DISPLACEMENT CONTROLS FOR GEOTECHNICAL PROBLEMS IN ABAQUS

Input specifications – an ABAQUS tutorial

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Using the displacement controls to achieve convergence on a geostatic step.

```
** STEP: Geostatic
**
*Step, name=Geostatic, unsymm=YES
*Geostatic, utol=tolerance for the maximum change of displacements
Initial time increment, Time period of the step, Minimum time increment allowed, Maximum time
increment allowed
**
** LOADS
**
** Name: gravity   Type: Gravity
*Dload, amplitude=instant
, GRAV, 10., 0., 0., -1.
**
*Controls, reset
*CONTROLS, PARAMETERS=FIELD, FIELD=DISPLACEMENT
R_n^α, C_n^α
, , ε_d^α
** OUTPUT REQUESTS
**
*Restart, write, frequency=0
**
** FIELD OUTPUT: F-Output-1
**
*Output, field, variable=PRESELECT
**
** HISTORY OUTPUT: H-Output-1
**
*Output, history, variable=PRESELECT
*End Step
```

Using the displacement controls to achieve convergence on a geostatic step.

```
*Controls, reset
*CONTROLS, PARAMETERS=FIELD, FIELD=DISPLACEMENT
R_n^α, C_n^α
, , E_d^α
```

Convergence criterion

$$R_n^\alpha = \frac{\text{Largest residual force}}{\text{Average force}} = \frac{r_{max}^\alpha}{\widetilde{q^\alpha}}$$

Convergence criterion

$$C_n^\alpha = \frac{\text{Largest correction to displacement}}{\text{Largest increment of displacement}} = \frac{C_{max}^\alpha}{\Delta U_{max}^\alpha}$$

Criterion for zero displacement increment

$$\epsilon_d^\alpha = \frac{\text{Largest increment of displacement}}{\text{Average size of the element}} = \frac{\Delta U_{max}^\alpha}{f_\beta^\alpha}$$

Default values

$R_n^\alpha = 5 \times 10^{-3}$

$C_n^\alpha = 10^{-2}$

$\epsilon_d^\alpha = 10^{-8}$

Using the displacement controls to achieve convergence on a geostatic step.

EXAMPLE

Given a characteristic element length in the model, $f_\beta^\alpha = 0.4$ m

For average geotechnical practice, $\Delta U_{max}^\alpha \approx 1\text{mm} = 0.001\text{m}$

$$\epsilon_d^\alpha = \frac{\text{Largest increment of displacement}}{\text{characteristic element length}} = \frac{\Delta U_{max}^\alpha}{f_\beta^\alpha} = \frac{0.001\text{m}}{0.4\text{ m}} = 0.0025$$

$$R_n^\alpha = \frac{\text{Largest residual force}}{\text{Average force}} = \frac{r_{max}^\alpha}{\widetilde{q^\alpha}} = 0.01 \quad *$$

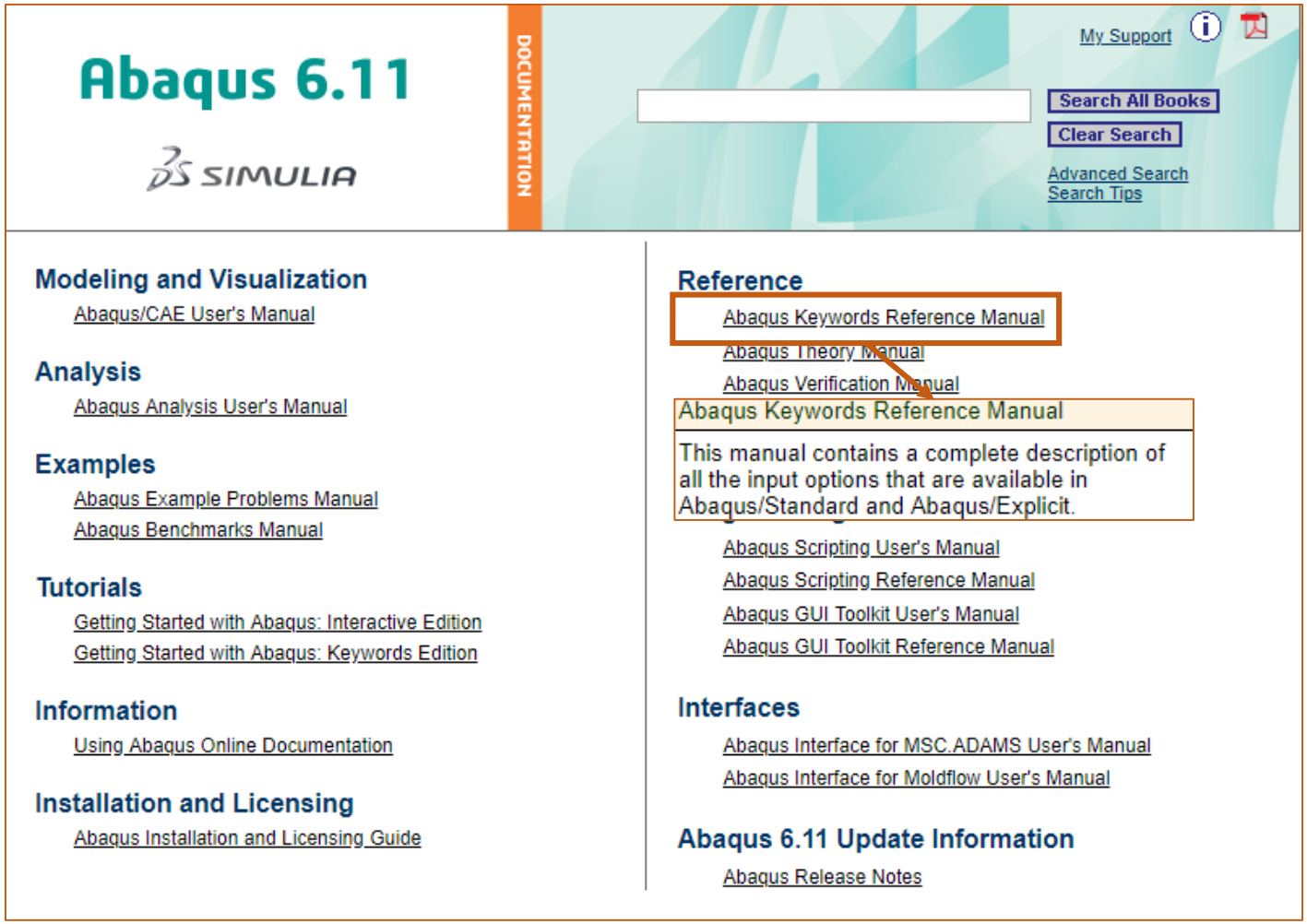
$$C_n^\alpha = \frac{\text{Largest correction to displacement}}{\text{Largest increment of displacement}} = \frac{C_{max}^\alpha}{\Delta U_{max}^\alpha} = 0.01 \quad *$$

```
*Controls, reset
*CONTROLS, PARAMETERS=FIELD, FIELD=DISPLACEMENT
0.01, 0.01
, , 0.0025
```

Note: The characteristic element length in the model (f_β^α) can be found in the message file (.msg)

* : Recommended values

Learn more at:



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