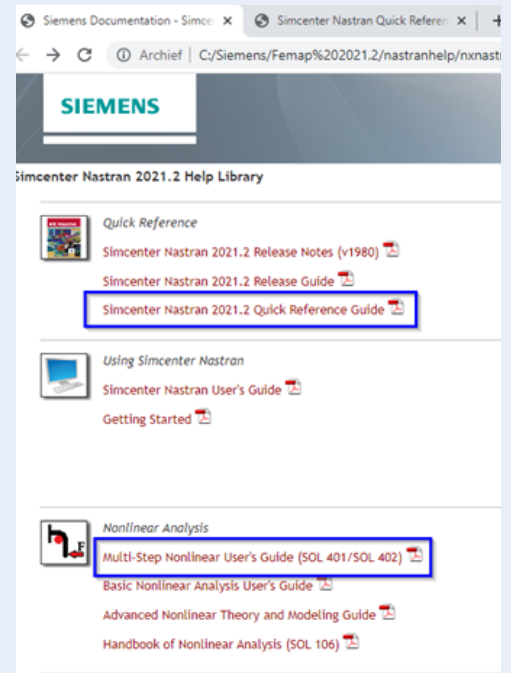
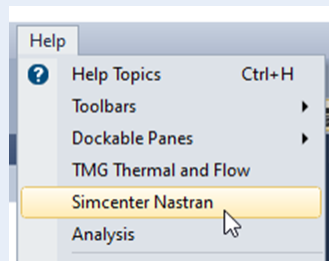


basics 401/402 solver

Where to find your information.

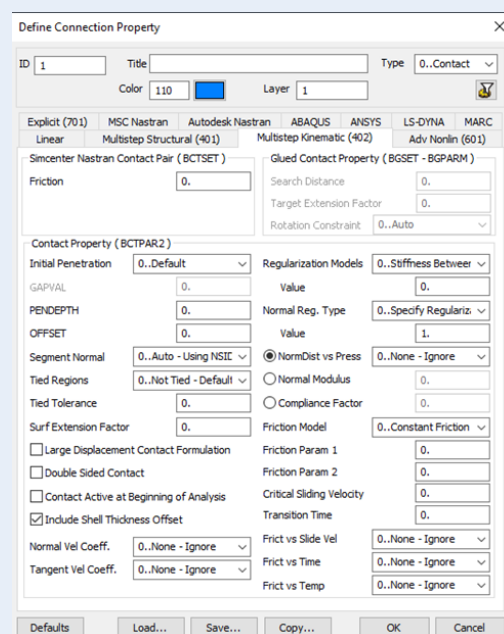
manual

See Quick Reference Guide and Multi_Step User's Guide for more information.



contact property Femap help

At the Define Connection Property window in Femap, press F1 to get extensive help on the connection parameters.

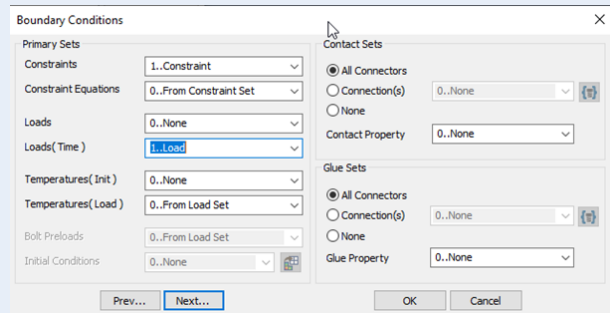


basics 401/402 solver

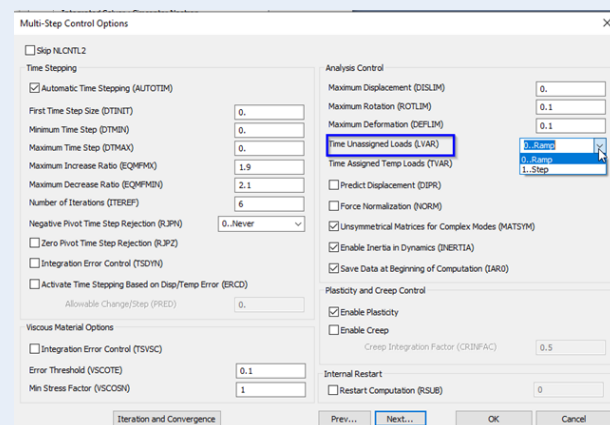
Where to find your information.

loads

If time functions are used to define the load, at the boundary conditions the load set must be defined at Loads (Time)

