



# Release Note

**FEA 2016 (v1.1)**

**Release date: June 25, 2015**

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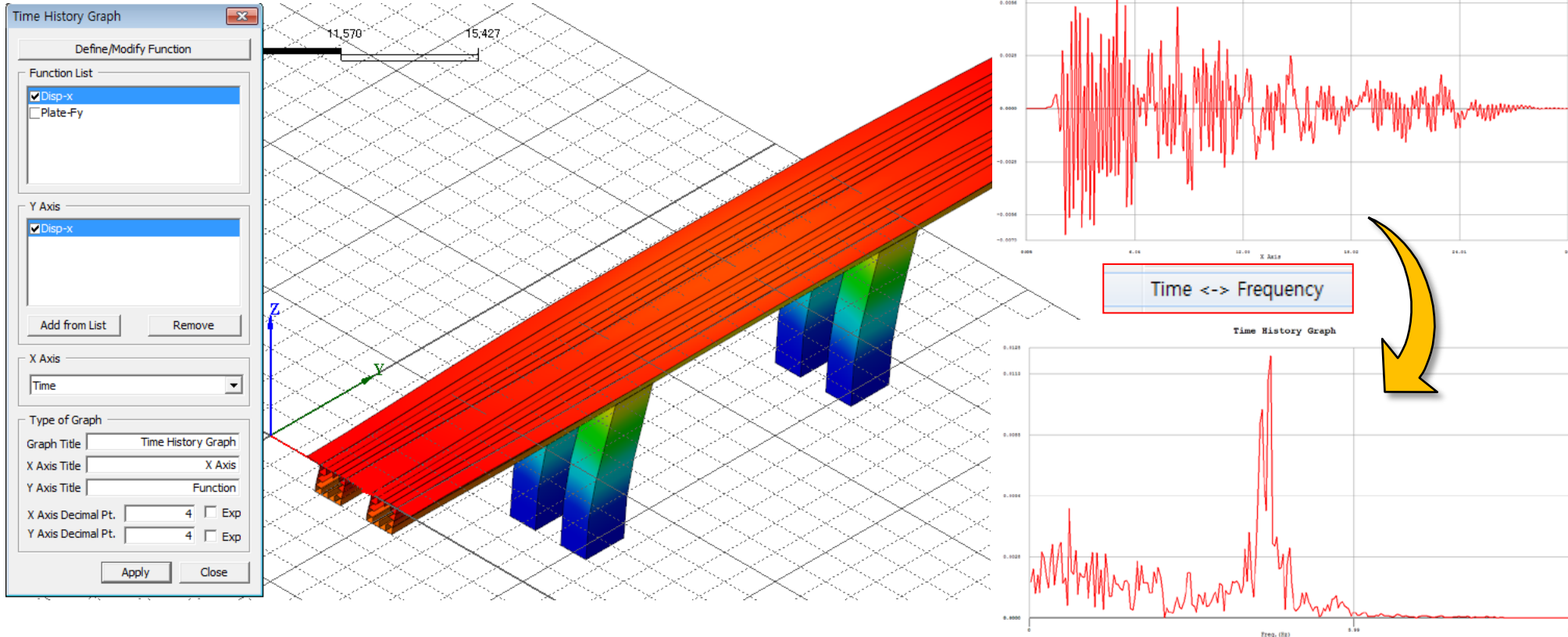
### **Post-Processing**

- 01 Improvement about the von-Mises Stresses at Nodes
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- 01 Convergence Error with Combined Cracking-Shearing-Crushing model
- 02 Incorrect Self Weight of Pyramid Element
- 03 Convergence Error in Nonlinear Analysis with Plate Offset

## (1) Fast Fourier Transform in Time-history Graph



- Menu: Post > Time History Analysis > Time History Graph (Time ↔ Frequency)

