

Altair Teknoloji Konferansı Türkiye 2023

24 Ekim 2023

DP600 Dual Fazlı Galvanizli Çeliğin Sünek Hasar Davranışının İncelenmesi

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 **ALTAIR**
HyperWorks

 **gom**
a ZEISS company

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ArcelorMittal

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ARGE TEST MERKEZİ

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- Giriş
- Çalışmanın Amacı
- Sonlu Elemanlar Modelleme
- Hosford-Coulomb Sünek Kırılma Modeli
- Malzeme Eğrisi (Flow Curve)
- Malzeme Karakterizasyon Testleri
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Borçelik



Üretim Kapasitesi
1,5 Mton/yıl



%50 Borusan %50 ArcelorMittal

Ürünler

Hot-Dip Galvanized Flat Steel

Cold Rolled Flat Steel

Hot-Rolled (Pickled and Oiled) Flat Steel

Drawing Steel (DX51D+Z, DX52D+Z, DX53D+Z, DX54D+Z, DX56D+Z, DX57D+Z)

Dual Phase Steel (DP450, DP500, DP600, DP800)

HSLA (H260LAD, H300LAD, H340LAD, H380LAD, H420LAD)

Bake Hardening Steel (HX180BD, HX220BD, HX260BD, HX300BD)

Structural Galvanized Steel (S220 GD+Z, S250 GD+Z, S280 GD+Z, S320 GD+Z, S350 GD+Z, S390 GD+Z, S420GD+Z, S450GD+Z, S550GD+Z, S550 GD)

Cold Forming Steel (DC01, DC03, DC04, DC05, DC06, DC04-C590)

