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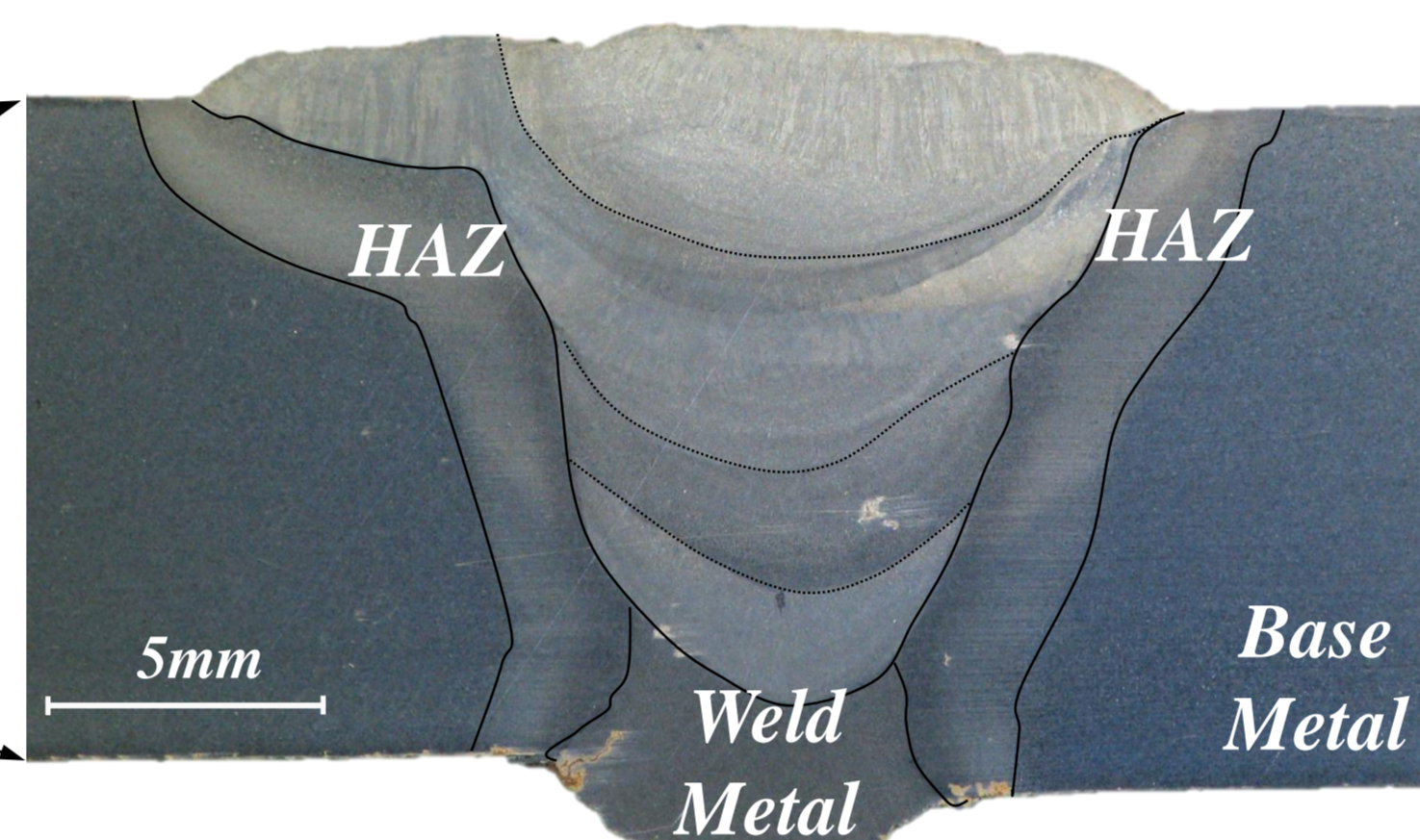


Welded structures like pressure vessels and pipelines are subjected to high pressure and large deformations. Under these conditions, a fracture could be fatal with damage to property and loss of life. The existence of defects makes the welds critical in terms of structural integrity. **Engineering critical assessment (ECA)** facilitates the user to understand the integrity of the weld. Currently, this approach is overly simplified by neglecting the aspect of variations in local constitutive property (strength, ductility, strain hardening etc.)