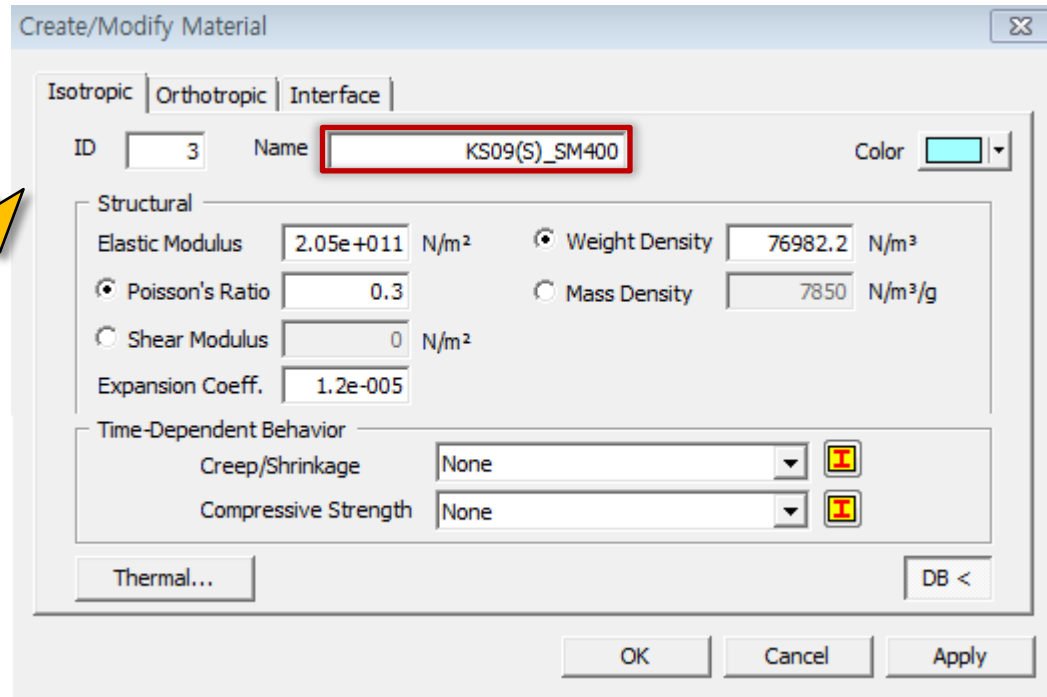
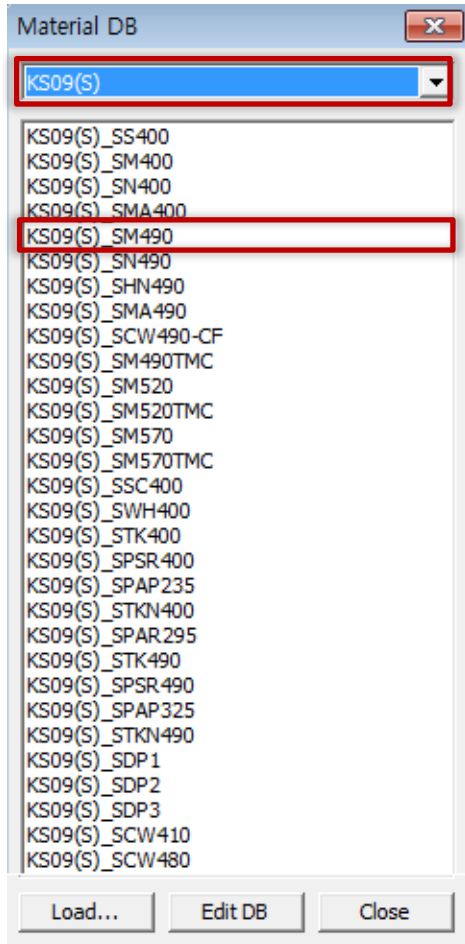
**Upgrade Contents**

- Using the Fast Fourier Transform algorithm, time history graphs can be converted to frequency history graphs and vice versa.

**Effects & Usage**

- Vibrations of footbridges or building floors due to walking loads can be checked in the frequency domain using FFT so that resonance frequency can be found.