Sektörler



Otomotiv



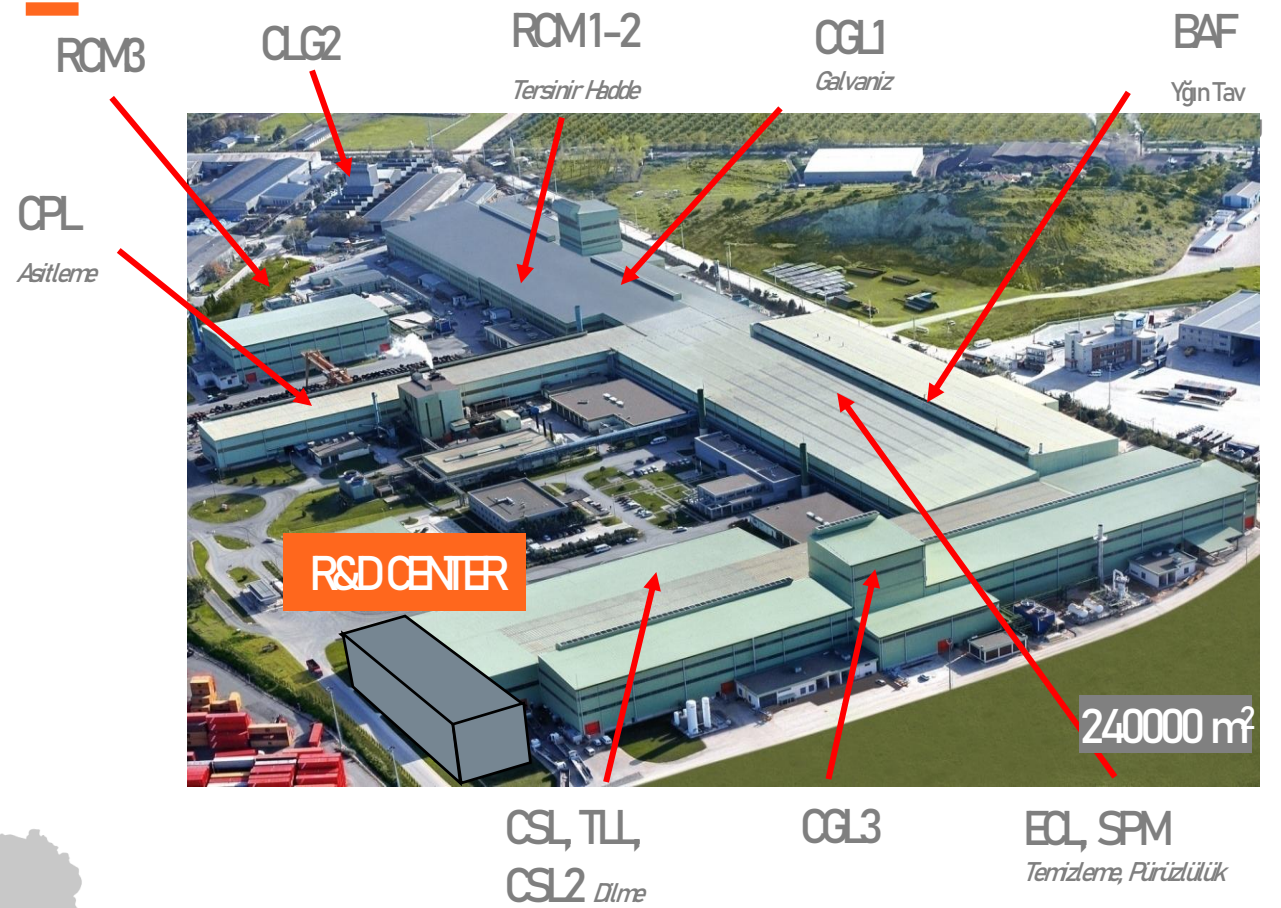
Beyaz Eşya



Radyatör

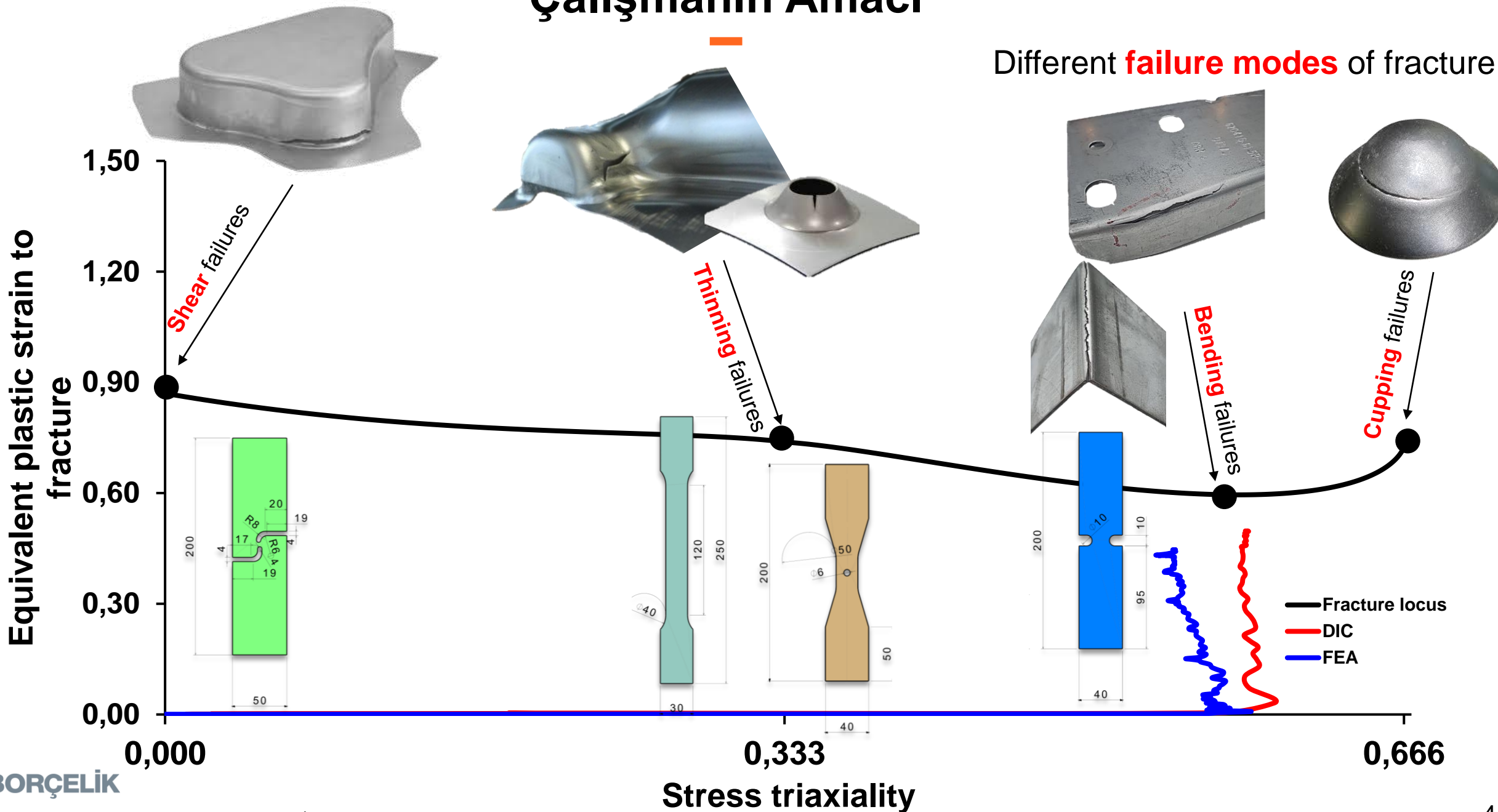


Yapı



Çalışmanın Amacı

Different **failure modes** of fracture



Sonlu Elemanlar Modelleri

Property

$t = 1.0 \text{ mm}$ P1 QEPH

Element type

0.5 x 0.5 mm 4-node quad 2D QEPH

Material model

LAW43 Hill

Fracture criteria

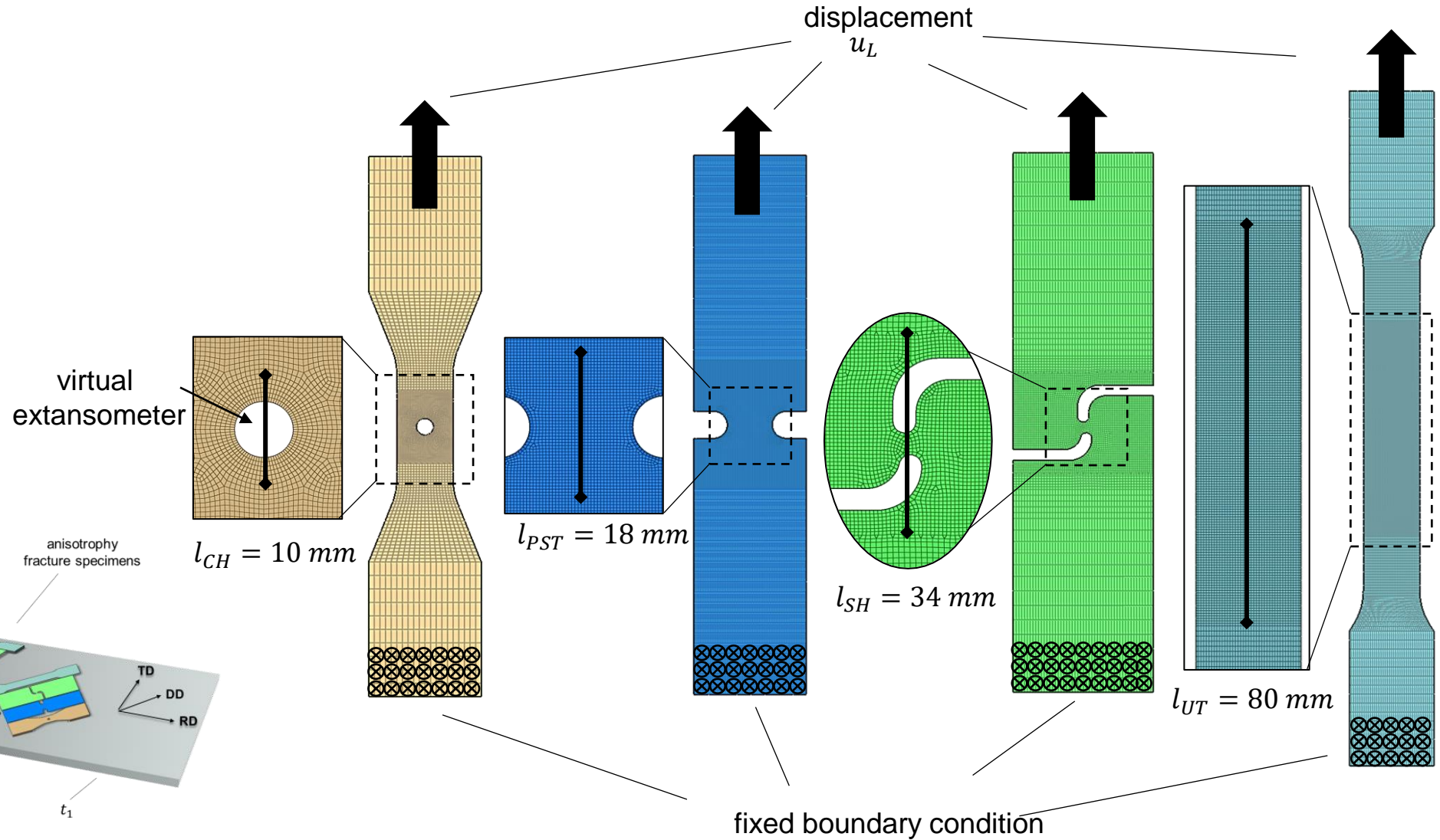
Hosford-Coulomb DSSE

Simulation solver

Altair Radioss

Time integration method

Explicit



5
Sınırlanmış: Borusan Grubu Özel
Classification: Borusan Group Confidential


Hosford-Coulomb Sünek Kırılma Modeli

/FAIL/HC_DSSE

Block Format Keyword

Strain-based Ductile Failure Model: Hosford-Coulomb with Domain of Shell-to-Solid Equivalence. A nonlinear strain based failure criteria for shells with linear damage accumulation.

The failure strain is described by the Hosford-Coulomb function (refer to /FAIL/EMC for solids). Works only with elasto-plastic material number > 28. This failure criteria was developed by Keunhwan Pack (Massachusetts Institute of Technology MIT) and Dirk Mohr (Swiss Federal Institute of Technology ETH Zurich). ^[1]

Name	Value
Solver Keyword:	/FAIL/HC_DSSE
ID:	2
Name:	failure2
Color:	
Include:	[Main Model]
Defined:	<input checked="" type="checkbox"/>
Config:	HC_DSSE
Export Fail Id:	<input type="checkbox"/>
Mat_Id:	(2000121) 114_raillowerouterL
lfail_sh:	
P_thickfail:	
l_Flag:	
a:	1.72
b:	0.5
c:	0.0392
d:	
n_f:	0.1
Metadata	

The Hosford-Coulomb failure criteria

$$\bar{\epsilon}_f[\eta, \bar{\theta}] = b(1+c)^n \left\{ \left[\frac{1}{2} \left((f_1 - f_2)^a + (f_2 - f_3)^a + (f_1 - f_3)^a \right) \right]^{\frac{1}{a}} + c(2\eta + f_1 + f_3) \right\}^{-1/n}$$

