



Plooi van slanke aluminium profielen bij brand

Johan Maljaars

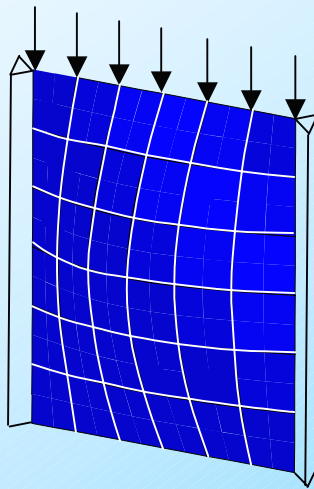
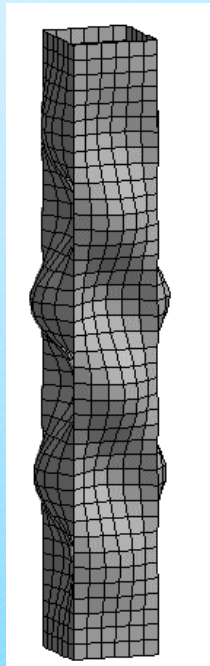
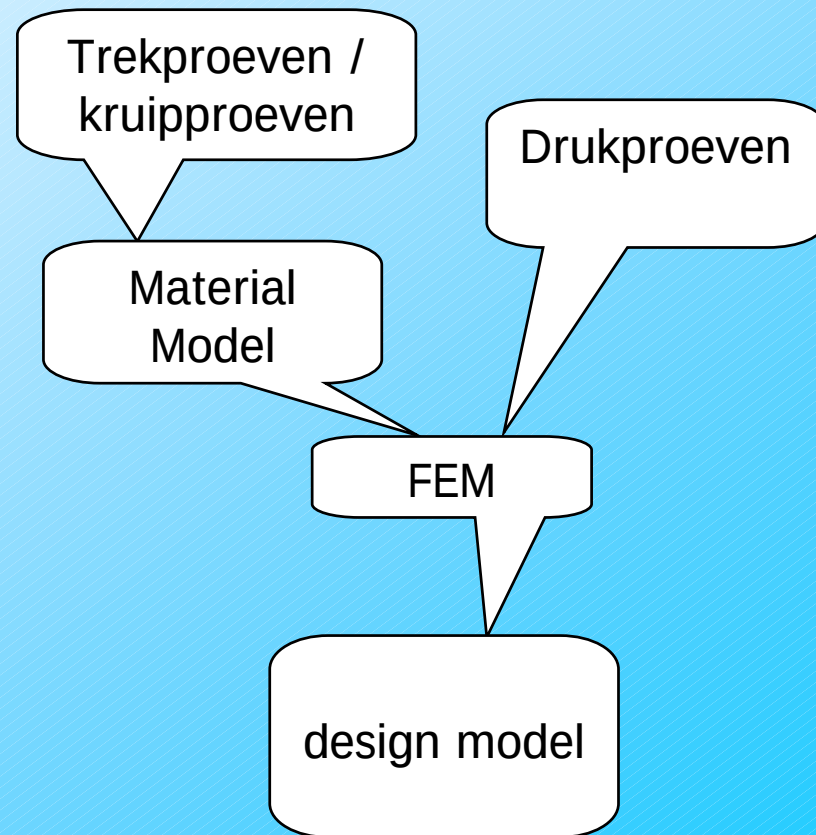
Aluminium en brand

- Aluminium zeer gevoelig voor brand (sterkteteruggang tussen 150 en 350 °C)
- Toepassingen



Onderzoeksvraag

Onderzoeksfocus: plooi



Inhoud

- Belang van kruip en kruipmodel
- Materiaalproeven voor brand
- Implementatie in DIANA
- Drukproeven op slanke profielen
- Validatie DIANA model
- Conclusions

Belang van kruip

- Kruip van aluminium bij kamertemp.
Verwaarloosbaar
- Kruip bij verhoogde temp ($>1/2 T_m = 150\text{ °C}$)
zeer dominant
- Verhoogde temp: Totale rek =
$$\varepsilon = \varepsilon_{th} + \varepsilon_{el} + \varepsilon_t :$$