## (2) New Material DB to Korean Standard



- Meun: Analysis>Material Manager>Create/Modify Material>Material DB

**Upgrade Contents**

- KSCE-LSD12(RC), KS09(S), KS08(S), KSCE-LSD12(S), KS10-Civil(S), KS08-Civil(S)

## (3) New Method of Defining Yield Stress–Strain Relations

The 'Create/Modify Function' dialog for 'Strain Hardening' shows a table with the following data:

|   | Plastic Strain | Yield Stress |
|---|----------------|--------------|
| 1 | 0.0000         | 300.0000     |
| 2 | 0.0100         | 310.0000     |
| 3 | 0.0200         | 320.0000     |
| 4 | 0.0300         | 330.0000     |
| 5 | 0.0400         | 340.0000     |
| 6 | 0.0500         | 350.0000     |
| 7 | 0.0600         | 360.0000     |
| 8 | 0.0700         | 370.0000     |
| 9 | 0.0800         | 380.0000     |
| 1 | 0.0900         | 390.0000     |
| 1 | 0.1000         | 400.0000     |

The 'Strain Hardening' graph shows a plot of yield stress  $f$  versus plastic strain  $\epsilon_p$ . The curve starts at the origin, passes through points  $(\epsilon_p^0, f^0)$  and  $(\epsilon_p^1, f^1)$ , and continues to rise. A red line segment is also shown, representing the initial linear elastic portion of the material's behavior.

- Menu: Analysis>Material

**Upgrade Contents**

- In the case of plastic materials, the constitutive model defines an elastic limit as a function of the equivalent plastic strain, which can be calculated based on the plastic strain obtained from the uni-axial tension test as follows. In the new version, the strain hardening can be defined based on the uni-axial plastic strain. The program will automatically convert it into the equivalent plastic strain.

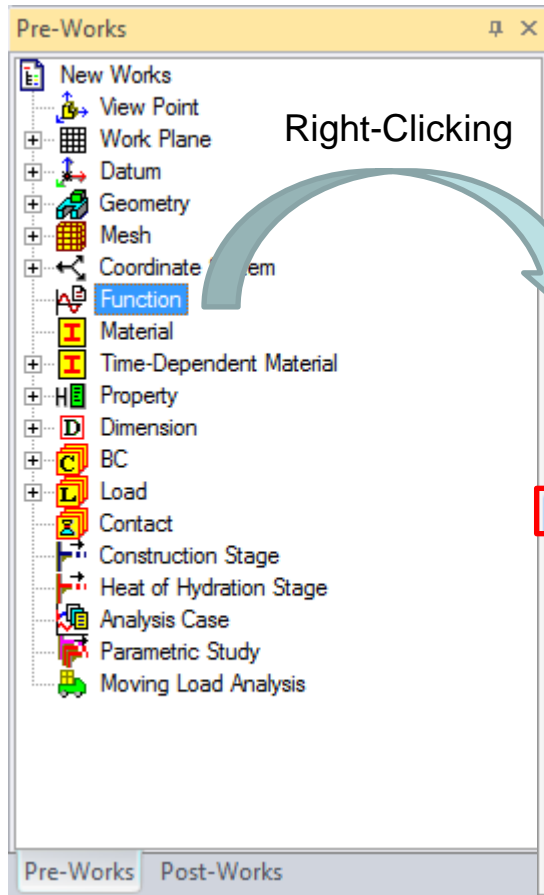
- von Mises  $\kappa = \lambda = \epsilon_1^p$

- Tresca  $\kappa = \frac{2}{\sqrt{3}} \lambda = \frac{2}{\sqrt{3}} \epsilon_1^p$