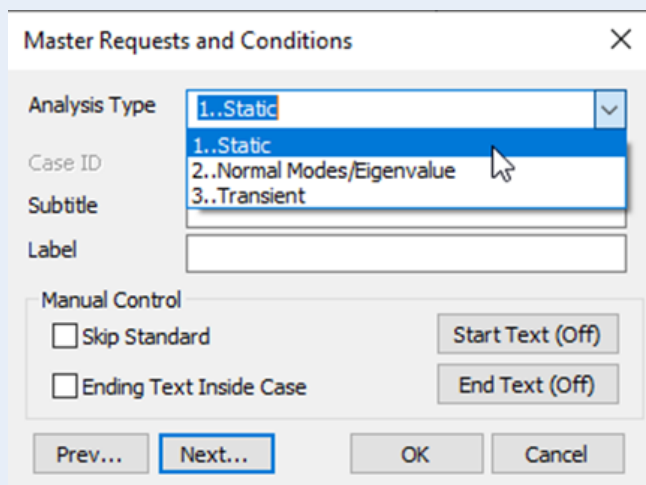


If no time functions are used to define the load, parameter LVAR decides if the load should be ramped or applied at once.



settings

In the analysis set manager you can find the default settings. In the following slides some suggestions are made whether or not to keep the default settings.

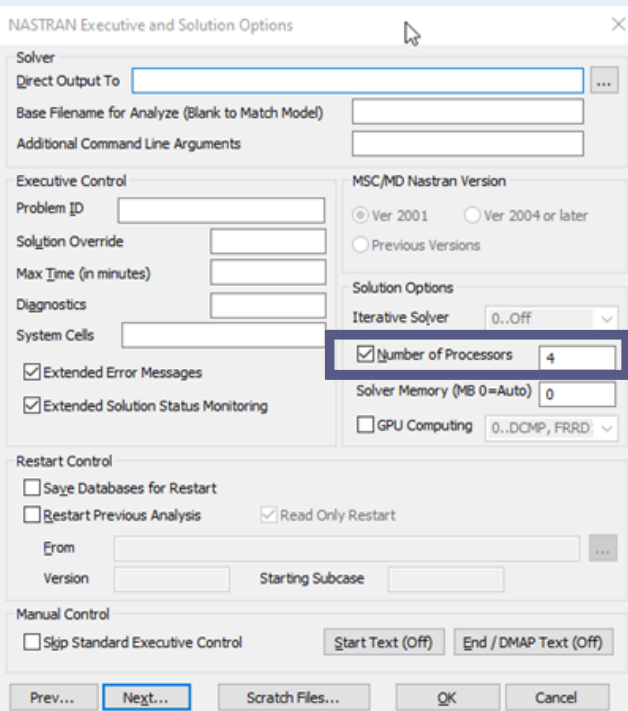


In the Master Requests and Conditions the different Analysis Types can be chosen.

settings sol 402

Executive and Solution Options

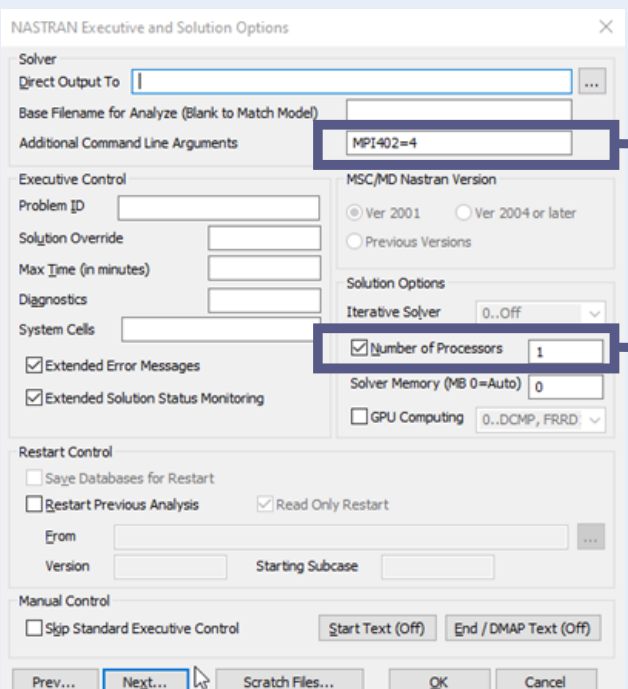
sol 601



The screenshot shows the 'NASTRAN Executive and Solution Options' dialog box. The 'Number of Processors' is set to 4. The 'Iterative Solver' is set to '0..Off'. The 'Solver Memory (MB 0=Auto)' is set to 0. The 'GPU Computing' is set to '0..DCMP, FRRD'. The 'Extended Error Messages' and 'Extended Solution Status Monitoring' are checked. The 'Restart Control' section has 'Read Only Restart' checked. The 'Manual Control' section has 'Skip Standard Executive Control' checked. The 'Start Text (Off)' and 'End / DMAP Text (Off)' buttons are visible.