Kruipmodel

1. Bestaand kruipmodel



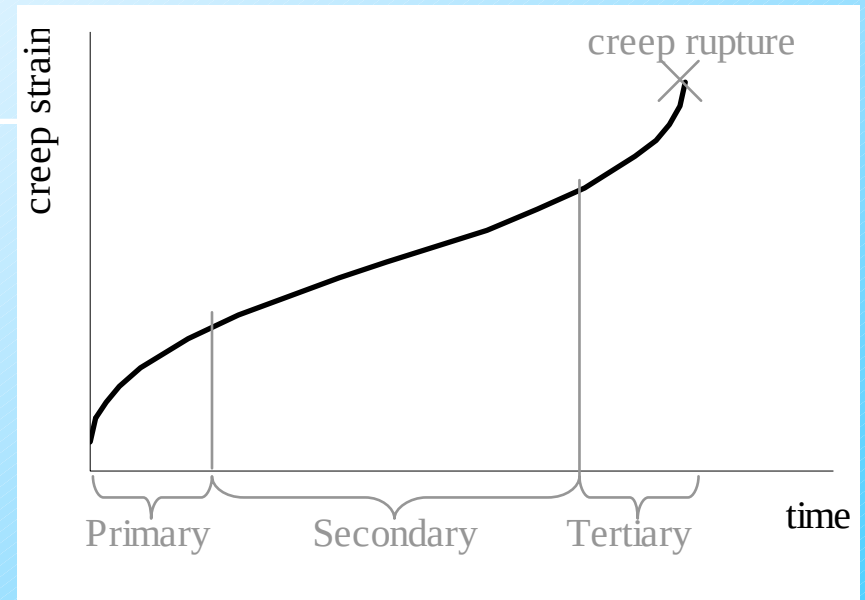
2. Parameter calibratie
alu alloys (kruipproeven)



