Normalized Voigt-Notation = Mandel notation

$$\mathbb{B}_i \cdot \mathbb{B}_j = \delta_{ij} \qquad \text{with } i,j \in [1,2,3,4,5,6]$$

with respect to orthonormal base system e_m, $m \in [1,2,3]$ in $\mathbb{R}^3$

$$\mathbb{B}_1 = e_1 \otimes e_1 \qquad \mathbb{B}_4 = \frac{\sqrt{2}}{2}\left(e_2 \otimes e_3 + e_3 \otimes e_2 \right)$$

$$\mathbb{B}_2 = e_2 \otimes e_2 \qquad \mathbb{B}_5 = \frac{\sqrt{2}}{2}\left(e_1 \otimes e_3 + e_3 \otimes e_1 \right)$$

$$\mathbb{B}_3 = e_3 \otimes e_3 \qquad \mathbb{B}_6 = \frac{\sqrt{2}}{2}\left(e_1 \otimes e_2 + e_2 \otimes e_1 \right)$$

and $\sigma_i = \sigma \cdot \mathbb{B}_i$

$C_{ij} = \mathbb{C} \cdot (\mathbb{B}_i \otimes \mathbb{B}_j)$

$$\sigma = \begin{pmatrix} \sigma_{11} & \sigma_{12} & \sigma_{13} \\ & \sigma_{22} & \sigma_{23} \\ \text{sym} & & \sigma_{33} \end{pmatrix} e_m \otimes e_n \qquad m,n \in [1,2,3]$$

back

$$= \begin{bmatrix} \sigma_{11} \\ \sigma_{22} \\ \sigma_{33} \\ \sqrt{2}\,\sigma_{23} \\ \sqrt{2}\,\sigma_{13} \\ \sqrt{2}\,\sigma_{12} \end{bmatrix} \mathbb{B}_i \qquad i \in [1..6]$$

$\Rightarrow$ Reduce required storage from 3×3 to 6 for Tensor 2. order

$\Rightarrow EW(\mathbb{C}_{Tensor}) = EW(\mathbb{C}_{matrix})$

$\Rightarrow \sigma = \mathbb{C}[\varepsilon]$

e.g. isotropic: $\sigma = 2\mu\,\varepsilon + \lambda\, sp(\varepsilon)\,\mathbb{1}$ $\qquad a = sp(\varepsilon) = \varepsilon_{11} + \varepsilon_{22} + \varepsilon_{33}$

$$\begin{bmatrix} \sigma_{11} \\ \sigma_{22} \\ \sigma_{33} \\ \sqrt{2}\,\sigma_{23} \\ \sqrt{2}\,\sigma_{13} \\ \sqrt{2}\,\sigma_{12} \end{bmatrix} = \begin{bmatrix} 2\mu\,\varepsilon_{11} + a\lambda \\ 2\mu\,\varepsilon_{22} + a\lambda \\ 2\mu\,\varepsilon_{33} + a\lambda \\ 2\mu\,\sqrt{2}\,\varepsilon_{23} \\ 2\mu\,\sqrt{2}\,\varepsilon_{13} \\ 2\mu\,\sqrt{2}\,\varepsilon_{12} \end{bmatrix}$$

Attention: If $\sigma(\varepsilon)$ is given as formula for tensorial ε, scale components 4, 5 and 6 of $\varepsilon = [\varepsilon_{11}, \varepsilon_{22}, \varepsilon_{33}, \underbrace{\sqrt{2}\,\varepsilon_{23}, \sqrt{2}\,\varepsilon_{13}, \sqrt{2}\,\varepsilon_{12}}]$ by $\frac{1}{\sqrt{2}}$ before calculation