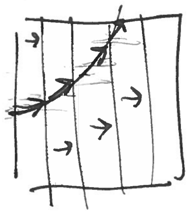
∇u



Dirichlet

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1) $a(u, \delta v) = 0 \Rightarrow u$

$$a(u, \delta v) := -\frac{1}{|\Omega|}\int_{\Omega^{cp}} J(u)\cdot \nabla \delta v \, d\Omega - \frac{1}{|\Omega|}\int_{\Gamma_{ITZ}} t\, J_{ITZ} \cdot \frac{\partial v}{\partial s} ds$$

~~Taylor w. homogenized ITZ~~

2) $$\bar{J}_{11} = -a(u, \underset{\sim}{e}_1 \cdot [x - \bar{x}]) = \frac{1}{|\Omega|}\int_{\Omega^{cp}} J_{11}\, d\Omega + \int_{\Gamma^{itz}} J_{itz,11}\, t\, ds$$

Discrete $$K u = 0$$

$$\bar{J}_{11} = \underline{e}_{11}^T \underline{K}\, \underline{u}$$

Taylor w. homogenized (surface) ITZ

1) $$u_{\#} = e_1 \cdot [x - \bar{x}]$$

2) $$\bar{J}_{11} = -a(u_{\#}, u_{\#})$$

Continuum Taylor

Alt.

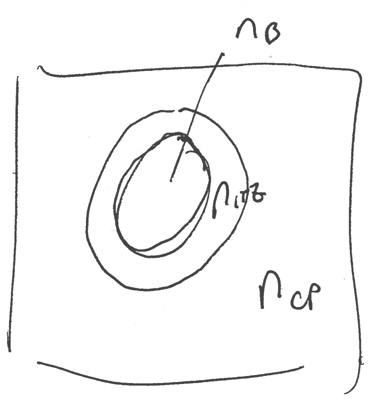
$$\bar{\underset{\frown}{D}}^{V} = n_{cp} \underset{\frown}{D}^{cp} + n_{ITZ} \hat{\underset{\frown}{D}}^{ITZ}$$

$$\frac{A_{ITZ}\, t_{ITZ}\, D_{ITZ}}{V_{SVE}}$$

$$n_{ITZ} = A_{ITZ}\, t_{ITZ}$$

A_{ITZ} = surface intensity $[m^2/m^3]$

$$A_{ITZ} = \frac{a_{ITZ}}{V_{CONC}}$$



$$\hat{\underset{\frown}{D}}^{ITZ} = \cancel{\frac{1}{2\pi^2}\int_{-\pi}^{\pi}\int_{0}^{\pi} \underset{\frown}{D}^{ITZ}(\varphi)}$$

Taylor or homogenised ITZ

$$\underset{\sim}{\bar{J}}_{\cancel{\#}} = n_{cp}\,\underset{\sim}{D}^{cp} + n_{itz}\left[\frac{1}{2\pi^2}\int_{-\pi}^{\pi}\int_{0}^{\pi} D^{ITZ}(\varphi,\theta)\,d\varphi\,d\theta\right]$$

$A_{itz}\,t_{itz}$

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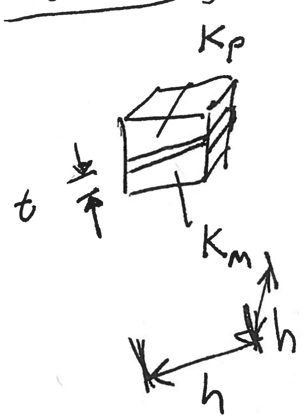
ITZ-modeling



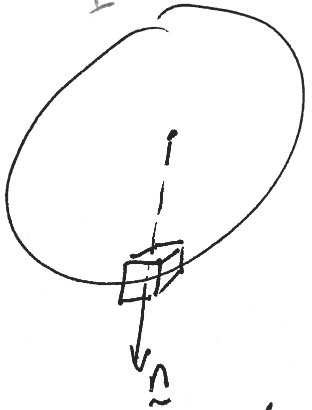
Isotropic Voigt assumption

$$\bar{K} \approx \frac{1}{2}(K_p+K_m) + \frac{\hat{K}_{itz}\cdot h^2}{h^3} = \frac{1}{2}(K_p+K_m) + \frac{\hat{K}_{itz}}{h}$$