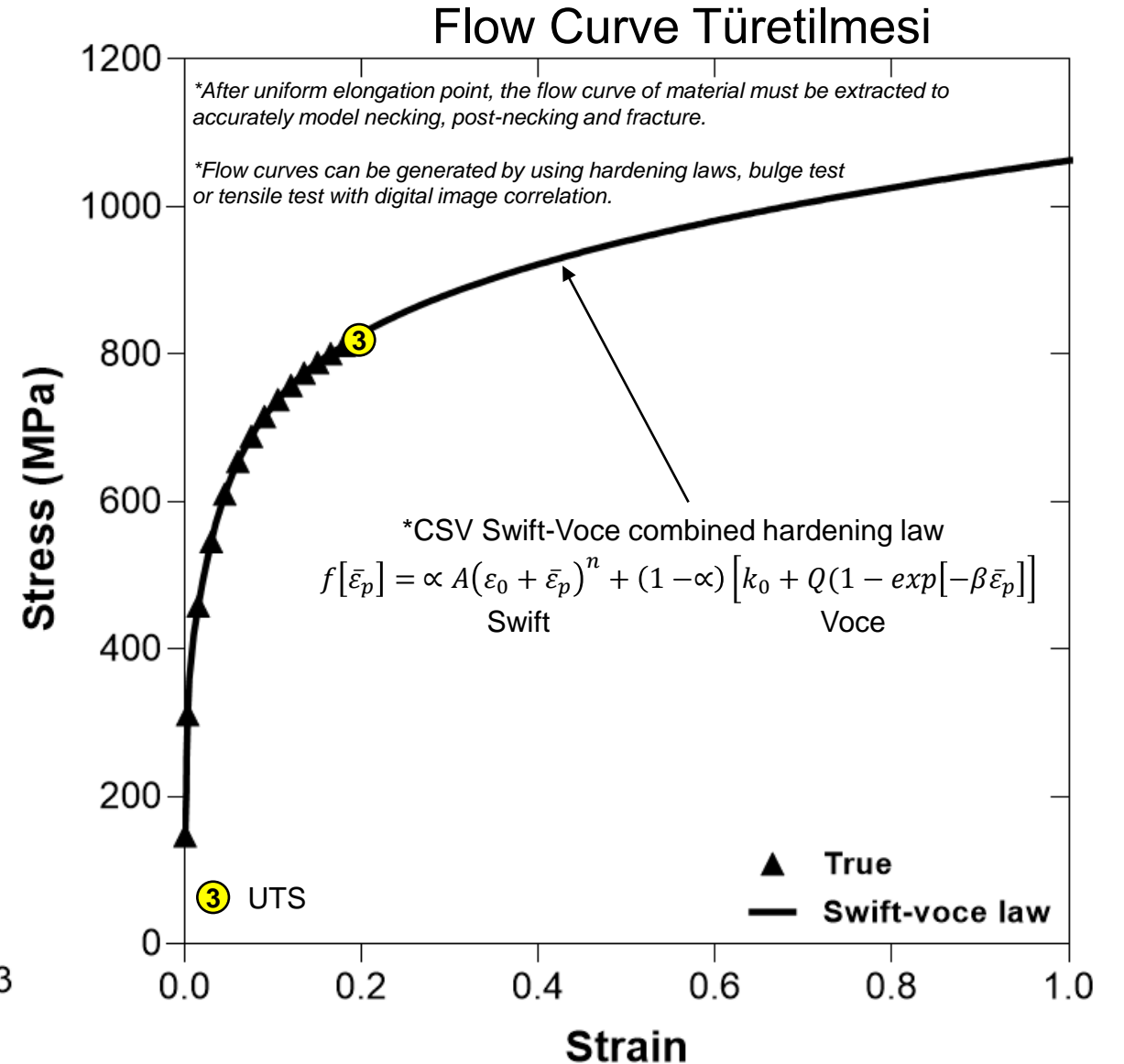
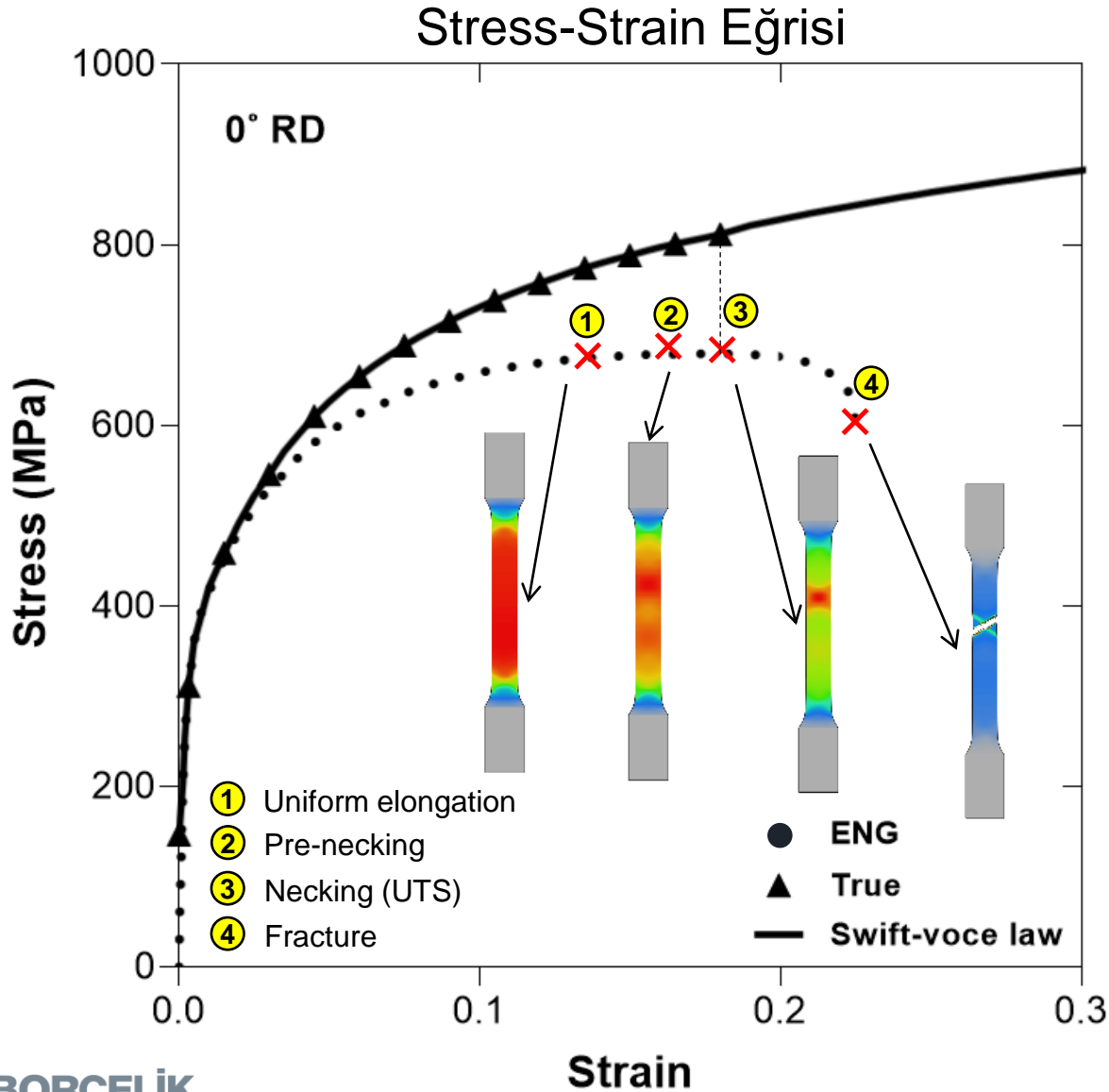
HC Parameters