3. Model uitbreiding voor prim. and tert. kruip

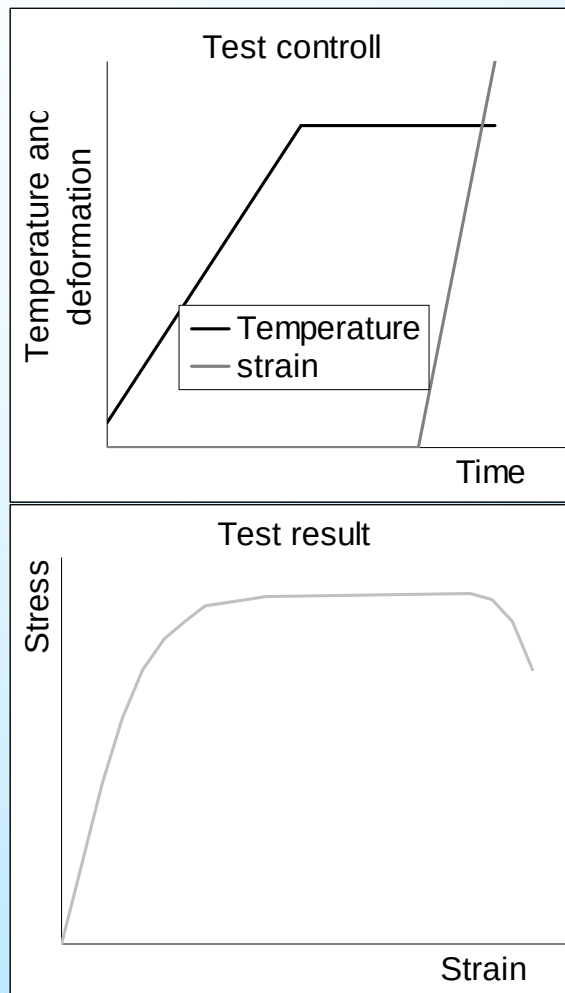


4. Toepassing en validatie voor toenemende
temperature

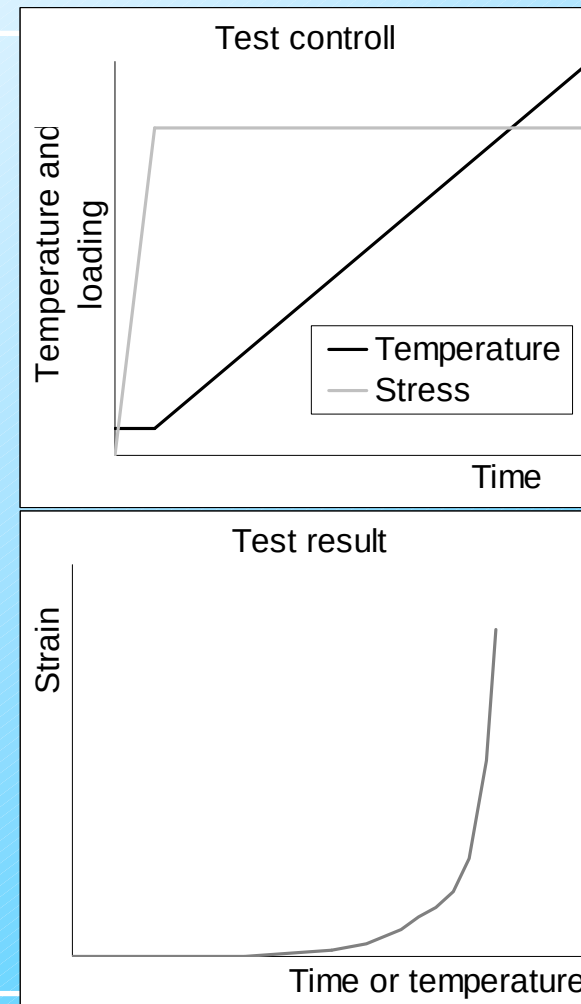


Type materiaalproeven

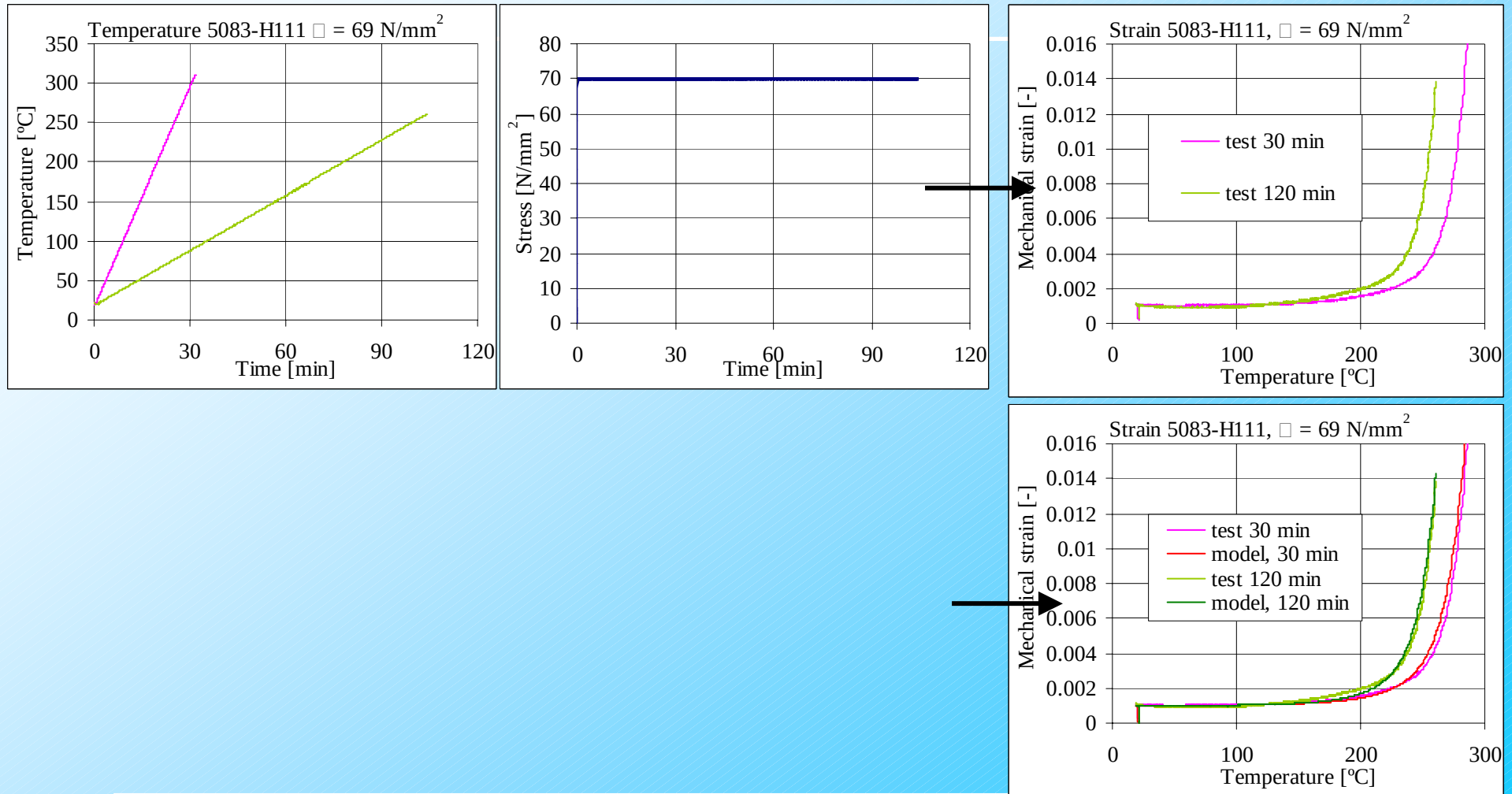
Steady-state



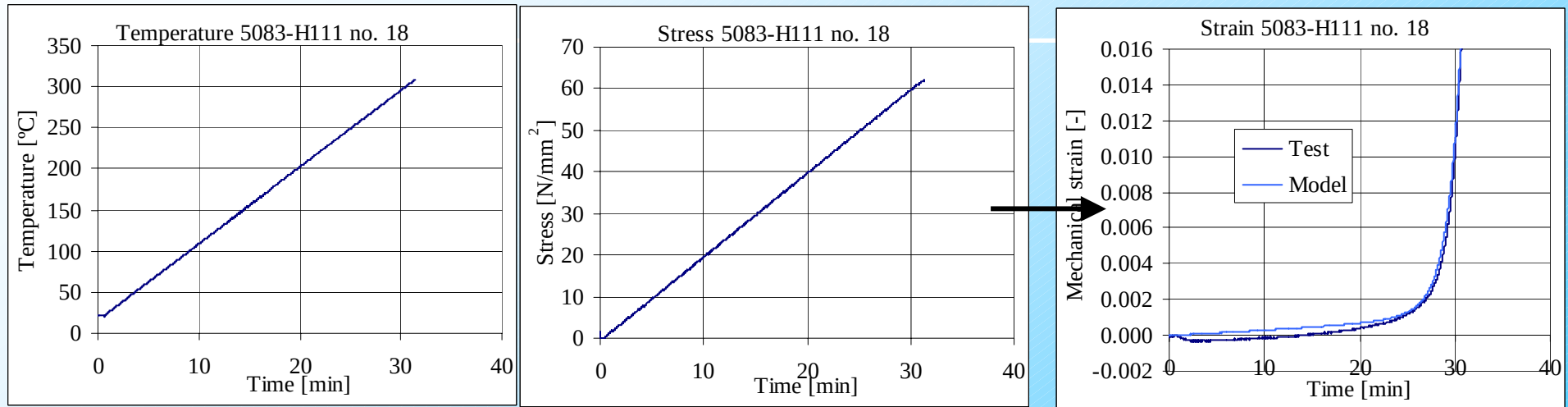
Transient state



Resultaat materiaalproeven I



Resultaat materiaalproeven II



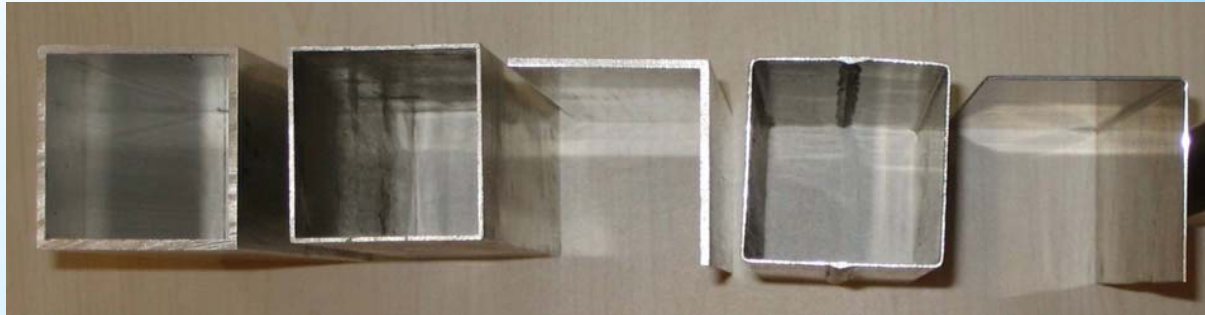
DIANA: User Supplied Subroutine

- Uitbreiding multiaxiaal (Von Mises)