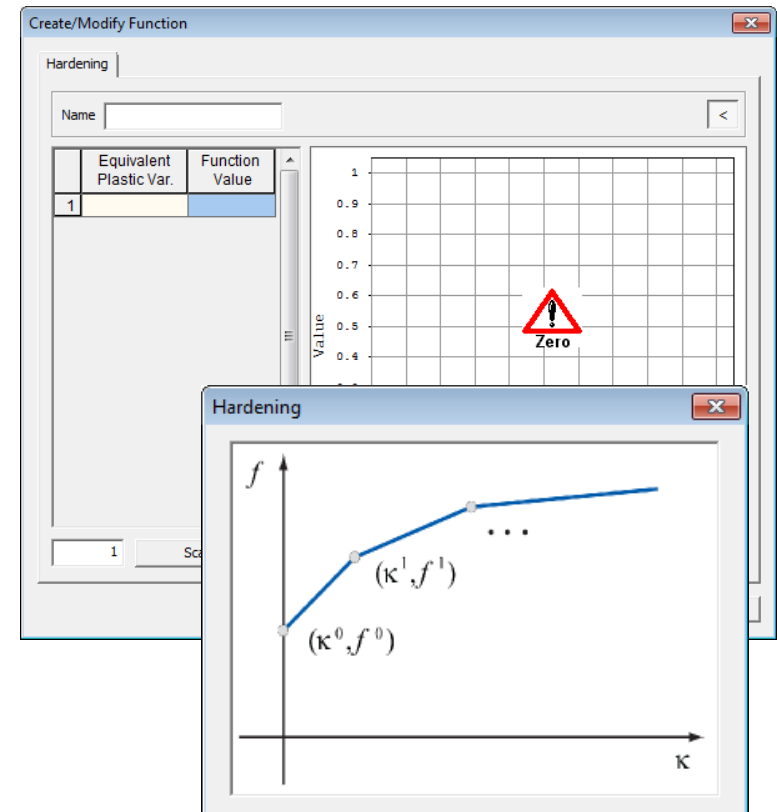
- Rankine  $\kappa = \sqrt{\frac{2}{3}} \lambda = \sqrt{\frac{2}{3}} \epsilon_1^p$

$\kappa$  Equivalent plastic strain

$\epsilon_1^p$  Uniaxial plastic strain



- The existing input method based on Equivalent Plastic Strain can be accessed from the Tree Menu.
- Menu: Tree menu>Function>Add Strain Hardening Function



## (4) Compression-only Point Spring for Soil Resistance

Create Surface Spring

Object  
Type: Solid-Face  
Element Width: 0 mm  
10 Element Face(s) Selected

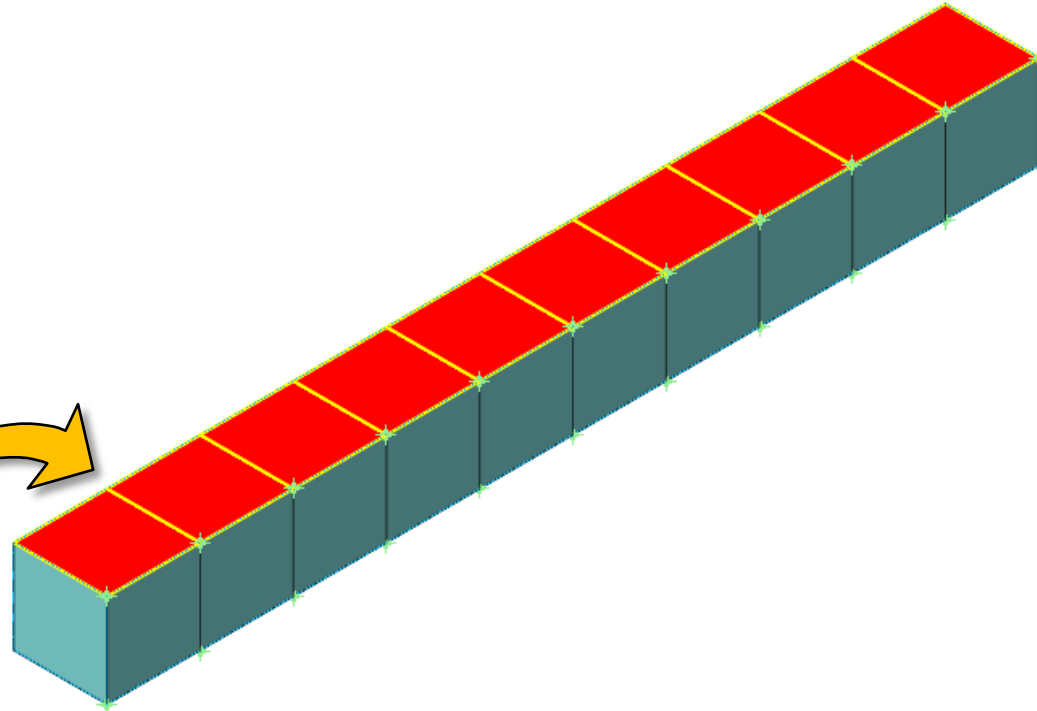
Spring Type  
 Point Spring  Elastic Link