a	1,57085
b	1,00256
c	0,04943
d	2
n	0,1
in.strain	1,003

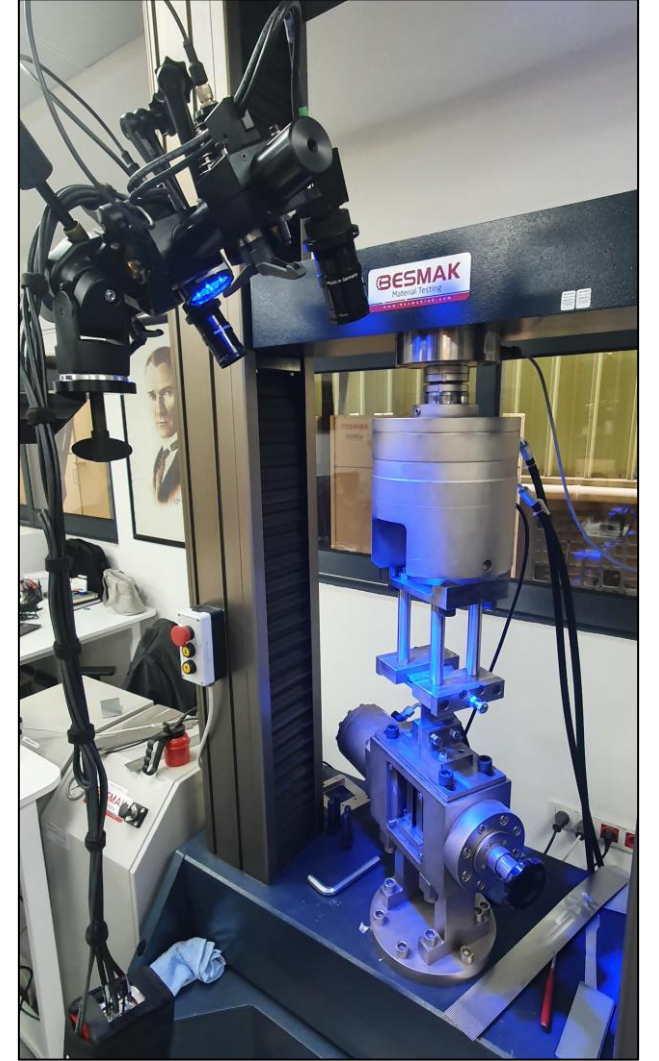
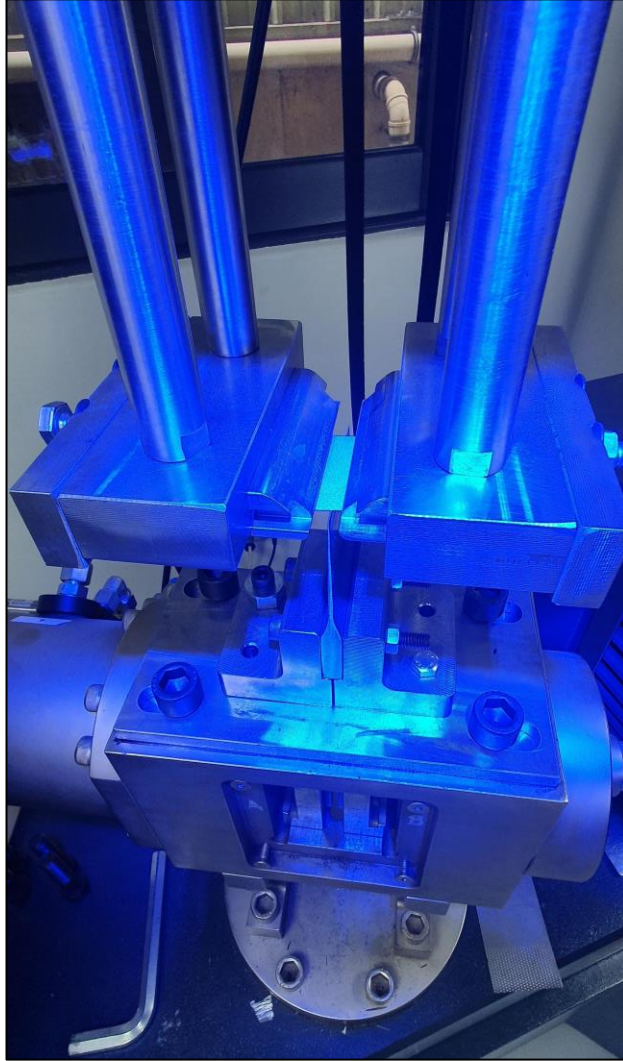
Triax.	Experimental Values	HC Calculated Values
0,333	Equi-Biaxial Tension(Uniaxial Ten.)	1,003
0,577	Plane Strain Tension	0,700
0	Pure Shear	1,200
0,666	ERICHSEN	1,003
0,495	Uniaxial Tensile(0,4-0,45 Triax.)	0,660

Equi-Biaxial Tension(Uniaxial Ten.)	1,003
Plane Strain Tension	0,700
Pure Shear	1,200
ERICHSEN	0,751
Uniaxial Tensile(0,4-0,45 Triax.)	0,868

Malzeme Eğrisi (Flow Curve, Hardening Curve)

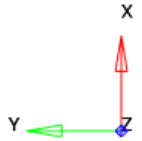
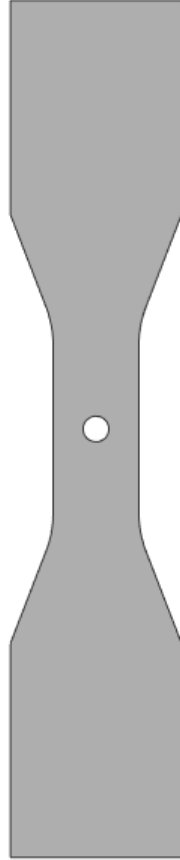
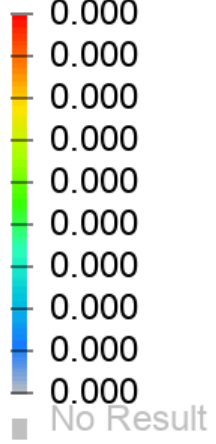