- Subroutine geeft $\delta\varepsilon_{ij}$ en vraagt om σ_{ij} en de tangent stijfheidsmatrix
- Model: $d\varepsilon/dt$ als functie van σ , T , t
- Iteratief bepalen van σ_{ij}
- Numerieke stijfheidsmatrix

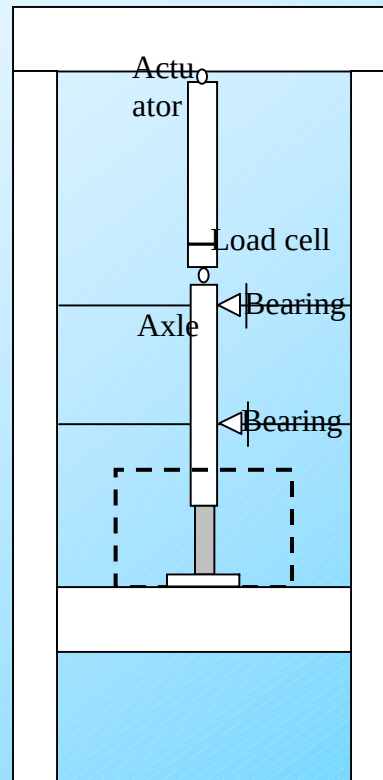
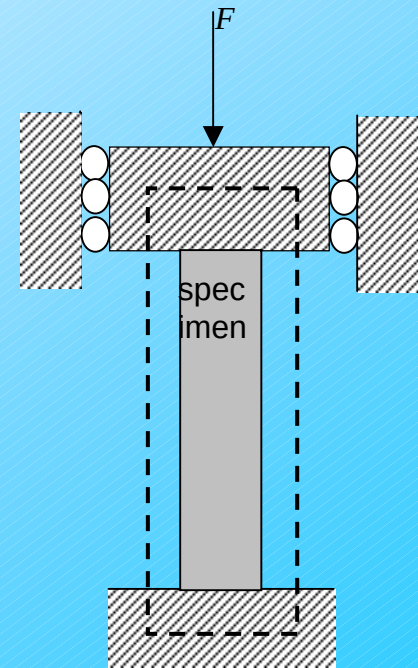
$$\frac{d\sigma}{d\varepsilon} \approx \frac{\sigma - \sigma_{err}}{\varepsilon - \varepsilon_{err}} = \frac{\sigma - \sigma_{err}}{\Delta\varepsilon - \Delta\varepsilon_{err}}$$

