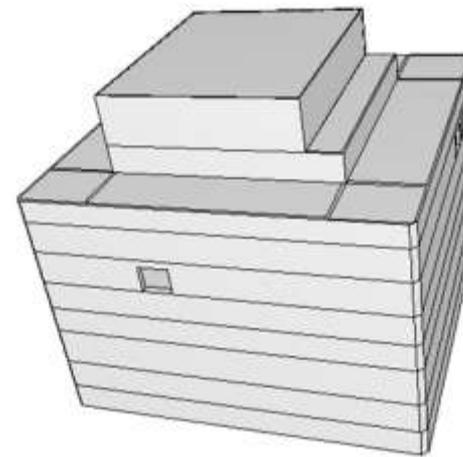# MACRO-MICRO ANALYSIS

NPP analysis for 2007 Chuetsu-Oki Earthquake

NPP building

40000[m]
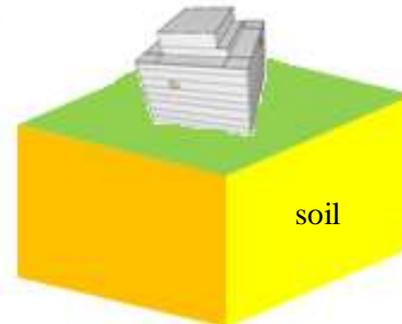
