

# Cohesive element orientation in Abaqus

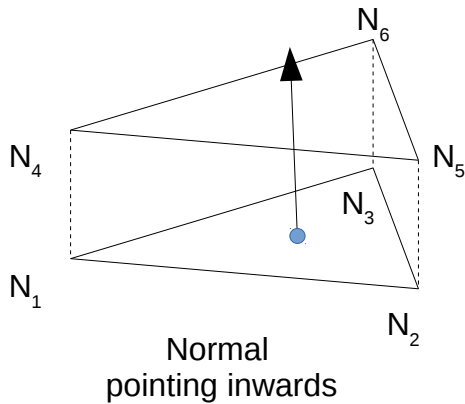
Ref : <http://dsk.ippt.pan.pl/docs/abaqus/v6.13/books/usb/default.htm?startat=pt06ch32s05alm43.html>

## Initial coordinates

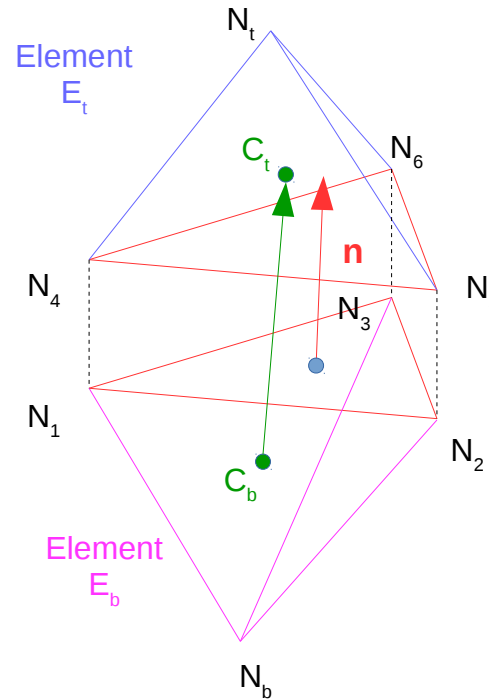
- $N_1(x_1, y_1, z_1)$
- $N_2(x_2, y_2, z_2)$
- $N_3(x_3, y_3, z_3)$
- $N_4(x_1, y_1, z_1)$
- $N_5(x_2, y_2, z_2)$
- $N_6(x_3, y_3, z_3)$

## Cohesive element connectivity

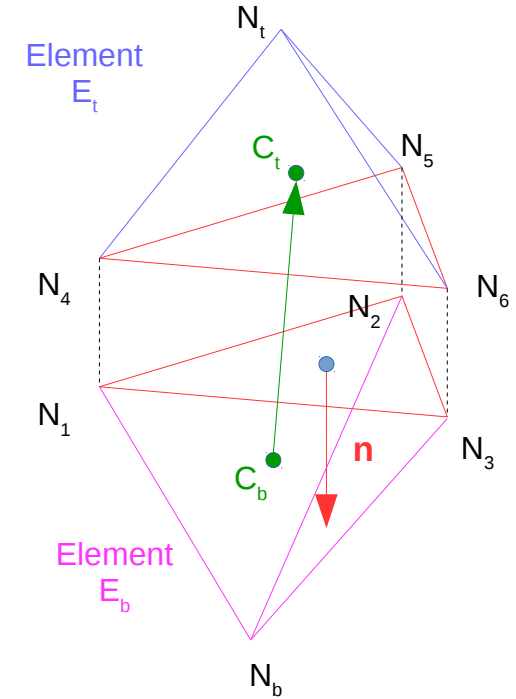
$N_{1'}$ ,  $N_{2'}$ ,  $N_{3'}$ ,  $N_{4'}$ ,  $N_{5'}$ ,  $N_{6'}$



## Correct orientation



## Incorrect orientation



## Bulk element connectivity

$E_t: N_{4'}, N_{5'}, N_{6'}, N_t$   
 $E_b: N_{1'}, N_{2'}, N_{3'}, N_b$

## Connectivity check/correction algorithm :

For all Cohesive elements with connectivity  $(N_1, N_2, N_3, N_4, N_5, N_6)$  do :

- Compute the cohesive element normal  $n = N_1 N_2 \wedge N_1 N_3$
- Find bulk Element  $E_t (N_4, N_5, N_6, N_t)$  and Element  $E_b (N_1, N_2, N_3, N_b)$
- Compute the bulk element center  $C_t$  and  $C_b$
- Compute the scalar product  $n \cdot C_t C_b$
- $n \cdot C_t C_b > 0 \Rightarrow$  the connectivity is consistent with Abaqus definition
- $n \cdot C_t C_b < 0 \Rightarrow$  the connectivity is incorrect, replace  $N_2$  by  $N_3$  and  $N_5$  by  $N_6$  so that the new cohesive element connectivity is  $(N_1, N_3, N_2, N_4, N_6, N_5)$