Number of real processors(cores)
601 only supports SMP parallelism

sol 402



The screenshot shows the 'NASTRAN Executive and Solution Options' dialog box for Sol 402. The 'Additional Command Line Arguments' field contains 'MPI402=4'. The 'Number of Processors' is set to 1. The 'Iterative Solver' is set to '0..Off'. The 'Solver Memory (MB 0=Auto)' is set to 0. The 'GPU Computing' is set to '0..DCMP, FRRD'. The 'Extended Error Messages' and 'Extended Solution Status Monitoring' are checked. The 'Restart Control' section has 'Read Only Restart' checked. The 'Manual Control' section has 'Skip Standard Executive Control' checked. The 'Start Text (Off)' and 'End / DMAP Text (Off)' buttons are visible.

This command switches on DMP
parallelism for 4 cores.
For DMP > 4 an extra license is needed.

In Sol 401 DMPPARALLEL = 4

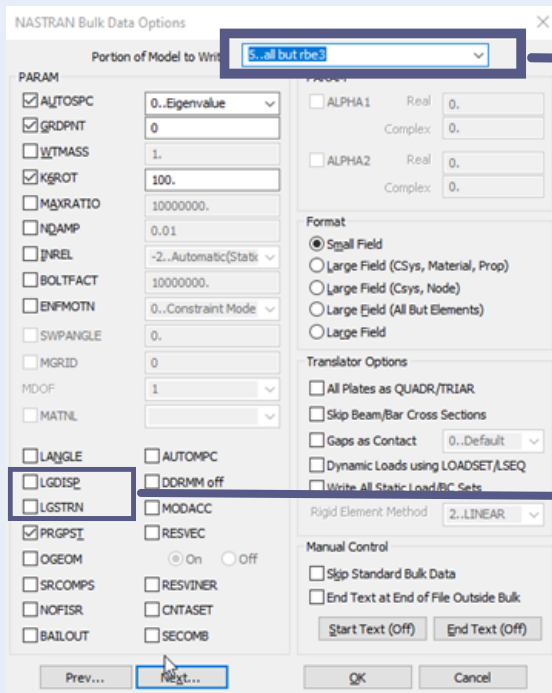
Mixed DMP/SMP parallelism possible:
If Number of processors =
2 then 4 additional SMP cores are used:
 $SMP * DMP = 2 * 4 = 8$.

SMP*DMP should not exceed the
number of real processors of your
machine.

Bulk Data Settings

Sol 402

601

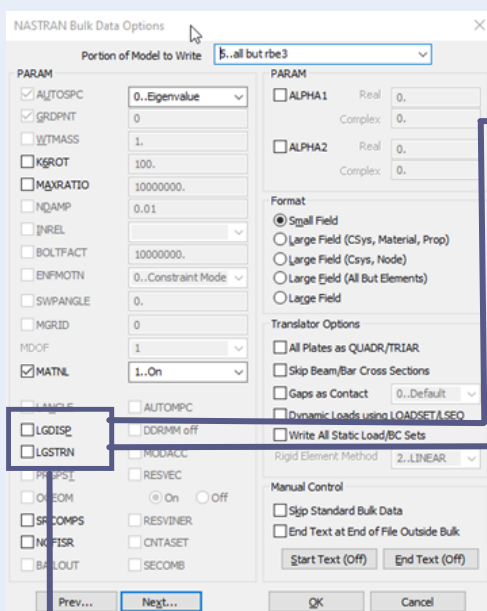
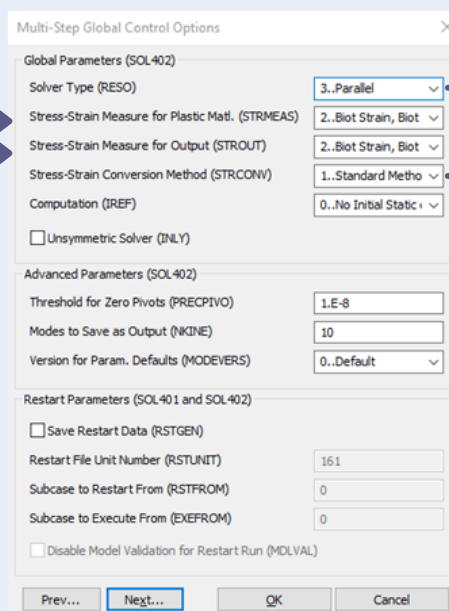


Number of real processors(cores)
601 only supports SMP parallelism

Small displacement and small strain
formulation

Sol 402 Leaves STRMEAS and STROUT to
2:Engineering values

402

RESO to "Parallel" mostly is faster

Preferred to the default "exact
method"

LGSTRN checked would switch on
STRMEAS and STROUT to
1:True values.

