UMMDp - Yield Criteria Derivatives

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- Barlat Yld2004-18p (2005), Cazacu (2006)

1 ABAQUS, ADINA

$$\sigma = \begin{bmatrix} \sigma_{xx} & \sigma_{yy} & \sigma_{zz} & \sigma_{xy} & \sigma_{xz} & \sigma_{yz} \end{bmatrix} \tag{1}$$

$$\frac{\partial H_q}{\partial s_{ij}} = \begin{bmatrix} 1/3 & 1/3 & 1/3 & 0 & 0 & 0 \\ -(s_{yy}+s_{zz})/3 & -(s_{zz}+s_{xx})/3 & -(s_{xx}+s_{yy})/3 & 2s_{xy}/3 & 2s_{xz}/3 & 2s_{yz}/3 \\ (s_{yy}s_{zz}-s_{yz}^2)/2 & (s_{zz}s_{xx}-s_{xz}^2)/2 & (s_{xx}s_{yy}-s_{xy}^2)/2 & s_{yz}s_{xz}-s_{zz}s_{xy} & s_{xy}s_{yz}-s_{yy}s_{xz} & s_{xz}s_{xy}-s_{xx}s_{yz} \end{bmatrix} \tag{2}$$

$$\frac{\partial^2 H_1}{\partial (s_{ij})^2} = \begin{bmatrix} 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix} \tag{3}$$

$$\frac{\partial^2 H_2}{\partial (s_{ij})^2} = \begin{bmatrix} 0 & -1/3 & -1/3 & 0 & 0 & 0 \\ -1/3 & 0 & -1/3 & 0 & 0 & 0 \\ -1/3 & -1/3 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 2/3 & 0 & 0 \\ 0 & 0 & 0 & 0 & 2/3 & 0 \\ 0 & 0 & 0 & 0 & 0 & 2/3 \end{bmatrix} \tag{4}$$

$$\frac{\partial^2 H_3}{\partial (s_{ij})^2} = \begin{bmatrix} 0 & s_{zz}/2 & s_{yy}/2 & 0 & 0 & -s_{yz} \\ s_{zz}/2 & 0 & s_{xx}/2 & 0 & -s_{xz} & 0 \\ s_{yy}/2 & s_{xx}/2 & 0 & -s_{xy} & 0 & 0 \\ 0 & 0 & -s_{xy} & -s_{zz} & s_{yz} & s_{xz} \\ 0 & -s_{xz} & 0 & s_{yz} & -s_{yy} & s_{xy} \\ -s_{yz} & 0 & 0 & s_{xz} & s_{xy} & -s_{xx} \end{bmatrix} \tag{5}$$

2 LS-DYNA, ANSYS, MSC.Marc

$$\sigma = \begin{bmatrix}\sigma_{xx} & \sigma_{yy} & \sigma_{zz} & \sigma_{xy} & \sigma_{yz} & \sigma_{xz}\end{bmatrix} \tag{6}$$

$$\frac{\partial H_q}{\partial s_{ij}} = \begin{bmatrix} 1/3 & 1/3 & 1/3 & 0 & 0 & 0 \\ -(s_{yy}+s_{zz})/3 & -(s_{zz}+s_{xx})/3 & -(s_{xx}+s_{yy})/3 & 2s_{xy}/3 & 2s_{yz}/3 & 2s_{xz}/3 \\ (s_{yy}s_{zz}-s_{yz}^2)/2 & (s_{zz}s_{xx}-s_{xz}^2)/2 & (s_{xx}s_{yy}-s_{xy}^2)/2 & s_{yz}s_{xz}-s_{zz}s_{xy} & s_{xz}s_{xy}-s_{xx}s_{yz} & s_{xy}s_{yz}-s_{yy}s_{xz} \end{bmatrix} \tag{7}$$

$$\frac{\partial^2 H_1}{\partial (s_{ij})^2} = \begin{bmatrix} 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix} \tag{8}$$

$$\frac{\partial^2 H_2}{\partial (s_{ij})^2} = \begin{bmatrix} 0 & -1/3 & -1/3 & 0 & 0 & 0 \\ -1/3 & 0 & -1/3 & 0 & 0 & 0 \\ -1/3 & -1/3 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 2/3 & 0 & 0 \\ 0 & 0 & 0 & 0 & 2/3 & 0 \\ 0 & 0 & 0 & 0 & 0 & 2/3 \end{bmatrix} \tag{9}$$

$$\frac{\partial^2 H_3}{\partial (s_{ij})^2} = \begin{bmatrix} 0 & s_{zz}/2 & s_{yy}/2 & 0 & -s_{yz} & 0 \\ s_{zz}/2 & 0 & s_{xx}/2 & 0 & 0 & -s_{xz} \\ s_{yy}/2 & s_{xx}/2 & 0 & -s_{xy} & 0 & 0 \\ 0 & 0 & -s_{xy} & -s_{zz} & s_{xz} & s_{yz} \\ -s_{xz} & 0 & 0 & s_{xz} & -s_{xx} & s_{xy} \\ 0 & -s_{yz} & 0 & s_{yz} & s_{xy} & -s_{yy} \end{bmatrix} \tag{10}$$