In this research, weld assessment is performed using **numerical and experimental techniques** to understand the effect of strength variations on crack behavior. The concepts of **fracture mechanics and plasticity theories** will be used. An update to current codes and standards to include heterogeneous components for weld defect analysis will be developed.

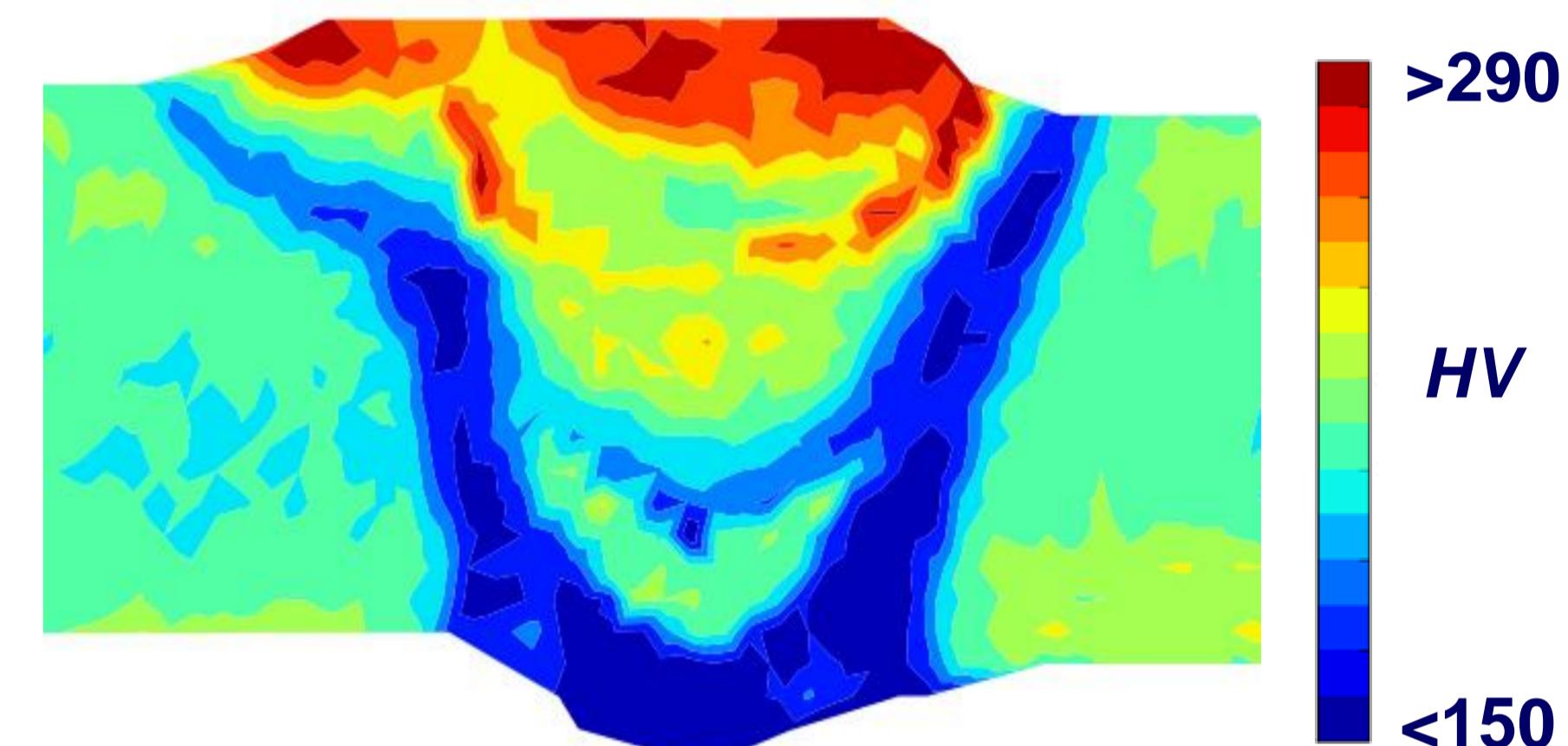


A welded oil pipeline



Cross section of a weld

Local constitutive property variations in weld and Heat Affected Zones (HAZ)