In contrast to 601 it is possible to
use an engineering material curve,
convert it internally to a
TRUE curve, do a LGSTRN
simulation (STRMEAS=1),
and convert the results back
(STRCONV) to Engineering values
(STROUT=2) for direct input
curve/output value comparison.

setting Sol 402

If settings in the beginning of the analysis require different settings, e.g. due to contact settling, then subcases can be useful.

401/402: Subcases supported to modify solution settings in contrast to 601 (where a restart would be required)

601

NASTRAN NXSTRAT Solver Parameters

Time Steps
Number of Steps: 1
Time Increment: 0.001
Output Every Nth Step: 1

Analysis Control
Solver: 0..Direct Sparse

Multigrid Solver
Max Iterations: 1000
EPSIA Tolerance: 1.E-6
EPSIB Tolerance: 1.E-4
EPSII Tolerance: 1.E-8

Restart Options
☒ Normal
☐ Restart Previous
☐ Recover Results
Restart at Time: 0.
Results Frequency: 0

Mass Formulation
☒ Consistent
☐ Lumped

Other Parameters
Bolt Force Increments: 1
Num Subgroups: 0

Analysis Options
Large Strain Form: 0..Auto
Shell Thickness Integ: 2..Gauss Integral
Shell DOF Angle: 5.
Element Death Time Delay: 0.
☒ Matrix Stabilization Factor: 1.E-12
☐ Ulp Formulation for Almost Incompressible
☐ Displacements Applied to Deformed
☒ Loads Change with Deformation
☒ Incompatible Modes for 4 Node Shells
☐ Use NNN v8.5 Elastic Beam Formulation
Max Disp/Iteration: 0.0005
Drilling DOF Factor: 1.E-4

Translation Options
☐ 9/27-Node Element Conversion
RBAR opt: 1..Rigid
RBE2 opt: 1..Rigid
Rigid Elem Spring Stiffness: 0.
Rigid Elem Young's Mod: 0.
Rigid Elem Effective Area: 0.
Rigid Elem Critical Length: 0.
☐ Convert Dependency to True Stress
☐ Allow Element Rupture
☐ Solid Results in Material CSys

Prev... Next... Extra Time Steps... OK Cancel

402

Analysis Set Manager (Active: 2..Simcenter Nastran Multi-Step NL KIN Analysis)

Analysis Set: 1..non-linear Transport 43001 - report LC5
Analysis Set: 2..Simcenter Nastran Multi-Step NL KIN Analysis
Solver: Simcenter Nastran
Type: Multi-Step Nonlinear Kinematic
Integrated Solver: Simcenter Nastran
Options
Global Requests and Conditions
Case: 1..Sub1_stab
Case: 2..Sub2_no_Stab
Analysis Set: 3..Simcenter Nastran Multi-Step NL KIN Analysis

Analyze
Analyze Multiple...
Export
Active...
Preview Input
MultiSet...

Subcase Settling

Multi-Step Control Options

Time Stepping
☒ Automatic Time Stepping (AUTOTM)
First Time Step (DTINT): 0.002
Minimum Time Step (DTMIN): 10.
Maximum Time Step (DTMAX): 0.
Maximum Increase Ratio (EQHFM): 1.9
Maximum Decrease Ratio (EQHFM): 1.
Number of Iterations (ITERF): 30
Negative Pivot Time Step Rejection (RJP): 0..Never
☐ Zero Pivot Time Step Rejection (RJP2)
☐ Integration Error Control (TSDYN)
☐ Activate Time Stepping Based on Disp/Temp Error (ERRCD)
Allowable Change/Step (PREO): 0.
Viscous Material Options
☐ Integration Error Control (TSVSC)
Error Threshold (VSCOTE): 0.1
Min Stress Factor (VSCOSF): 1