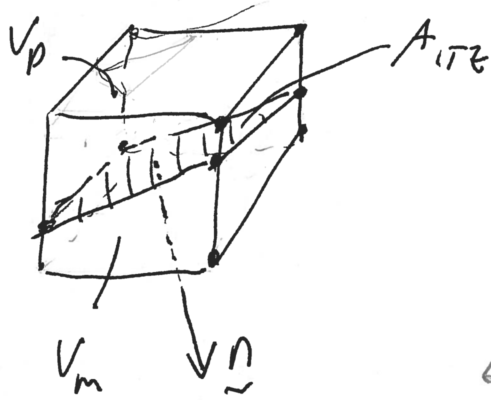
$$\hat{K}_{itz} = K_{itz}\, t \qquad \text{2D-permeability}$$

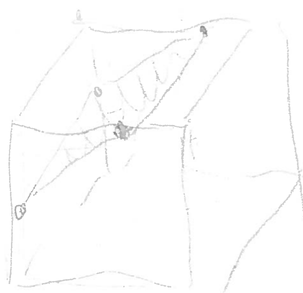
Anisotropic Voigt (known normal)

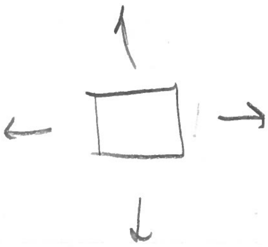
$$\Gamma = \frac{M}{I} z$$

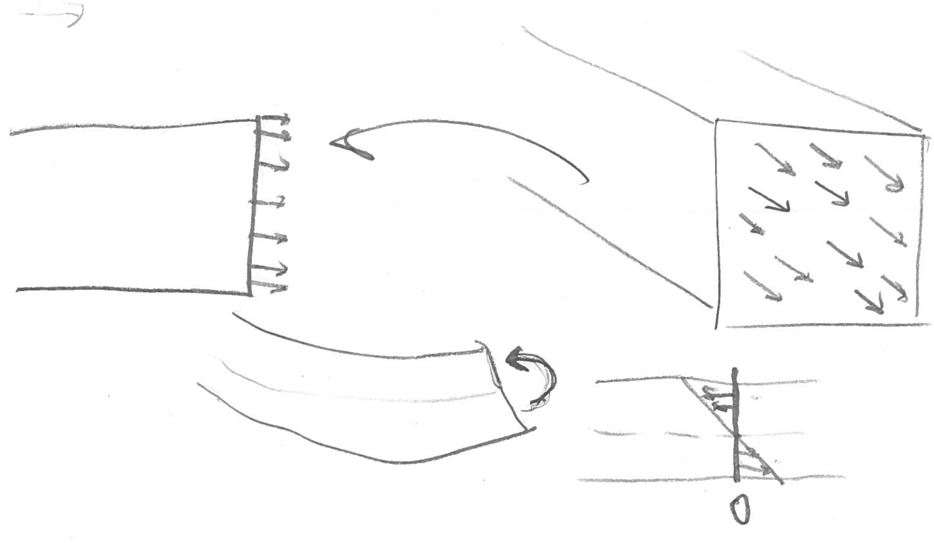


$$\bar{K} = \frac{V_p K_p + V_m K_m}{V_p+V_m}\,\underset{\sim}{I} + \frac{A_{ITZ}\,\hat{K}_{ITZ}}{V_p+V_m}\left[\underset{\sim}{I} - \underset{\sim}{n}\otimes\underset{\sim}{n}\right]$$

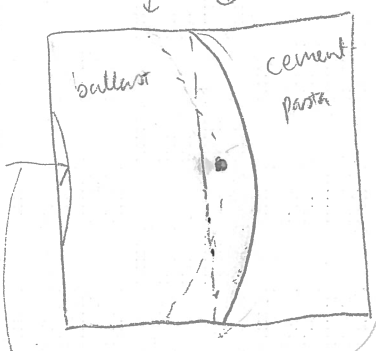








$V_{ballast} = V_{cementpasta}$



Om ballastgräns har räknas av inte med

no ITZ (old) går efter tyngdpunkt

⇒ mängden ballast underskattas alltid

Isotropic Voigt räknar alltid 50% var

⇒ mängden ballast underskattas lite

Anisotropic Voigt räknar efter punkt streckade linjen

⇒ mängden ballast underskattas

Mesh sensitivity (ITZ)