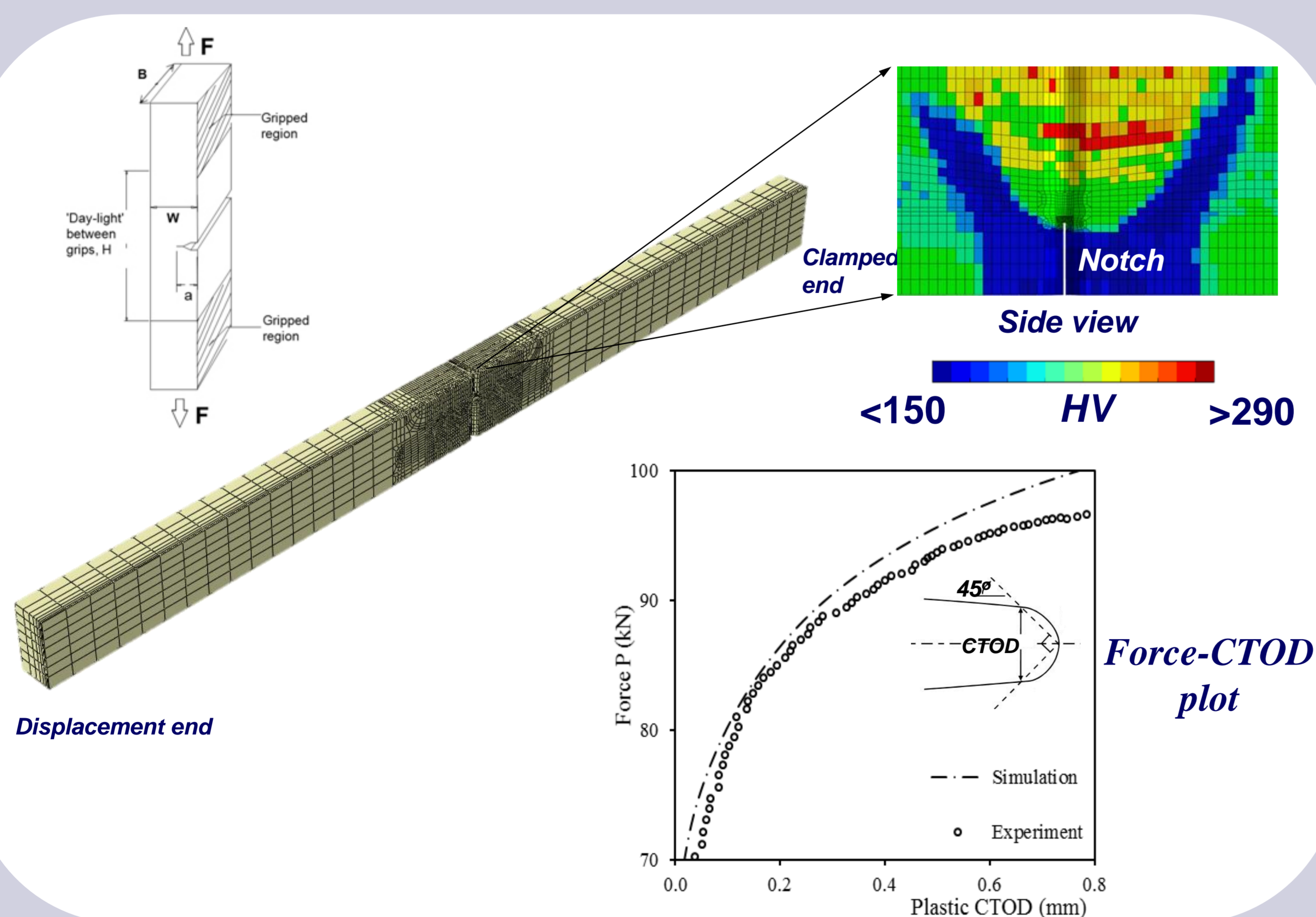
Vickers hardness contour plot of weld cross section

Numerical Model

Single Edge notched Tension (SE(T)) tests are being used to study the structural response of a notched weld.

Soete Laboratory is equipped with a in-house developed FE code (in Abaqus Software) to implement local weld characteristics. It assigns each element with material properties obtained from Hardness mapping.