Modulus of Subgrade Reaction  
Kx: 0 N/mm<sup>3</sup>  
Ky: 0 N/mm<sup>3</sup>  
Kz: 1000 N/mm<sup>3</sup>  
 Damping Constant / Area  
Cx: 0 N·sec/mm<sup>3</sup>  
Cy: 0 N·sec/mm<sup>3</sup>  
Cz: 0 N·sec/mm<sup>3</sup>  
 Compression-Only

Mesh Set  
 As Sub-Set: Surface Spring  
Add to: Mesh Set

Max. Number of Properties: 100

OK Cancel Apply >



- Menu: Mesh>Element>Create Surface Spring>Point Spring

- Point Spring with Compression-Only type can simulate the elastic behavior of soil resistance.

Upgrade Contents

## (5) Time Dependent Material to Eurocode

Time-Dependent Material (Creep/Shrinkage)

Name:  Code: Korean Standard

KS

Mean Compressive Strength of Concrete at Age of 28 Days

Relative Humidity of Ambient Environment (40 ~ 99)

Notational Size of Member

$h = 2 * A_c / u$  (Ac: Section Area, u: Perimeter in Cor)

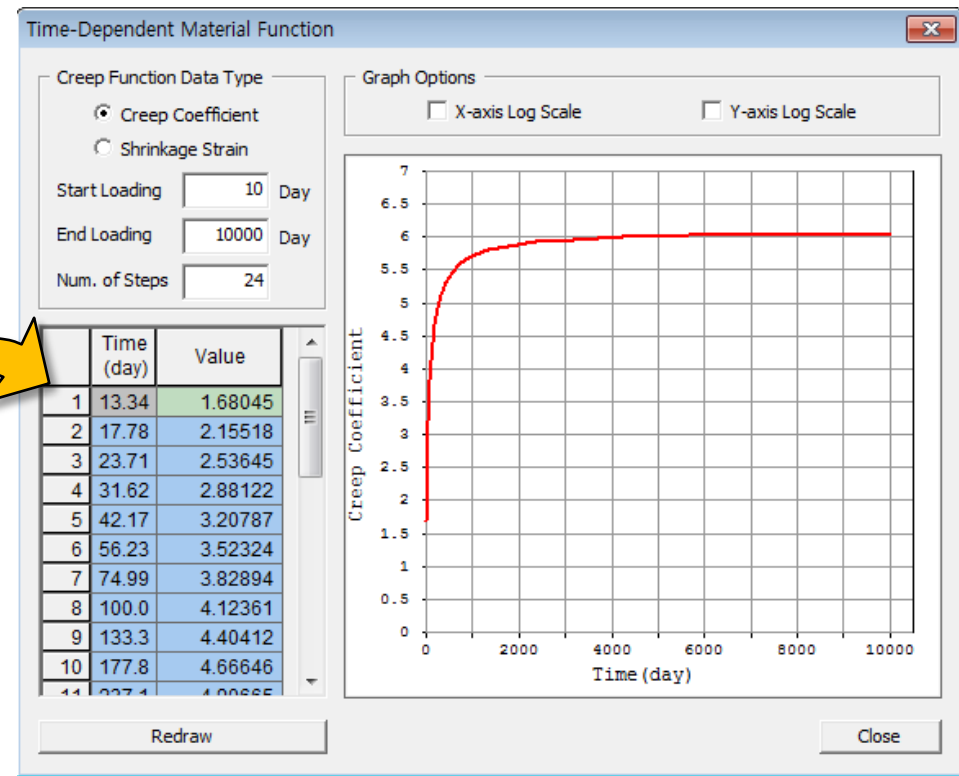
Type of Cement

Rapid Hardening High Strength Cement

Normal or Rapid Hardening Cement (N, R)