Test Sistemi

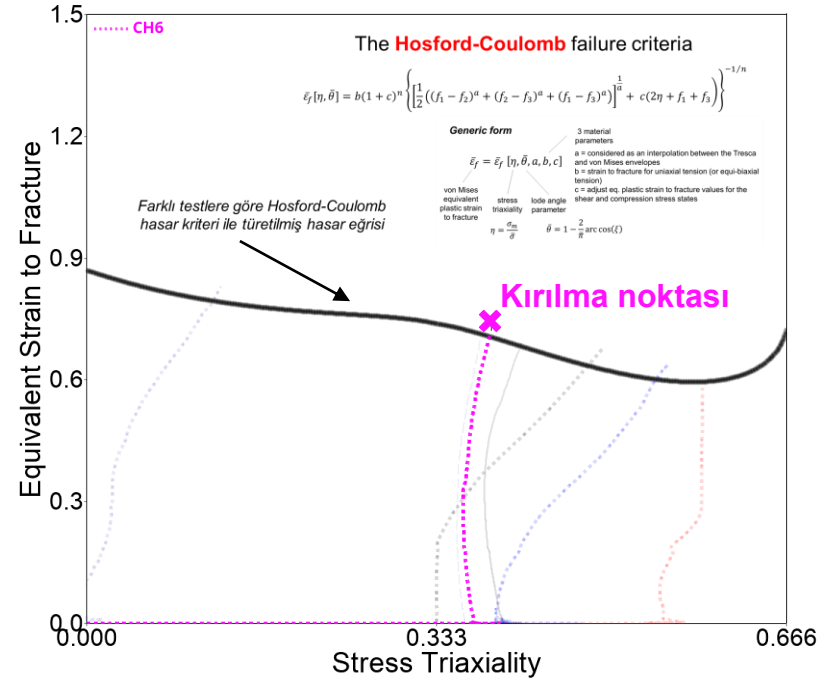


CH (Central Hole) Numunesi

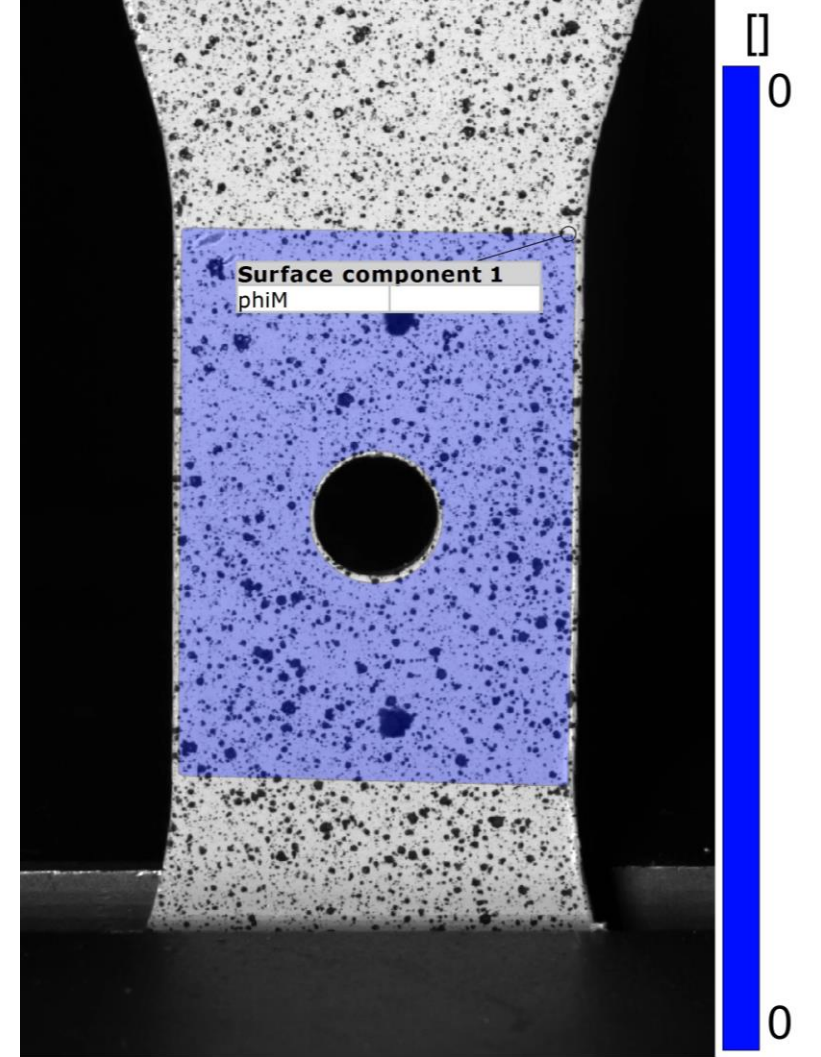
Contour Plot
Plastic Strain(Scalar value, Mid)
Simple Average



1: Tensile_Test
Loadcase 1 : Time = 0.0000e+00 : Frame 1



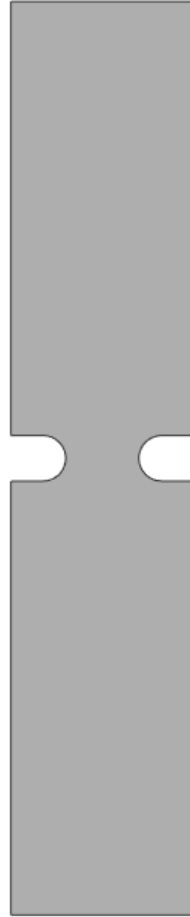
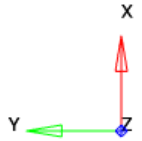
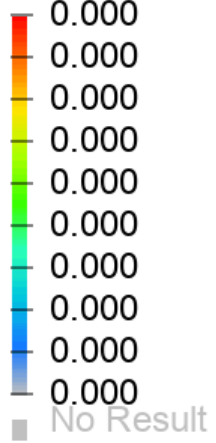
CH Strain patikası



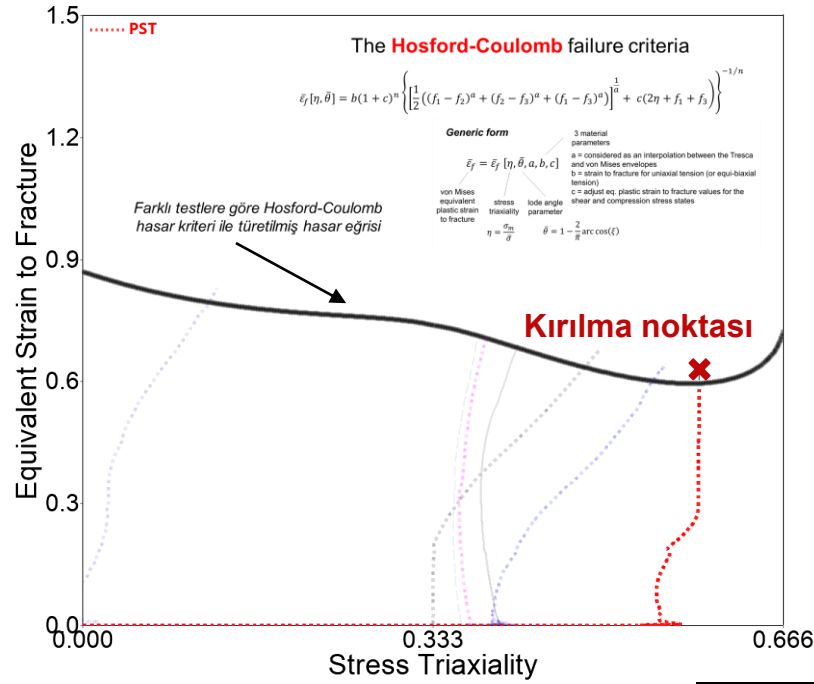
Dijital görüntü korelasyonu (DIC)

