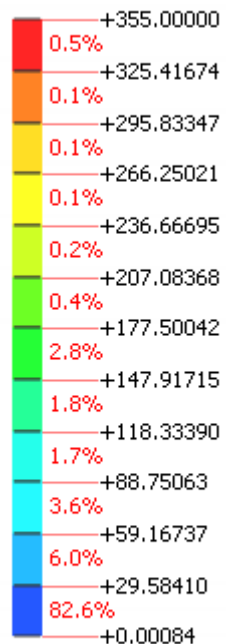
Unit : N/mm²

分析結果 | STRESS VON MISES



Stress

STRESS VON MISES

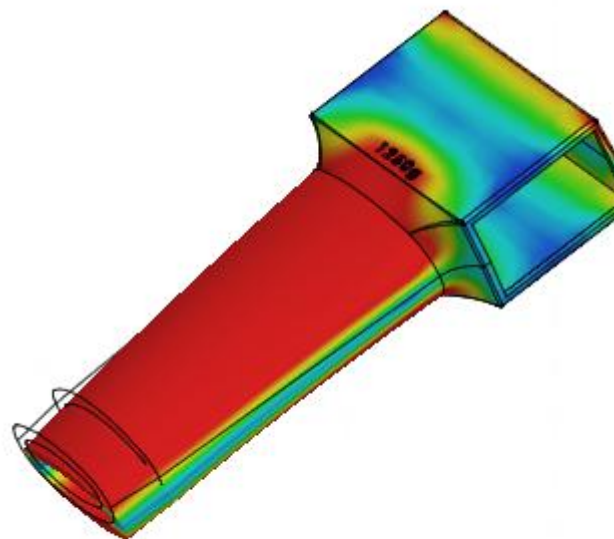


Nonlinear Static-1

Sub Case-1

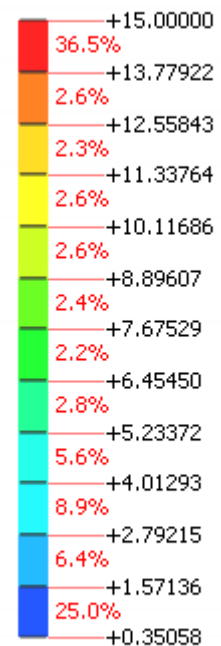
INCR=50 (LOAD=1.000)

Unit : N/mm²



Stress

STRESS VON MISES



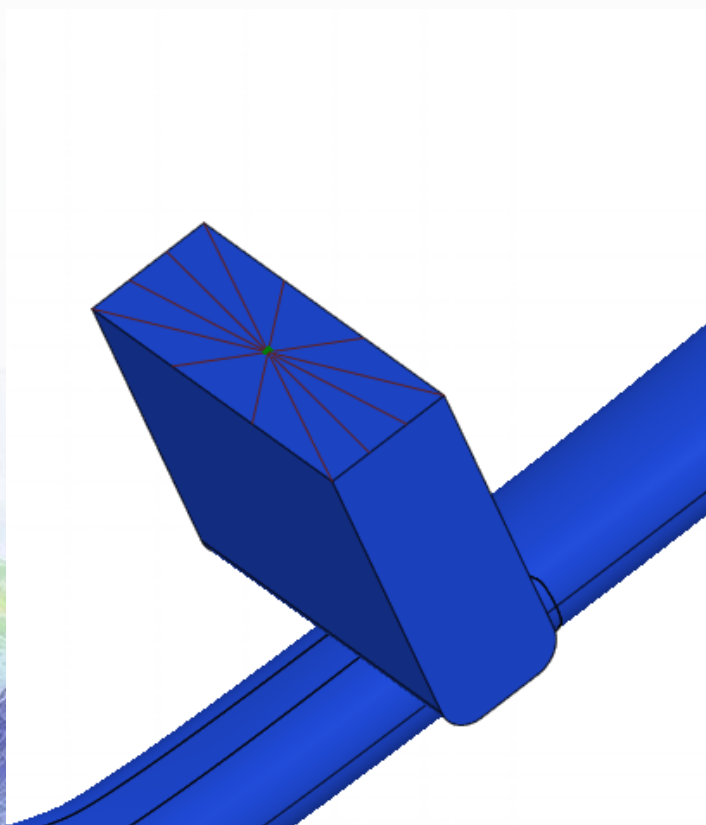
Nonlinear Static-1

Sub Case-1

INCR=50 (LOAD=1.000)

Unit : N/mm²

分析結果 | FORCE DISPLACEMENT CURVE



Reaction

Selected 1 Object(s)