44800[m]   44800[m]
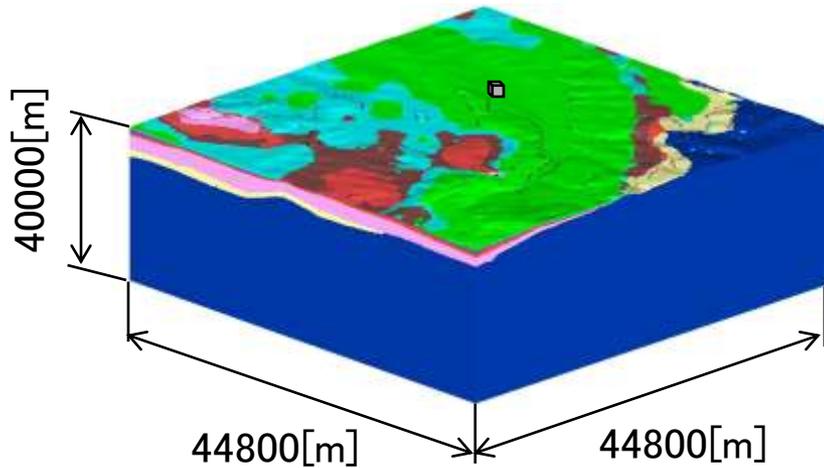
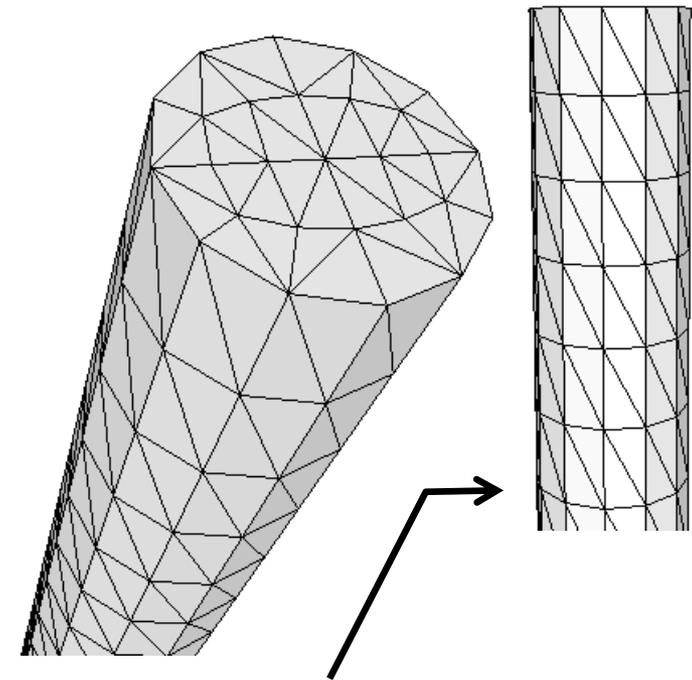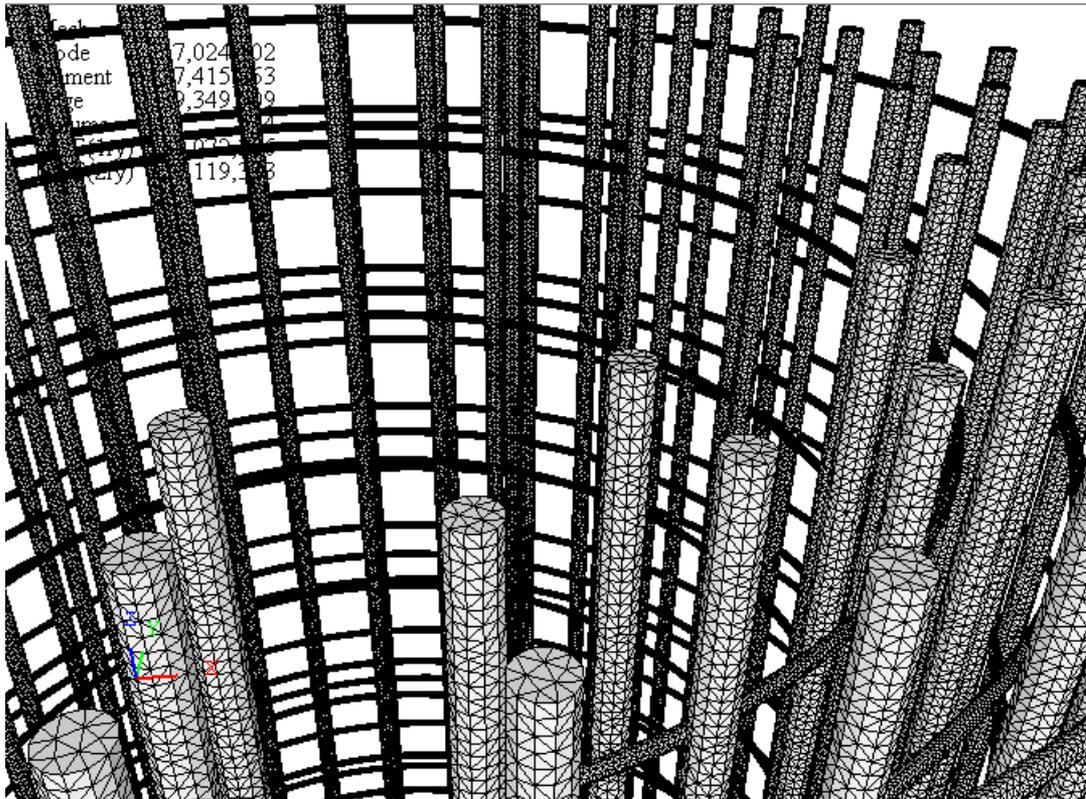Macro-Analysis