The material properties like *Yield Strength, Ultimate tensile strength and Strain hardening* are obtained from hardness values using transfer functions calibrated from *all weld metal tensile tests*.

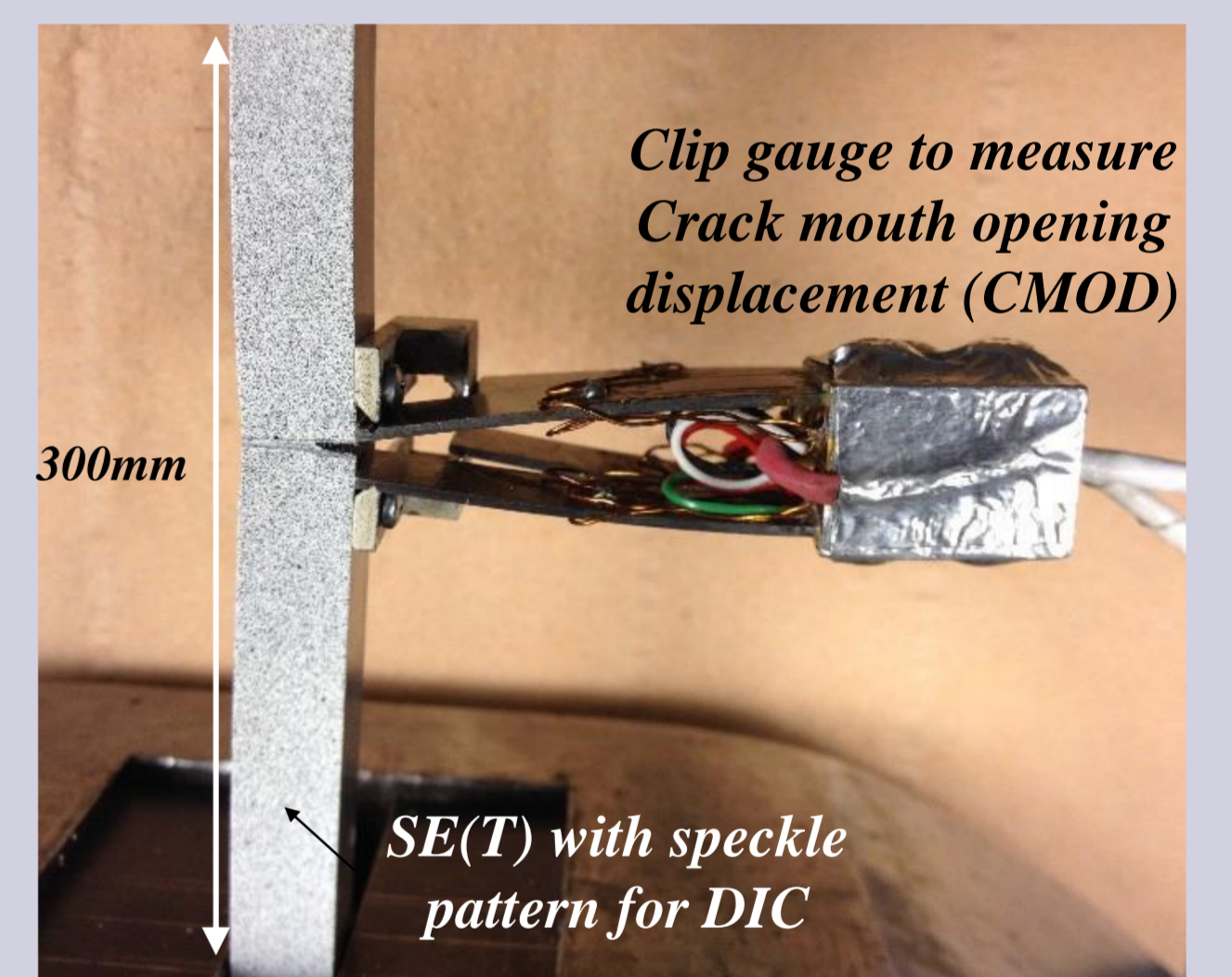


Good agreement was observed with the numerical model and experimental results. (*Force – Crack tip opening displacement (CTOD) plot*).