PST (Plane Strain Tension) Numunesi

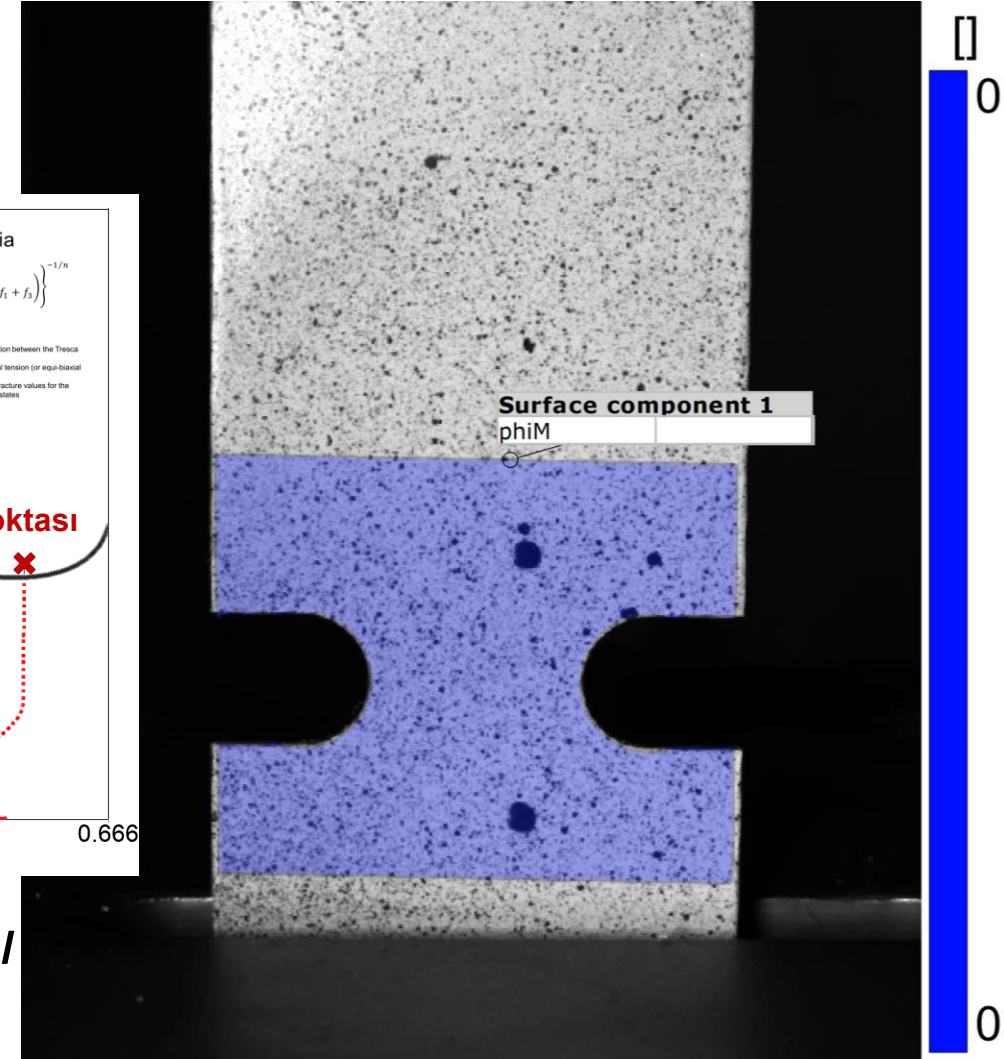
Contour Plot
Plastic Strain(Scalar value, Mid)
Simple Average



1: Tensile_Test
Loadcase 1 : Time = 0.0000e+00 : Frame 1



PST Strain patikası

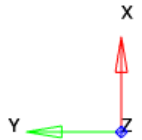
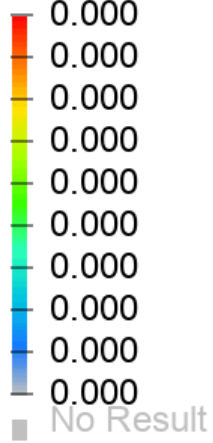


Sonlu elemanlar analizi (FEA)

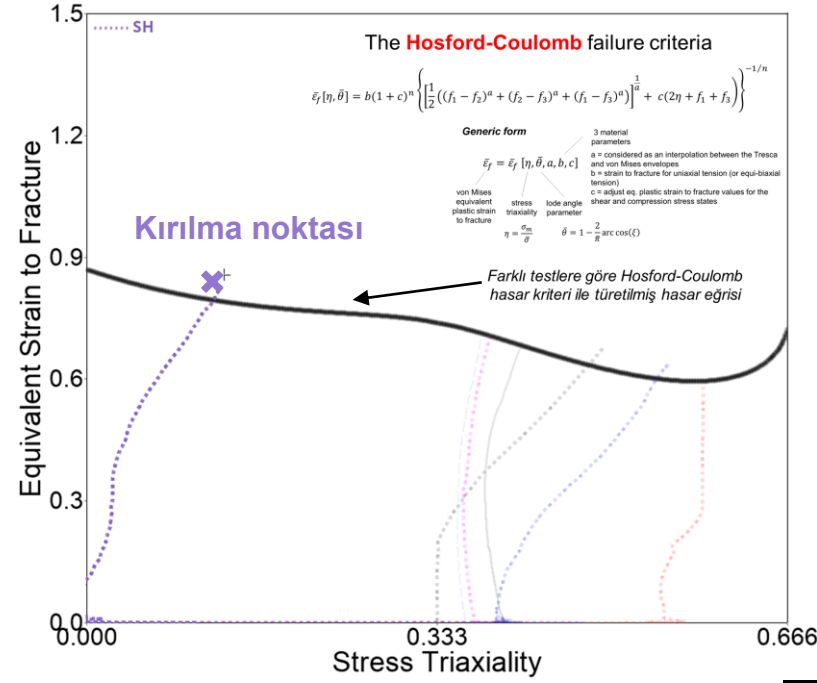
Dijital görüntü korelasyonu (DIC)