seismic wave
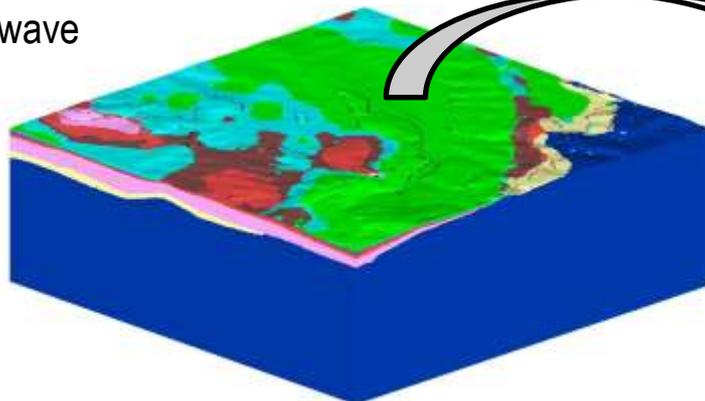
Micro-Analysis

soil-structure interaction

soil

FIDELTY MODEL

Structure model of reinforced concrete

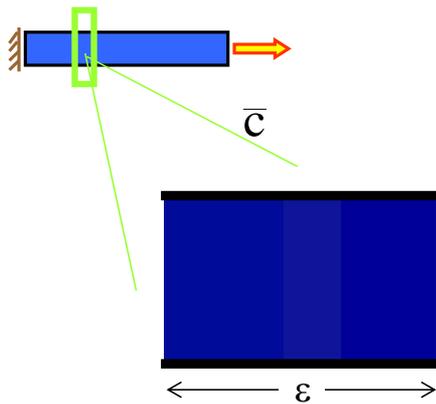steel bars for reinforcement, surrounded by concrete

surface covered by rectangular of 15 x 7.4 mm

ADVANCED NUMERICAL ANALYSIS

Multi-scale analysis

HIGH HETEROGENEITY

$\overline{c}$

ε

SINGULAR PERTURBATION

fast variable $\quad y = \dfrac{1}{\varepsilon} x$
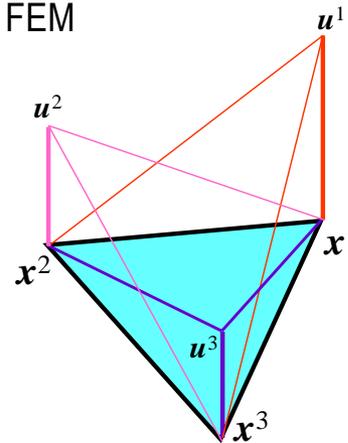
$c \to c(y), \quad u \to u_o(x) + \varepsilon u_1(x, y)$

$$Cu_o'' = 0, \quad u_1(x, y) = \chi(y) u_o'(x)$$

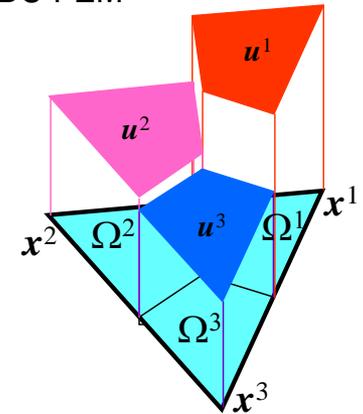## Accurate discretization scheme

FEM

u^1
u^2
x^2 $\quad x^1$
u^3
x^3

PDS-FEM

u^1
u^2
$x^2 \quad \Omega^2 \quad u^3 \quad \Omega^1 \quad x^1$
Ω^3
x^3

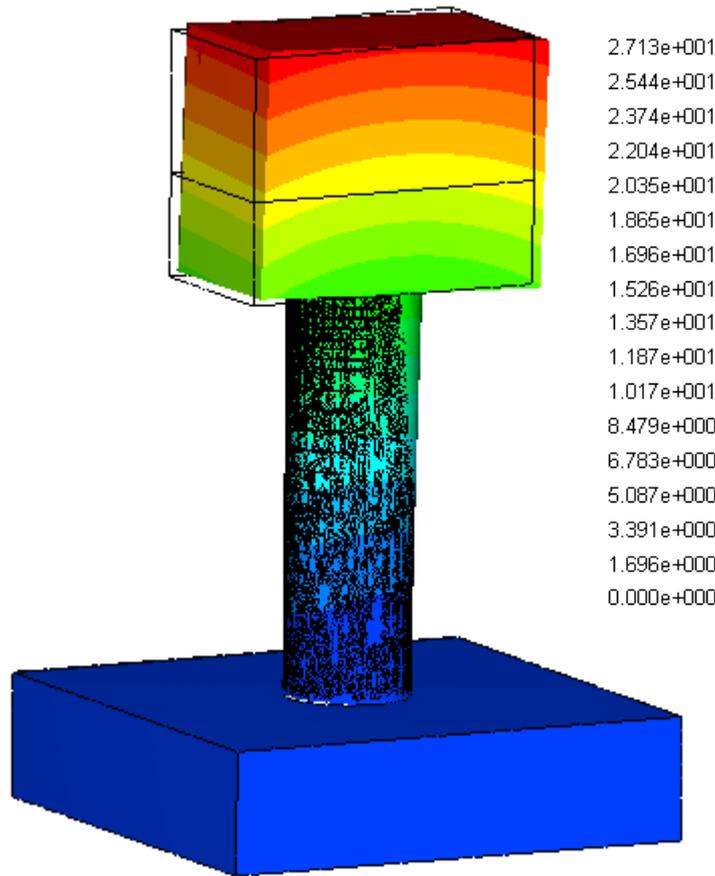continuous basis functions   discontinuous basis functions