Typen drukproeven

Typen secties

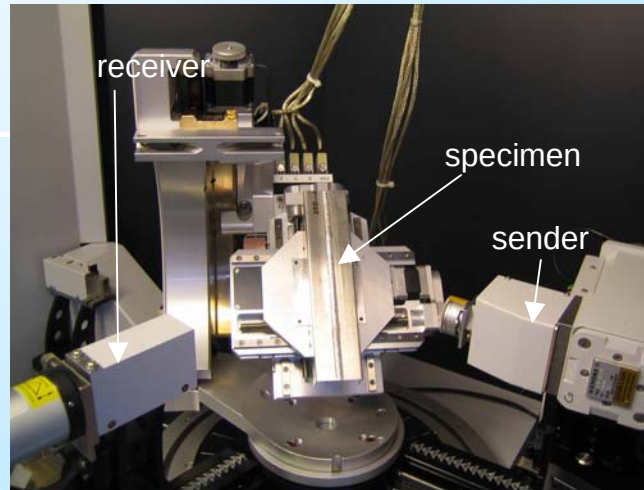
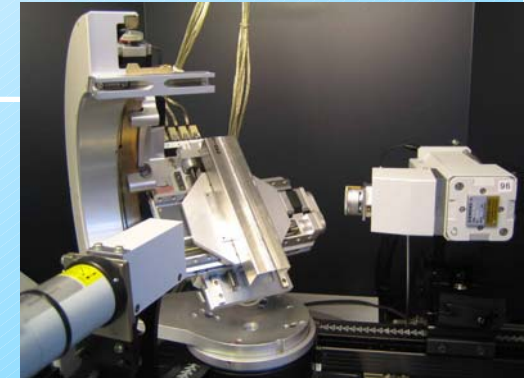
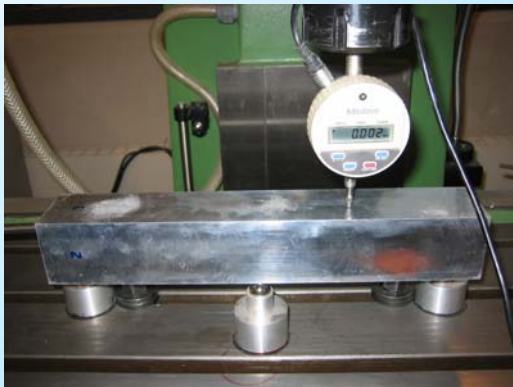
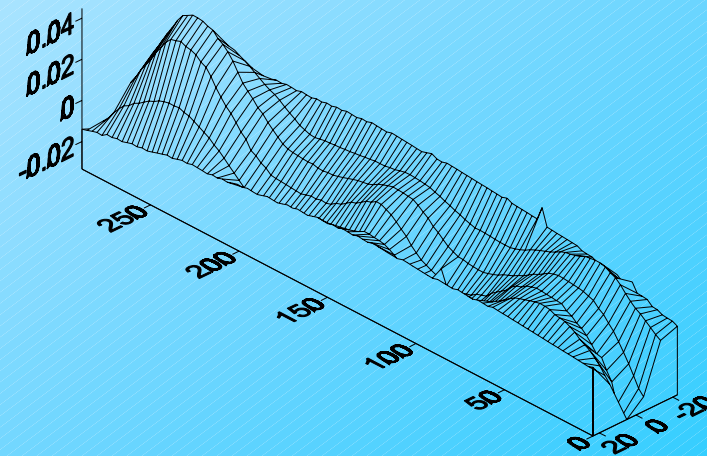