Analysis Control
Maximum Displacement (DISLIM): 0.
Maximum Relative Displacement (DISLRM): 0.1
Maximum Deformation (DEFLIM): 0.1
Time Unassigned Loads (LVAR): 0..Ramp
Time Assigned Temp Loads (TVAR): 0..Ramp
☐ Predict Displacement (DPR)
☐ Force Normalization (NORM)
☒ Unsymmetrical Matrices for Complex Modes (MATSYM)
☒ Enable Inertia in Dynamics (INERTIA)
☒ Save Data at Beginning of Computation (IAR0)
Plasticity and Creep Control
☒ Enable Plasticity
☐ Enable Creep
Creep Integration Factor (CIRFAC): 0.5
Internal Restart
☐ Restart Computation (RSTB): 0

Iteration and Convergence
Prev... Next... OK Cancel

Increased to default

Start value in case of automatic time stepping checked

Solution and Convergence Options

Analysis Options
Stabilization Factor (STAB): 1.E-3
Maximal Disp Variation (MAD0): 0.2
Time Integration
Line Search (LNS)
Line Search Convergence Tol (PRLN): 0.1
Min Line Search Factor (AMN): 0.5
Max Line Search Convergence Factor (AMAX): 2.
Max Iter (ITMA): 50
Rel Iter (ITMA): 0.001
Reference Force Tol (PRCR): 1.
Reference Force (REFP): 1.
Relative Disp Force (PRCQ): 1.
Reference Disp (REFU): 1.
Rel Energy Tol (PRCE): 0.001
Reference Energy (REFE): 1.
Stiffness Update Param 1 (IT3K): 1
Stiffness Update Param 2 (IT2K): 2
Stiffness Update Param 3 (IT3K): 1
First Iteration Strategy (PLAS): 1..Plastic tangent r
Rigid Body Motion Convergence (OTRI): 1..Enable based on

Equilibrium Iteration and Convergence
Line Search (LNS)
Line Search Convergence Tol (PRLN): 0.1
Min Line Search Factor (AMN): 0.5
Max Line Search Convergence Factor (AMAX): 2.
Max Iter (ITMA): 50
Rel Iter (ITMA): 0.001
Reference Force Tol (PRCR): 1.
Reference Force (REFP): 1.
Relative Disp Force (PRCQ): 1.
Reference Disp (REFU): 1.
Rel Energy Tol (PRCE): 0.001
Reference Energy (REFE): 1.
Stiffness Update Param 1 (IT3K): 1
Stiffness Update Param 2 (IT2K): 2
Stiffness Update Param 3 (IT3K): 1
First Iteration Strategy (PLAS): 1..Plastic tangent r
Rigid Body Motion Convergence (OTRI): 1..Enable based on

Time Integration
Newmark Param 1 (BETA): 0.25
Newmark Param 2 (GAMA): 0.5
HHT Scheme Param (ALFA): 0.05
Generalized Scheme Param (TETA): 0.8
Intg Control Param 1 (PRCO): 0.001
Intg Control Param 2 (PRCO): 0.
Contact
Relaxation Force (RELX): 1.
Characteristic Length (DCON): 0.
Intg Regularization Factor (PRCS): 0.
Threshold for Contact Force Variation (PRCF): 0.1
Diagnostic
Print Frequency (DMPG): 10
Max Residual Printout (DMPR): 0
Max Pivots (DMPV): 5

Cancel OK

Subcase setting: More stabilization

No Line search (I=line search)

Increased to default

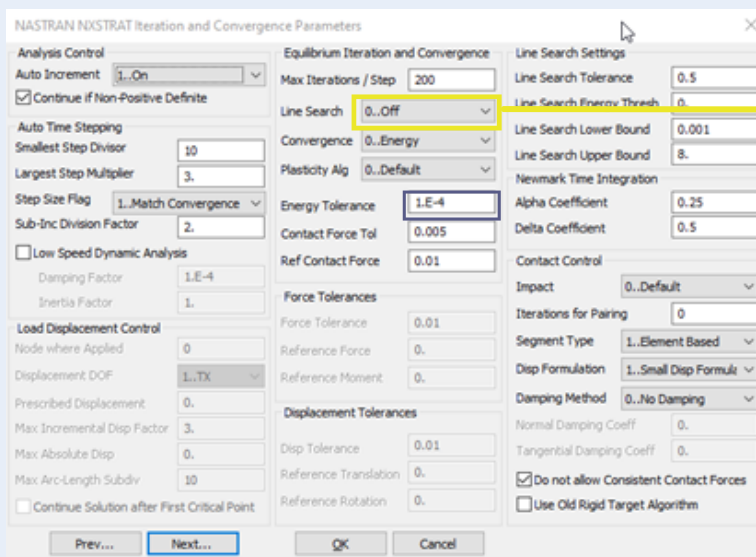
Force convergence tolerance: additional check compared to 601 setting