Slowly Hardening Cement (SL)

Age of Concrete at Beginning of Shrinkage:  day



- Menu: Analysis>Time Dependent Material>Creep/Shrinkage, Compressive Strength

**Upgrade Contents**

- Prestressed structures can be analyzed with the effects of creep, shrinkage and compressive strength to Eurocode.

## (6) DTIME Parameter for User Supplied Material Subroutine

```

|*****
!   USER SUPPLIED MATERIAL SUBROUTINE
|*****
SUBROUTINE USRMAT(EP SO, DEPS, EPSP, NS, INFM_STEP, COORD, SE, USRVAL, NUV,  &
                USRSTA, NUS, IUSRIND, NUI, SIG, STIFF, ID, DETJ)

IMPLICIT NONE

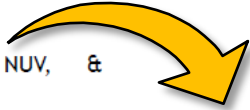
!DEC$ ATTRIBUTES DLLEXPORT::USRMAT

INTEGER, INTENT(IN)  :: NS           ! NUMBER OF STRESS COMPONENT
INTEGER, INTENT(IN)  :: INFM_STEP(5) ! STEP INFORMATION FOR STAGE, INCREMENT,
ITERATION, ELEMENT, INTEGRATION POINT
! INFM_STEP(1) : STAGE ID
! INFM_STEP(2) : LOAD INCREMENTAL STEP ID
! INFM_STEP(3) : ITERATION STEP ID
! INFM_STEP(4) : ELEMENT ID
! INFM_STEP(5) : INTEGRATION POINT ID
INTEGER, INTENT(IN)  :: ID           ! MATERIAL ID OF CURRENT ELEMENT
INTEGER, INTENT(IN)  :: NUV          ! NUMBER OF PARAMETERS
INTEGER, INTENT(IN)  :: NUS          ! NUMBER OF INTERNAL STATE VARIABLES
INTEGER, INTENT(IN)  :: NUI          ! NUMBER OF INTEGER INDICATOR VARIABLES
REAL*8, INTENT(IN)   :: DETJ         ! DETERMINENT VALUE AT CURRENT

User Supplied Subroutine

RETURN
END SUBROUTINE USRMAT
|*****

```



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**SUBROUTINE USRMAT (EP SO, DEPS, EPSP, NS, INFM\_STEP, COORD, SE, USRVAL, NUV, USRSTA, NUS, IUSRIND, NUI, SIG, STIFFM, ID, DETJ, DTIME)**

- SUBROUTINE USRMAT (EP SO, DEPS, EPSP, NS, INFM\_STEP, COORD, SE, USRVAL, NUV, USRSTA, NUS, IUSRIND, NUI, SIG, STIFFM, ID, DETJ, DTIME), **DTIME: Total Time Increment**

The user can program the material which is dependent on time, e.g. visco-elastic model.

**Upgrade Contents**



## (1) Improvement about the von-Mises Stresses at Nodes

The screenshot shows the midas FEA software interface. On the left, a tree view lists various result types, with 'LO-Solid, Equivalent' highlighted. The main window displays a 3D model of a rectangular block with a color-coded stress distribution. A 'Create/Modify Material' dialog box is open, showing the following settings:

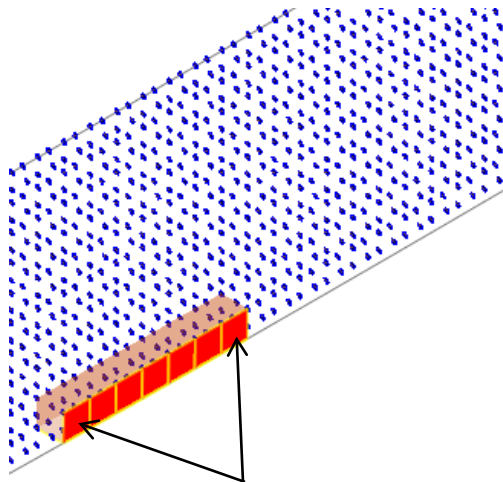
- Isotropic
- ID: 1, Name: [empty], Color: [cyan]
- Structural
  - Elastic Modulus: 200000 N/mm<sup>2</sup>
  - Poisson's Ratio: 0.3
  - Expansion Coeff.: 0
- Constitutive Model
  - Model Type: Von Mises
  - Nonlinear Parameters
    - Initial Yield Stress: 325 N/mm<sup>2</sup> (highlighted in a red box)
    - Hardening/Softening Function: None
    - Temp. Dep. Hardening/Softening Function: None

On the right, a legend titled '3D ELEMENT STRESS Equivalent, N/mm<sup>2</sup>' shows a color scale from 3.3% to 9.7%.

**Upgrade Contents**

- von-Mises stresses including Tresca and Rankine cannot exceed yield stress at nodal points as well as integration points.

## (2) Summation of Crack Widths of Group of Elements



Select elements

Extract Result

Output Data  
 Analysis Set: linear static (Structural Linear Static)  
 Ref. Step: linear static(1)  
 Data: LO-Solid, SXX

Step : Data  
 linear static(1) : LO-Solid, SXX

Select All    Unselect All

Order  
 Step     Element    Global Rectangular

Total Summation

Element Result Extraction  
 User-Defined  
 47541 47551 47561 47571 47581 47591 47601

Sort X(R) Dir    Y(T) Dir    Z Dir     Ascending

Maximum  
 Minimum  
 Absolute Maximum     Only Active Node/Element

Extraction Position in Element: Center

Table    Close

| No | Element         | X         | Y           | Z        | linear static(1) : LO-Solid, SXX |
|----|-----------------|-----------|-------------|----------|----------------------------------|
| 1  | 47541           | 19.000000 | -509.000000 | 1.000000 | 0.000032                         |
| 2  | 47551           | 19.000000 | -511.000000 | 1.000000 | 0.000032                         |
| 3  | 47561           | 19.000000 | -513.000000 | 1.000000 | 0.000032                         |
| 4  | 47571           | 19.000000 | -515.000000 | 1.000000 | 0.000032                         |
| 5  | 47581           | 19.000000 | -517.000000 | 1.000000 | 0.000032                         |
| 6  | 47591           | 19.000000 | -519.000000 | 1.000000 | 0.000032                         |
| 7  | 47601           | 19.000000 | -521.000000 | 1.000000 | 0.000032                         |
| 8  | Total Summation |           |             |          | 0.000221                         |

-01(1) , LO-Solid,Cwnn

**Upgrade Contents**

- In the total strain crack model, the crack width of single element depends on the element size. Summation of crack widths of group of elements is provided so that the crack width within certain distance can be checked regardless of mesh size.

## (1) Convergence Error with Combined Cracking-Shearing-Crushing model

### Problem

Convergence error in nonlinear analysis of interface elements with the 'Combined Cracking-Shearing-Crushing' material model.

### Related Functions

- Analysis > Material > Interface

### Correction

Improvement of convergence algorithm of CCSC material model.

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## (2) Incorrect Self Weight of Pyramid Element

### Problem

Incorrect total weight with the model consisting of pyramid elements.

### Related Functions

- \*.OUT Files

### Correction

Corrected.

### (3) Convergence Error in Nonlinear Analysis with Plate Offset

#### Problem

Convergence error in nonlinear analysis with plate offset.

#### Related Functions

- Analysis > Property > Plate

#### Correction

Improved.