Sub Case-1 : INCR=50 (LOAD=1.000) Calculation

Name	Value
FX	0.0
FY	0.0
FZ	0.0
MX	0.0
MY	0.0
MZ	0.0

Step

Multi-step result table

Step : Result

- ☒ Sub Case-1 : INCR=0 (LOAD=0.000)
- ☒ Sub Case-1 : INCR=1 (LOAD=0.020)
- ☒ Sub Case-1 : INCR=2 (LOAD=0.040)
- ☒ Sub Case-1 : INCR=3 (LOAD=0.060)
- ☒ Sub Case-1 : INCR=4 (LOAD=0.080)
- ☒ Sub Case-1 : INCR=5 (LOAD=0.100)
- ☒ Sub Case-1 : INCR=6 (LOAD=0.120)

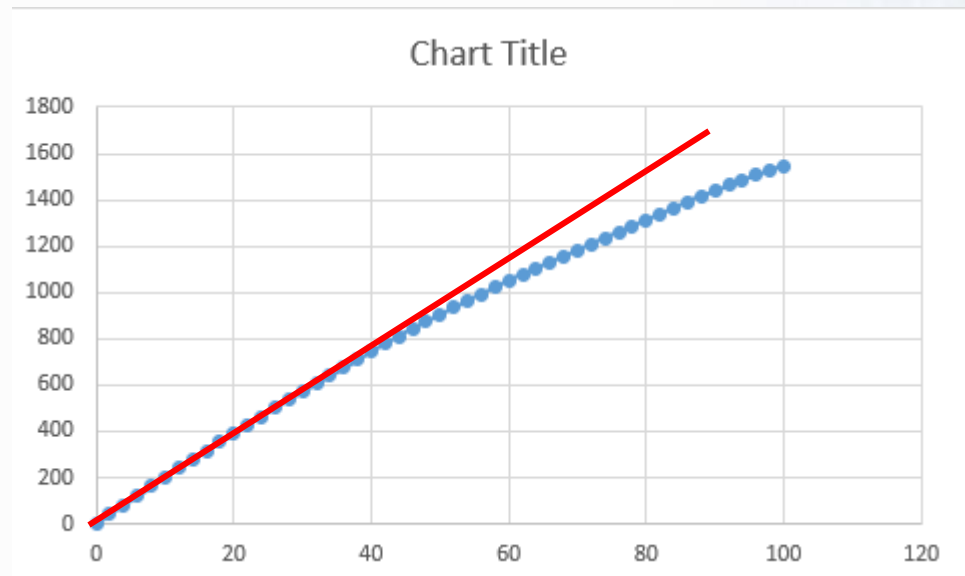
分析結果 | FORCE DISPLACEMENT CURVE

Multi-step result table

Step	FX	FY	FZ	MX	MY	MZ
0.000	0.000e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00	0.000e+00
0.020	0.000e+00	0.000e+00	-4.118e+01	0.000e+00	0.000e+00	0.000e+00
0.040	0.000e+00	0.000e+00	-8.182e+01	0.000e+00	0.000e+00	0.000e+00
0.060	0.000e+00	0.000e+00	-1.219e+02	0.000e+00	0.000e+00	0.000e+00
0.080	0.000e+00	0.000e+00	-1.615e+02	0.000e+00	0.000e+00	0.000e+00
0.100	0.000e+00	0.000e+00	-2.007e+02	0.000e+00	0.000e+00	0.000e+00
0.120	0.000e+00	0.000e+00	-2.394e+02	0.000e+00	0.000e+00	0.000e+00
0.140	0.000e+00	0.000e+00	-2.776e+02	0.000e+00	0.000e+00	0.000e+00
0.160	0.000e+00	0.000e+00	-3.155e+02	0.000e+00	0.000e+00	0.000e+00
0.180	0.000e+00	0.000e+00	-3.529e+02	0.000e+00	0.000e+00	0.000e+00
0.200	0.000e+00	0.000e+00	-3.900e+02	0.000e+00	0.000e+00	0.000e+00
0.220	0.000e+00	0.000e+00	-4.267e+02	0.000e+00	0.000e+00	0.000e+00
0.240	0.000e+00	0.000e+00	-4.631e+02	0.000e+00	0.000e+00	0.000e+00
0.260	0.000e+00	0.000e+00	-4.992e+02	0.000e+00	0.000e+00	0.000e+00
0.280	0.000e+00	0.000e+00	-5.349e+02	0.000e+00	0.000e+00	0.000e+00

分析結果

FORCE DISPLACEMENT CURVE



Red Line: Linear curve (theoretical)

Blue Line: Non linear curve (actual)