Energy convergence tolerance default 1E-3 kept...601 setting: 1E-4

setting Sol 402

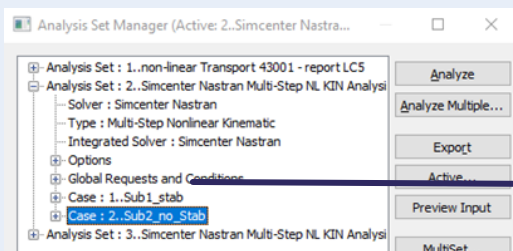
401/402: Subcases supported to modify solution settings
in contrast to 601 (where a restart would be required)

601

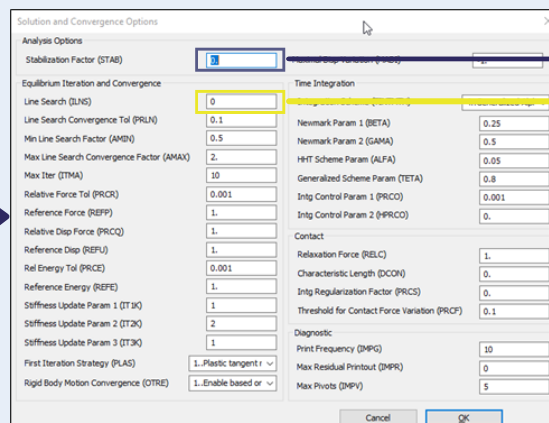
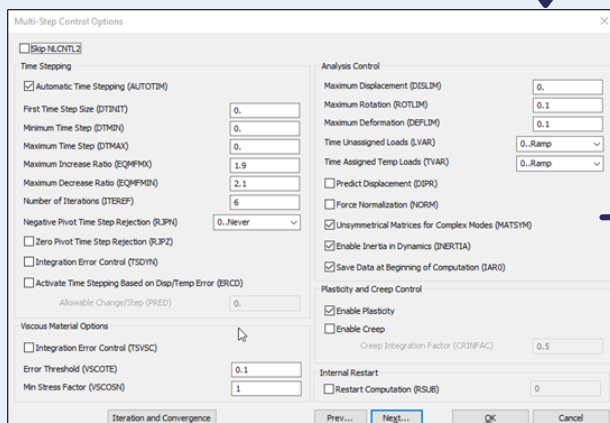


No Line search

402



Subcase loading



Subcase setting: no stabilization(default)

No Line search
ILNS = 1, then Line Search

setting time steps

601

402

NASTRAN Advanced Nonlinear Time Steps

	Num Steps	Time Increment	Output Interval
1	1	0.001	1
2	2	0.0495	2
3	18	0.05	18
4	3	0.05	3
5	4	0.043125	4
6	4	0.043125	4
7	2	0.046	2
8	0	0.	1
9	0	0.	1
10	0	0.	1

OK Cancel

Setting subcase

Loading subcase

Subcase 1 Time Steps

	End Time	Number of Increments	Output Frequency	Output Increment
0	0.1	2	Requested Increment	0
1	0.	0	Requested Increment	0
2	0.	0	Requested Increment	0
3	0.	0	Requested Increment	0
4	0.	0	Requested Increment	0

Prev... Next... OK Cancel

Subcase 2 Time Steps

	End Time	Number of Increments	Output Frequency	Output Increment
0	1.	18	Skip Factor	18
1	1.15	3	Skip Factor	3
2	1.3225	4	Skip Factor	4
3	1.495	4	Skip Factor	4
4	1.587	2	Skip Factor	2

Prev... Next... OK Cancel

contact settings

601

402

Define Connection Property

ID 1 Title Z-shim (Friction 0 or 1) Type 0..Contact

Color 110 Layer 1

Exploit (701) MSC Nastran Autodesk Nastran ABAQUS ANSYS LS-DYNA MARC

Linear Multistep Structural (401) Multistep Kinematic (402) Adv Nonlin (601)

Simcenter Nastran Glued Contact Property (BGSET)

Extension Factor 0.

General

Contact Type 0..Constraint Function

Initial Penetration 0..Eliminate

Gap Distance 0..Eliminate

Penetration Depth 1..Eliminate/Print 2..Ignore 3..Specify with Gap Distance

Segment Normal 0..Default

Offset Type 0..Single Sided

Offset Distance 0.

Birth Time 0.

Death Time 0.

Constraint Function Contact Algorithm

Normal Constraint 0.