Opstelling

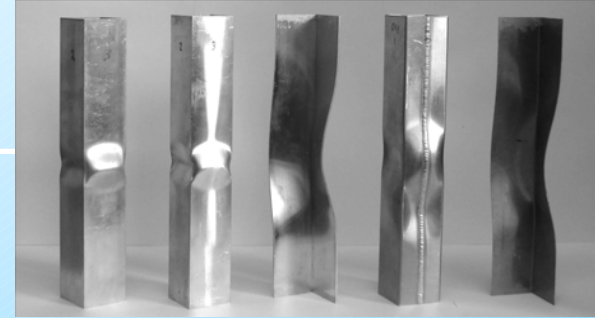
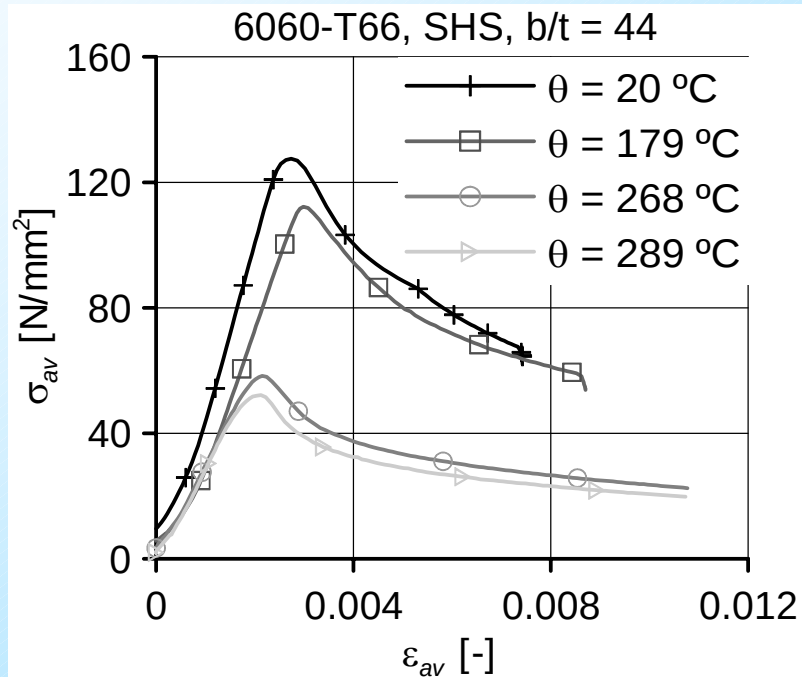
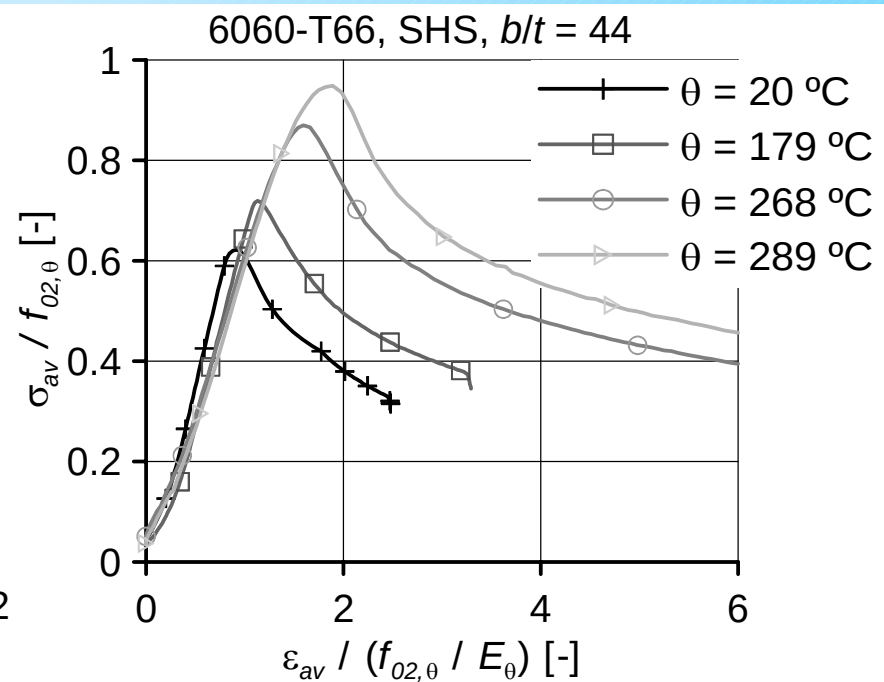