PARTICLE DISCRETIZATION SCHEME

$$f(\mathbf{x}) \quad : \quad f^d(\mathbf{x}) = \sum_\alpha f^\alpha \varphi^\alpha(\mathbf{x})$$
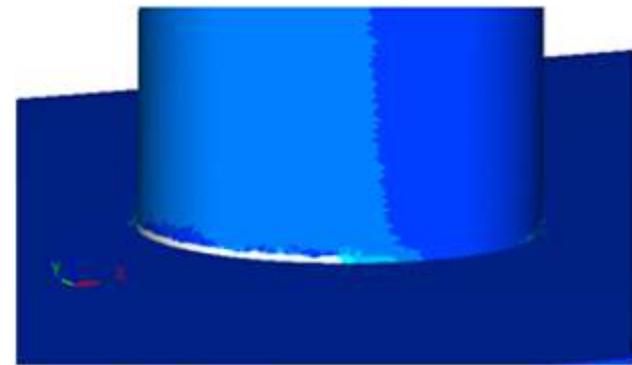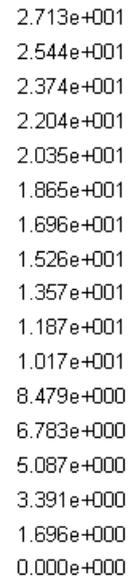
$$f_{,i}(\mathbf{x}) \quad : \quad g_i^d(\mathbf{x}) = \sum_\beta g_i^\beta \psi^\beta(\mathbf{x})$$

applicable to differential equations by means of *dual discretization* for function and its derivative, even though discontinuous basis functions are employed
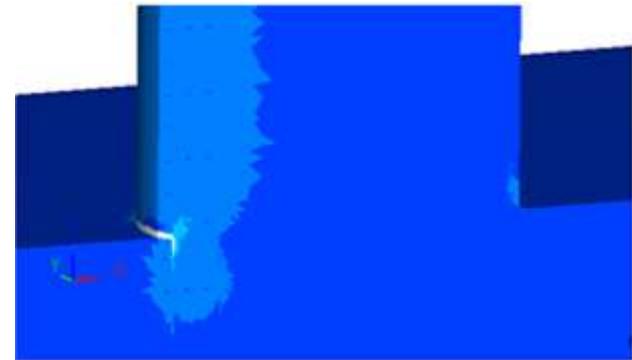
TENATIVE RESULTS

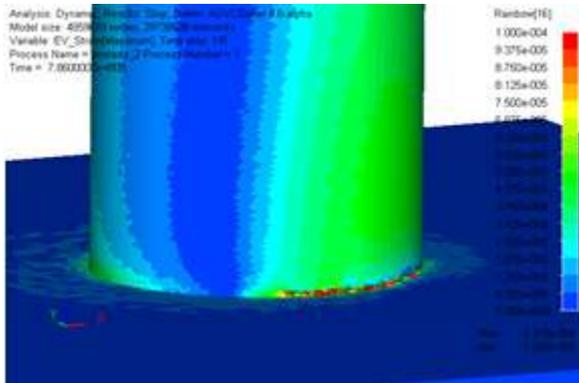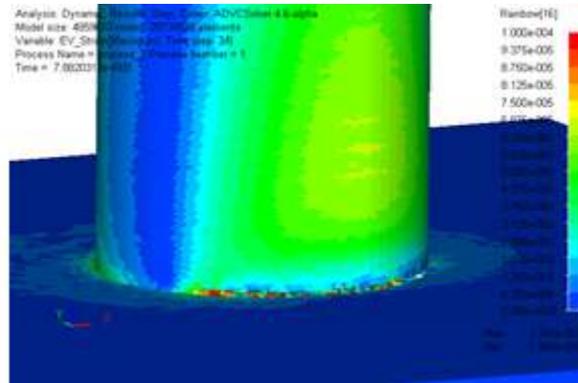|	
2.713e+001	
2.544e+001	
2.374e+001	
2.204e+001	
2.035e+001	
1.865e+001	
1.696e+001	
1.526e+001	
1.357e+001	
1.187e+001	
1.017e+001	
8.479e+000	
6.783e+000	
5.087e+000	
3.391e+000	
1.696e+000	
0.000e+000	