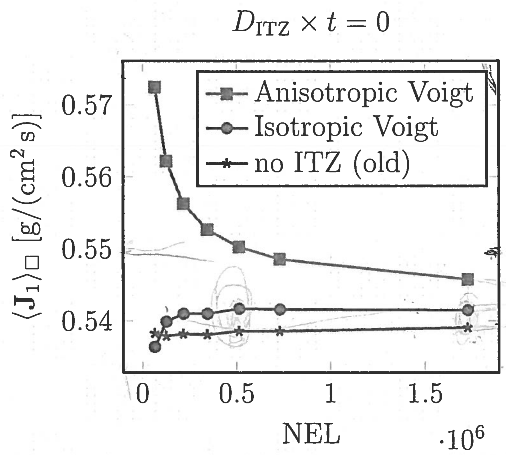
Filip Nilenius

March 12, 2013

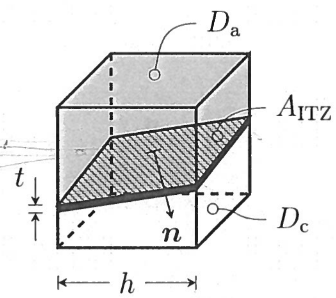
≈ 55% cement

0,2 cm → h = 0,029 cm

⇒ $\frac{0,2}{0,029} \approx 10$



(a) Mesh sensitivity.



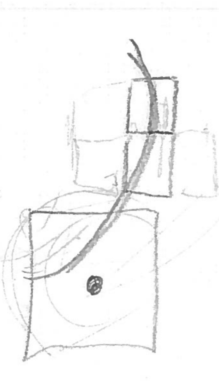
(b) Interface voxel.

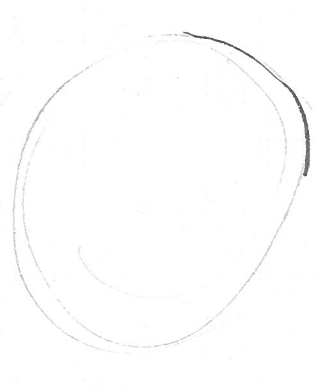
$D_{ITZ} = 0$

$$\text{Anisotropic Voigt: } \bar{\boldsymbol{D}} = \boxed{\frac{V_a D_a + V_c D_c}{V_a + V_c}} \boldsymbol{I} + \cancel{\frac{A_{ITZ} D_{ITZ} t}{V_a + V_c} (\boldsymbol{I} - \boldsymbol{n} \otimes \boldsymbol{n})}$$

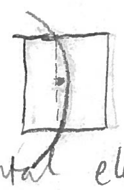
≈ 0

$$\text{Isotropic Voigt: } \bar{D} = \frac{1}{2}(D_b + D_c) + \cancel{\frac{t}{h} D_{ITZ}}$$