Experimental techniques

SE(T) tests have been performed on welded Steel (S690) samples obtained from Maribor University.

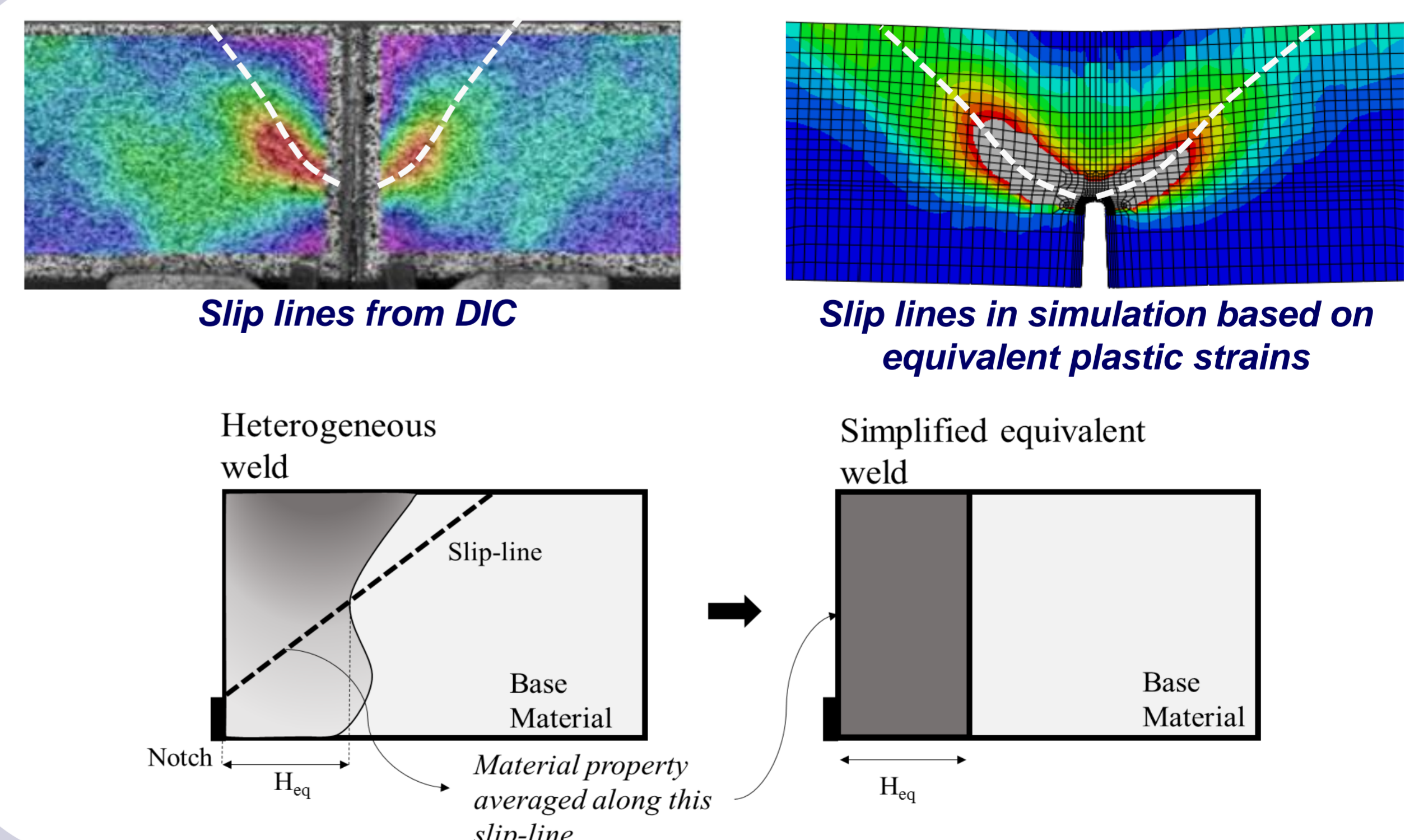
Digital image correlation (DIC) is used to determine full-field strain distribution.



Analytical development

Study of slip lines originating from the crack tip which assists in simplifying a heterogeneous weld.

A simplified weld is obtained by averaging material properties over the slip lines.



This simplified weld will be an input to existing ECA procedures.