Metingen

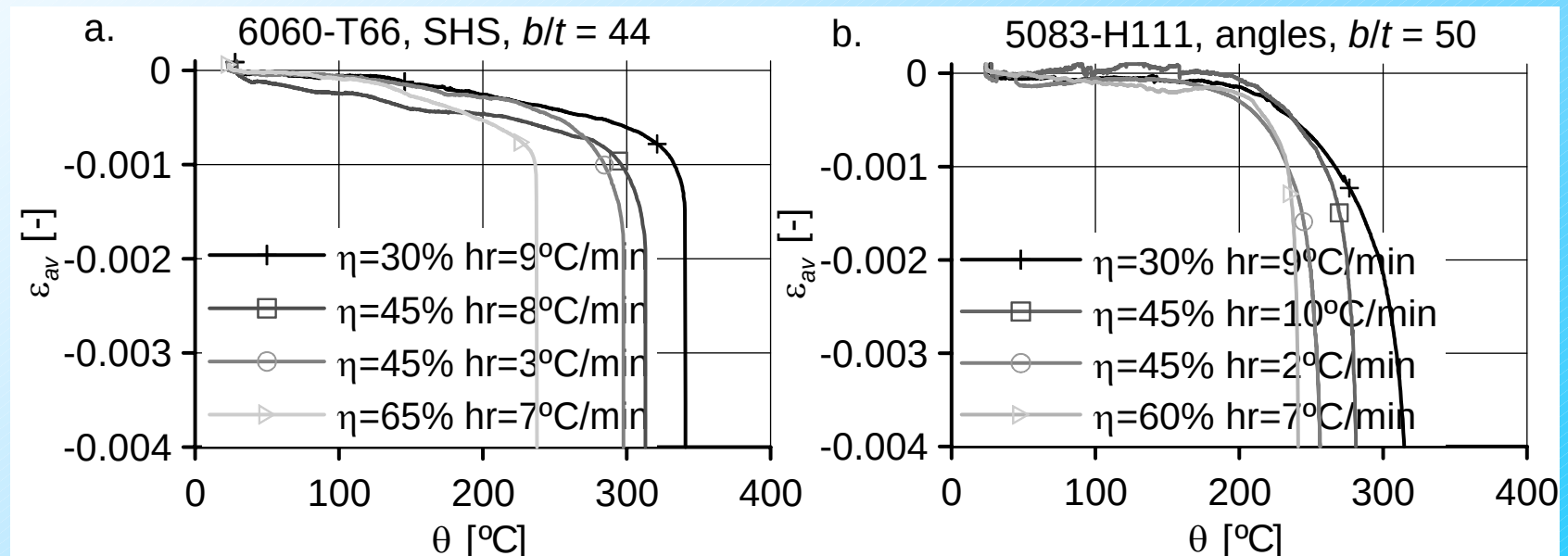
Geometrie
Imperfecties
Restspanningen



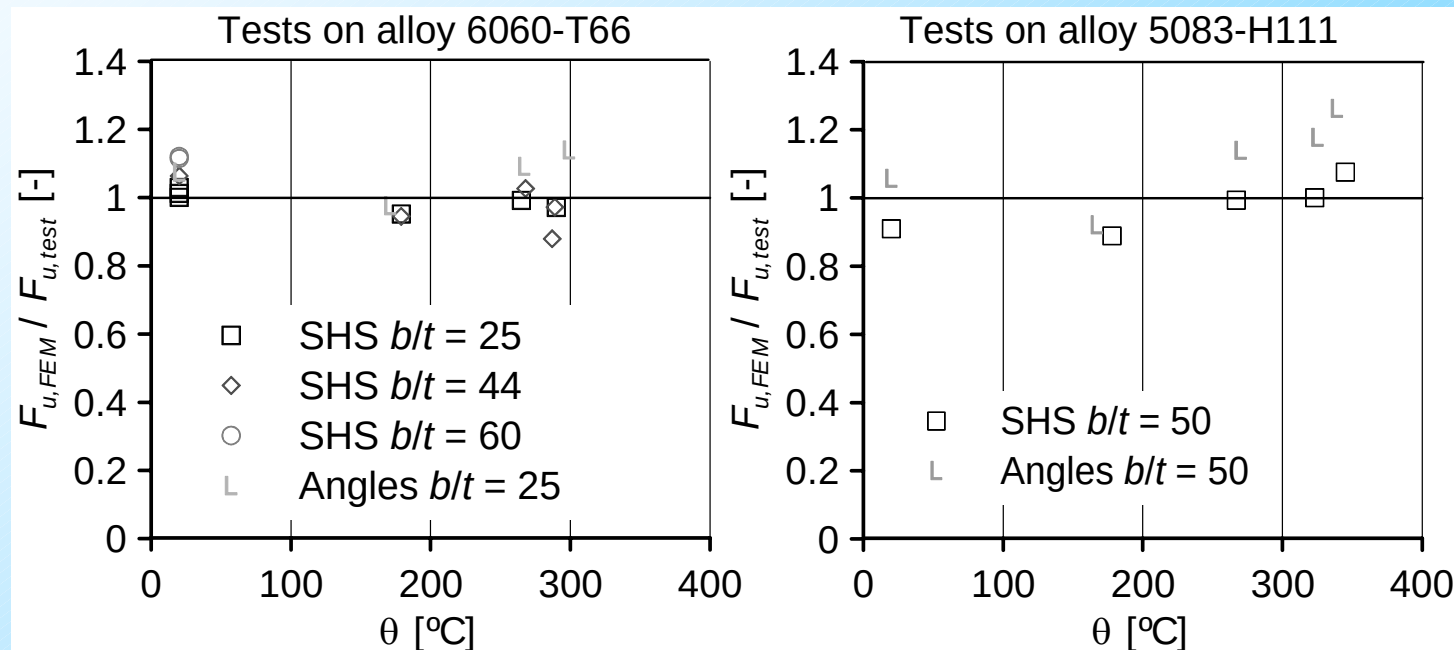
Steady state drukproeven



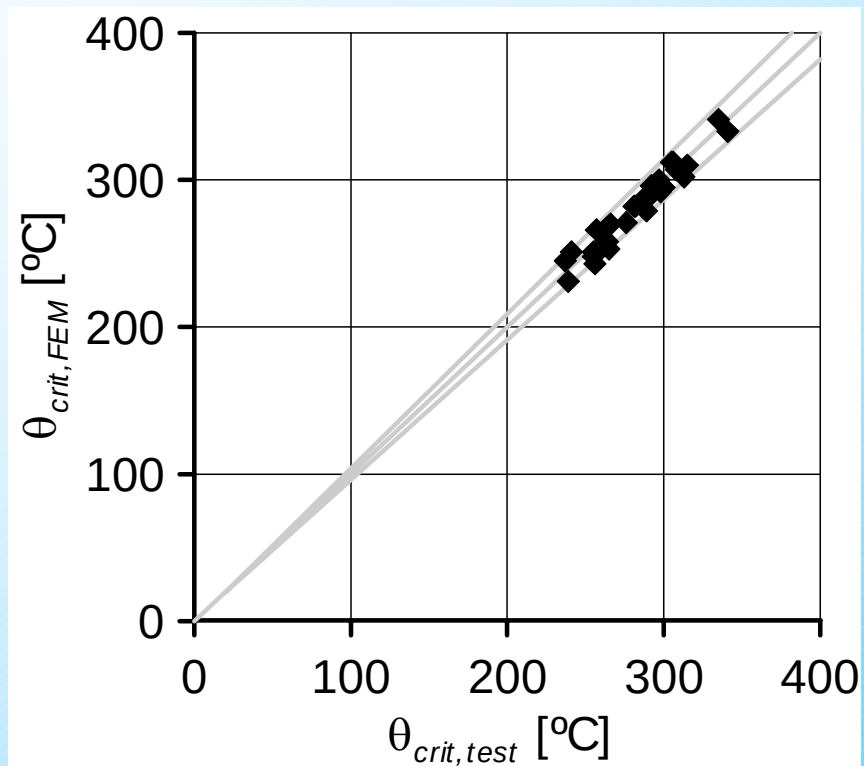
Transient state drukproeven



Validatie FEM model steady-state

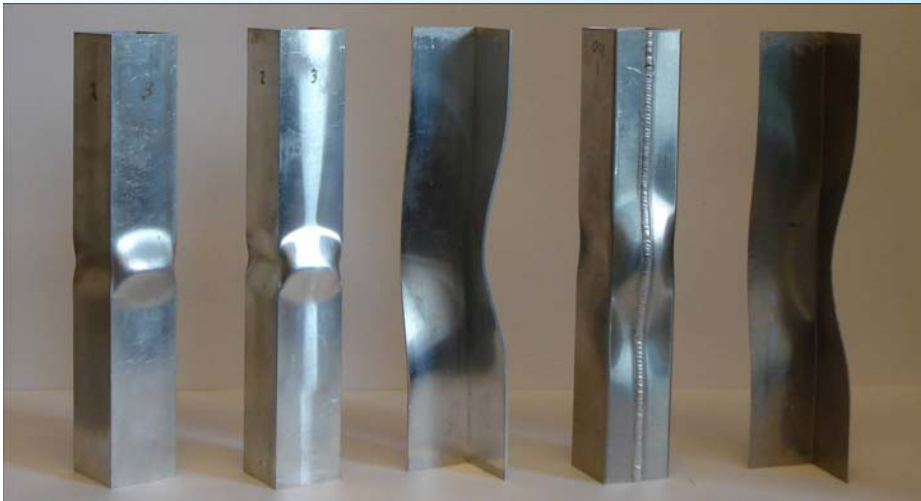