Frictional Constraint 0.

Compliance Factor 0.

Standard Contact Algorithm

Disp Formulation 1..Small Disp Formulation

Consistent Stiffness

Tied Tolerance 0.

Init Penetration Duration 0.

Surface Extension Factor 0.

Friction Model 0..Default (Param 1)

Friction Param 1 0.5

Friction Param 2 0.

Friction Param 3 0.

Friction Param 4 0.

Friction Param 5 0.

Friction Delay

Rigid Target Options

Defaults Load... Save... Copy... OK Cancel

Define Connection Property

ID 1 Title Z-shim (Friction 0 or 1) Type 0..Contact

Color 110 Layer 1

Exploit (701) MSC Nastran Autodesk Nastran ABAQUS ANSYS LS-DYNA MARC

Linear Multistep Structural (401) Multistep Kinematic (402) Adv Nonlin (601)

Simcenter Nastran Contact Pair (BCTSET)

Friction 0.5

Glued Contact Property (BGSET - BGPARM)

Search Distance 10.

Target Extension Factor 0.01

Rotation Constraint 0..Auto

Contact Property (BCTPAR2)

Initial Penetration 0..Default

GAPVAL 0..Default

PENDEPTH 1..Initial Penetrations - Eliminated 2..Initial Penetrations - Ignored 3..Initial Penetrations - GAPVAL Override 12..Zero Penetrations for Closest Node 13..Set Penetrations to GAPVAL for Closest Node

OFFSET 0..Auto - Using NSI

Segment Normal 0..Not Tied - Default

Tied Regions 0..Not Tied - Default

Tied Tolerance 0.

Surf Extension Factor 0.

Regularization Models 0..Stiffness Between

Normal Vel Coeff. 0..None - Ignore

Tangent Vel Coeff. 0..None - Ignore

Friction Model 0..Constant Friction

Friction Param 1 0.

Friction Param 2 0.

Critical Sliding Velocity 0.

Transition Time 0.

Frict vs Slide Vel 0..None - Ignore

Frict vs Time 0..None - Ignore

Frict vs Temp 0..None - Ignore

Defaults Load... Save... Copy... OK Cancel

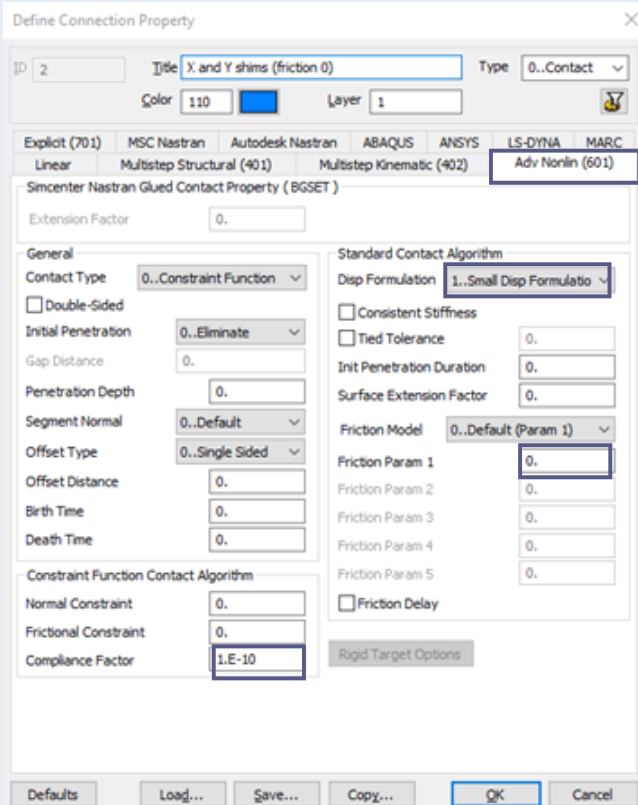
Additional option 13 specified:
The contact region is shifted with the very small (unphysical) initial penetration of the closest node (See f06), such that the closest node becomes initially stress free touching.

Connection property with friction, without compliance

example contact settings

601

402



Define Connection Property

ID: 2 Title: X and Y shims (friction 0) Type: 0..Contact

Color: 110 Layer: 1

Exploit (701) MSC Nastran Autodesk Nastran ABAQUS ANSYS LS-DYNA (601) MARC
Linear Multistep Structural (401) Multistep Kinematic (402) Adv Nonlin (601)

Simcenter Nastran Glued Contact Property (BGSET)

Extension Factor: 0.