a) whole view

b) connecting part

c) cross section at connecting part
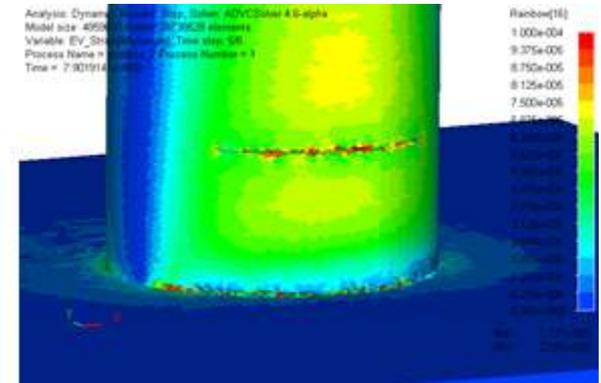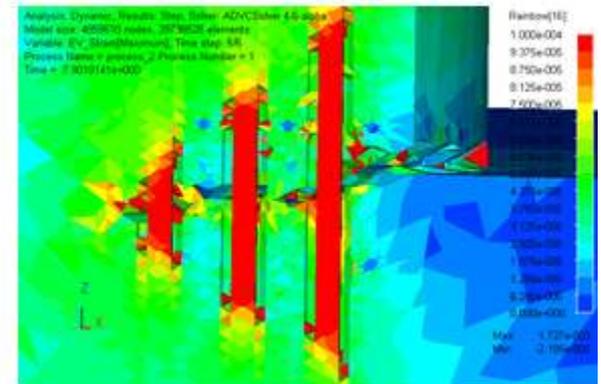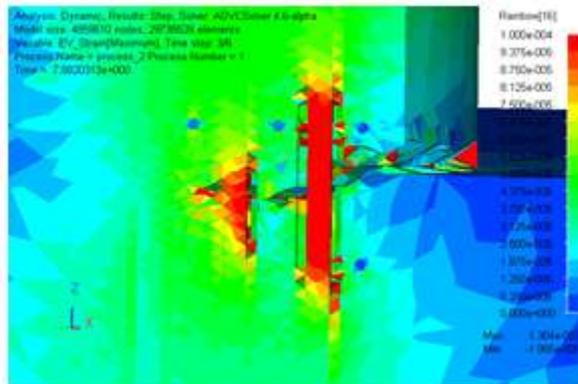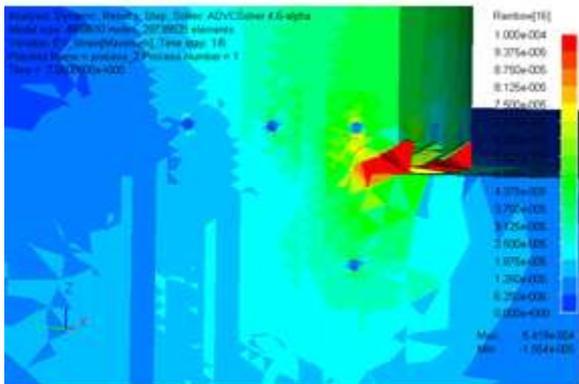
TENATIVE RESULTS

0.86 [s]　　　　　　　　0.88 [s]　　　　　　　　0.90 [s]

a) surface

b) stress distribution inside of column