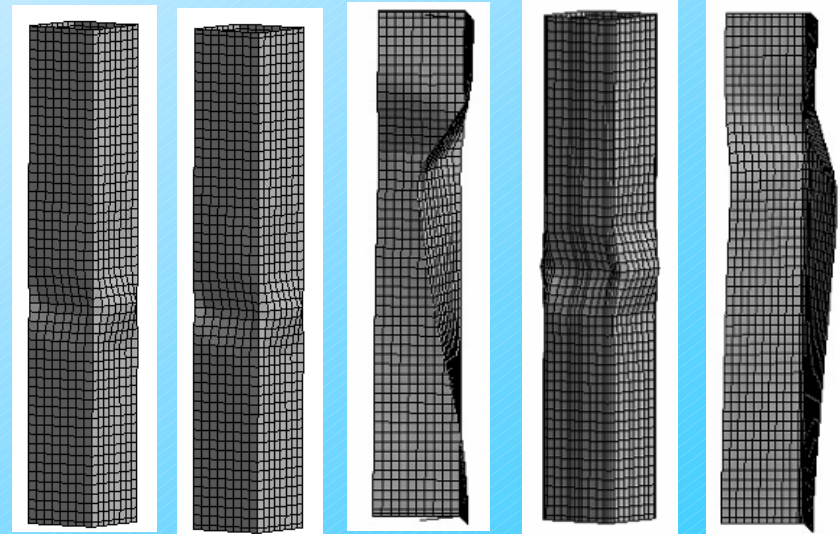


Validatie FEM model transient state



Validatie FEM model

Vervormde proefstukken en modellen



Conclusies

- Materiaal model ontwikkeld, t, T, σ afhankelijk
- Materiaal model ingebracht in DIANA
- FE modellen voor local buckling van alu bij brand gevalideerd
- Alu minder gevoelig voor plooï bij brand