General

Contact Type: 0..Constraint Function

☐ Double-Sided

Initial Penetration: 0..Eliminate

Gap Distance: 0.

Penetration Depth: 0.

Segment Normal: 0..Default

Offset Type: 0..Single Sided

Offset Distance: 0.

Birth Time: 0.

Death Time: 0.

Constraint Function Contact Algorithm

Normal Constraint: 0.

Frictional Constraint: 0.

Compliance Factor: 1.E-10

Standard Contact Algorithm

Disp Formulatio: 1..Small Disp Formulatio

☐ Consistent Stiffness

☐ Tied Tolerance: 0.

Init Penetration Duration: 0.

Surface Extension Factor: 0.

Friction Model: 0..Default (Param 1)

Friction Param 1: 0.

Friction Param 2: 0.

Friction Param 3: 0.

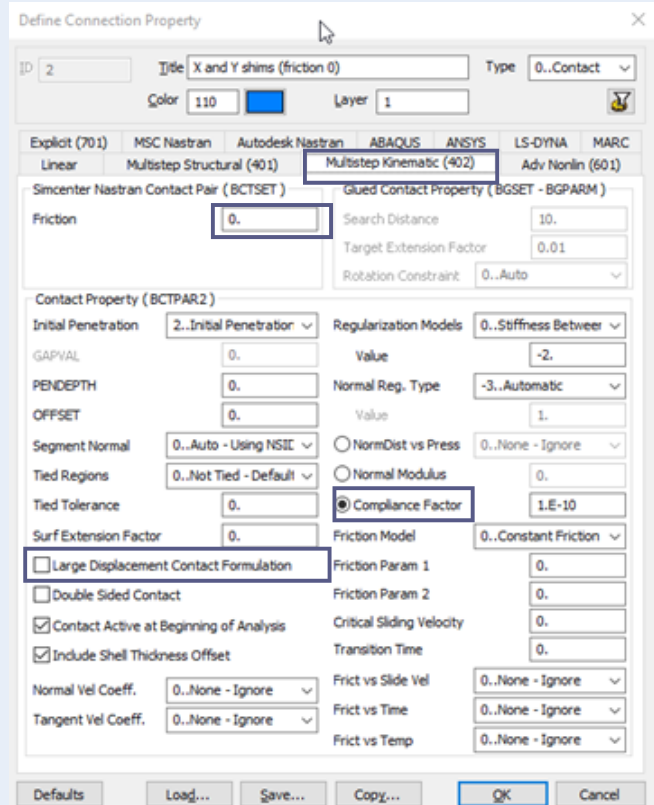
Friction Param 4: 0.

Friction Param 5: 0.

☐ Friction Delay

Rigid Target Options

Defaults Load... Save... Copy... OK Cancel



Define Connection Property

ID: 2 Title: X and Y shims (friction 0) Type: 0..Contact

Color: 110 Layer: 1

Exploit (701) MSC Nastran Autodesk Nastran ABAQUS (402) ANSYS LS-DYNA (601) MARC
Linear Multistep Structural (401) Multistep Kinematic (402) Adv Nonlin (601)

Simcenter Nastran Contact Pair (BCTSET) Glued Contact Property (BGSET - BGPARM)

Friction: 0.

Search Distance: 10.

Target Extension Factor: 0.01

Rotation Constraint: 0..Auto

Contact Property (BCTPAR2)

Initial Penetration: 2..Initial Penetration

GAPVAL: 0.

PENDEPTH: 0.

OFFSET: 0.

Segment Normal: 0..Auto - Using NSIC

Tied Regions: 0..Not Tied - Default

Tied Tolerance: 0.

Surf Extension Factor: 0.

☐ Large Displacement Contact Formulation

☐ Double Sided Contact

☒ Contact Active at Beginning of Analysis

☒ Include Shell Thickness Offset

Normal Vel Coeff.: 0..None - Ignore

Tangent Vel Coeff.: 0..None - Ignore

Regularization Models: 0..Stiffness Between

Value: -2.

Normal Reg. Type: -3..Automatic

Value: 1.

☐ NormDist vs Press: 0..None - Ignore

☒ Normal Modulus: 0.

☒ Compliance Factor: 1.E-10

Friction Model: 0..Constant Friction

Friction Param 1: 0.

Friction Param 2: 0.

Critical Sliding Velocity: 0.

Transition Time: 0.

Frict vs Slide Vel: 0..None - Ignore

Frict vs Time: 0..None - Ignore

Frict vs Temp: 0..None - Ignore

Defaults Load... Save... Copy... OK Cancel

Connection property without friction, with compliance