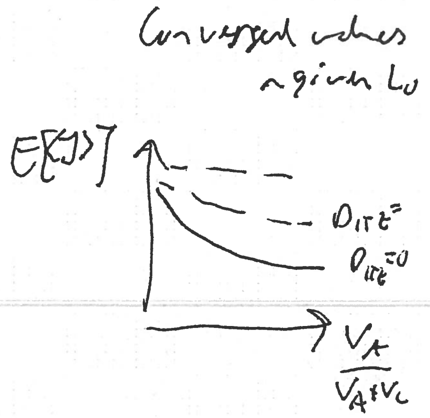


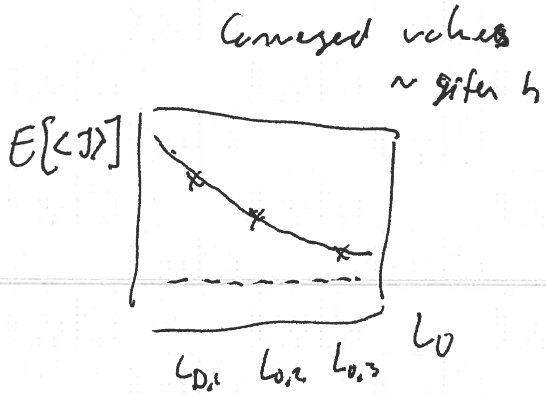


$\frac{V_a}{V_c}$



Andelen
Mängden gränselement minskar för ökande antal element

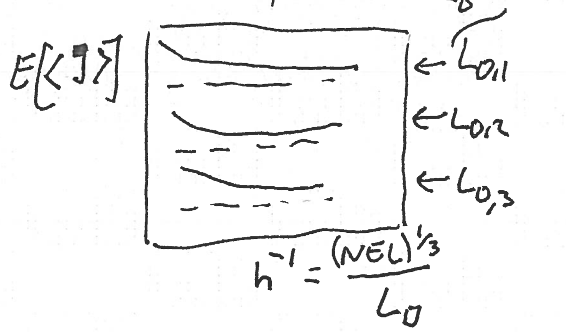


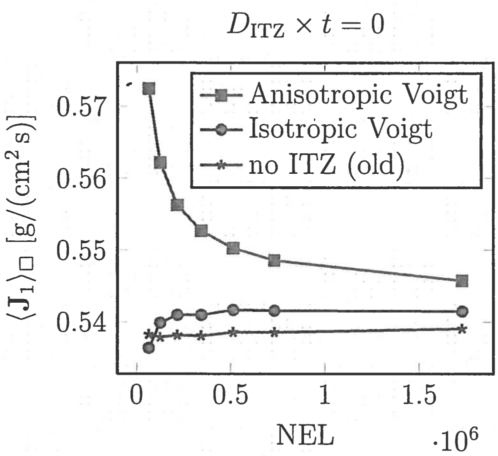


Mesh sensitivity (ITZ)

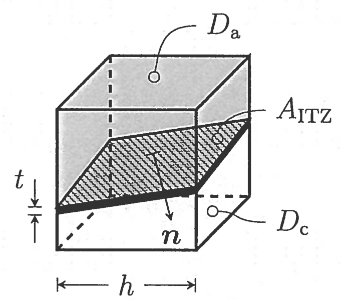
Filip Nilenius

March 12, 2013





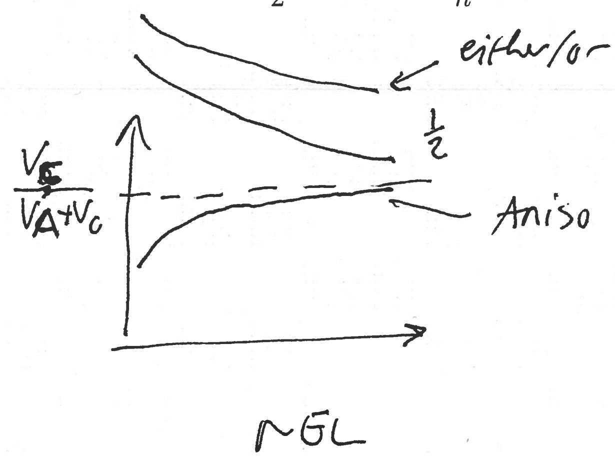
(a) Mesh sensitivity.

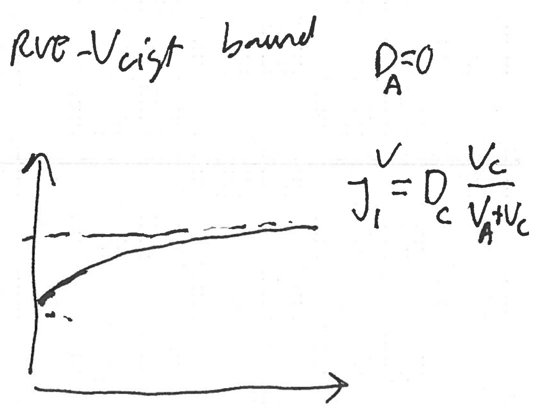


(b) Interface voxel.

Anisotropic Voigt: $\bar{\boldsymbol{D}} = \dfrac{V_a D_a + V_c D_c}{V_a + V_c} \boldsymbol{I} + \dfrac{A_{ITZ} D_{ITZ} t}{V_a + V_c} (\boldsymbol{I} - \boldsymbol{n} \otimes \boldsymbol{n})$

Isotropic Voigt: $\bar{D} = \dfrac{1}{2}(D_b + D_c) + \dfrac{t}{h} D_{ITZ}$





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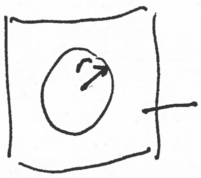
Voigt ($L_0 \to 0$) with ITZ

$$D = \frac{V_a D_a + V_c D_c + A_{ITZ}\, t\, D_{ITZ}}{V_a + V_c} = D^V + \frac{t}{\bar{r}} D_{ITZ}$$

"average" radius

Voigt utan ITZ

$$\frac{1}{\bar{r}} = \frac{A_{ITZ}}{V_A + V_c}$$



$$V_A + V_c = L^3$$

$$\frac{V_c}{V_A + V_c} = n \Rightarrow V_A + V_c = \frac{V_c}{n}$$

$$V_c = \frac{4}{3}\pi r^3$$

$$A_{ITZ} = 4\pi r^2$$

$$\Rightarrow \frac{1}{\bar{r}} = \frac{n 4\pi r^2}{\frac{4}{3}\pi r^3} = \frac{3n}{r}$$

$$\Rightarrow \bar{r} = \frac{r}{3n}$$