SH (Shear) Numunesi

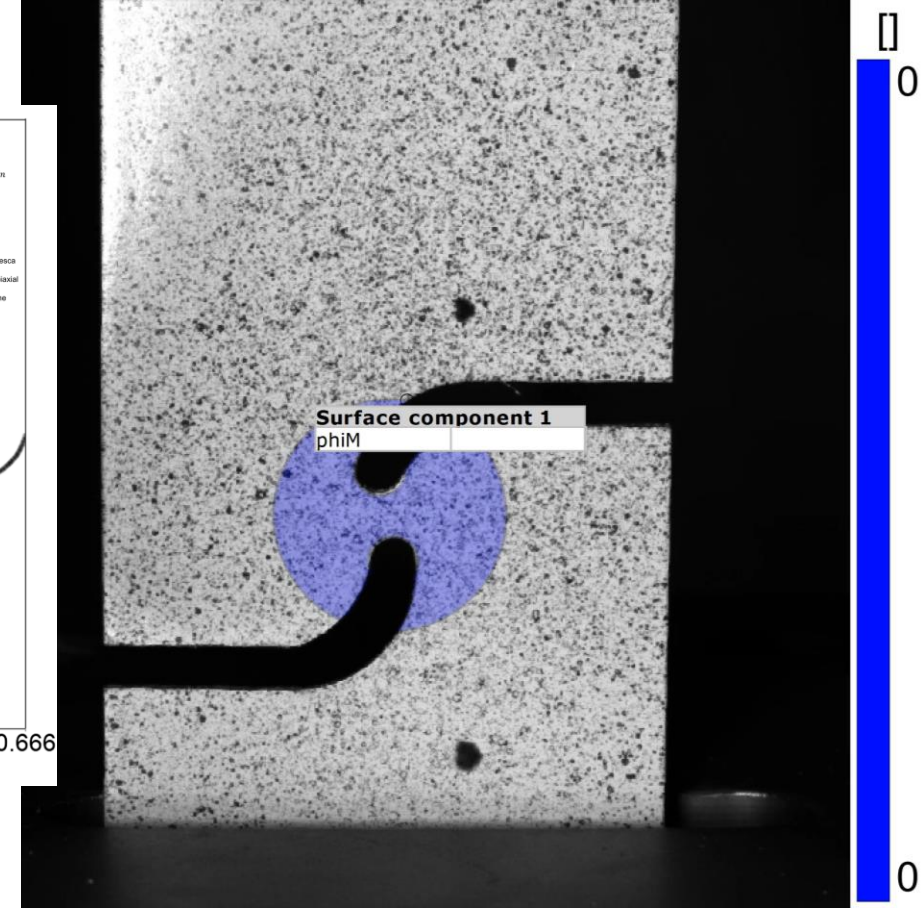
Contour Plot
Plastic Strain(Scalar value, Mid)
Simple Average



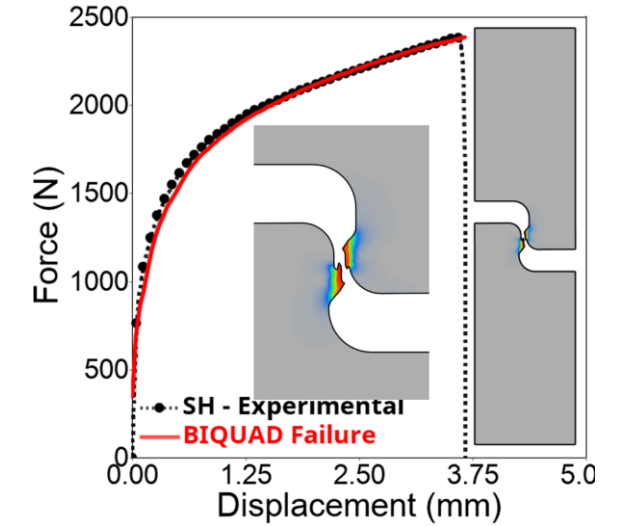
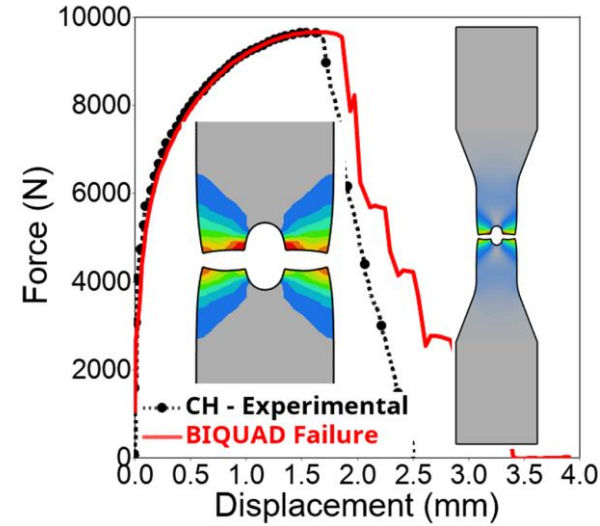
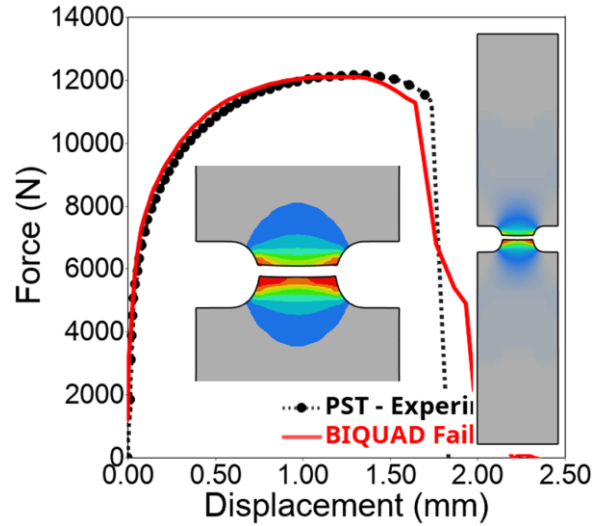
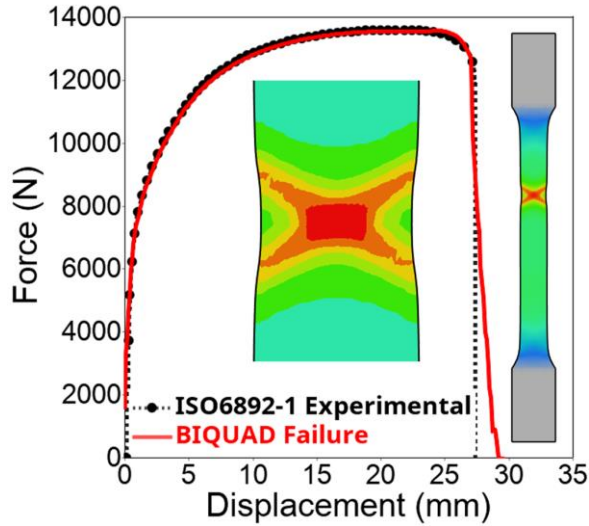
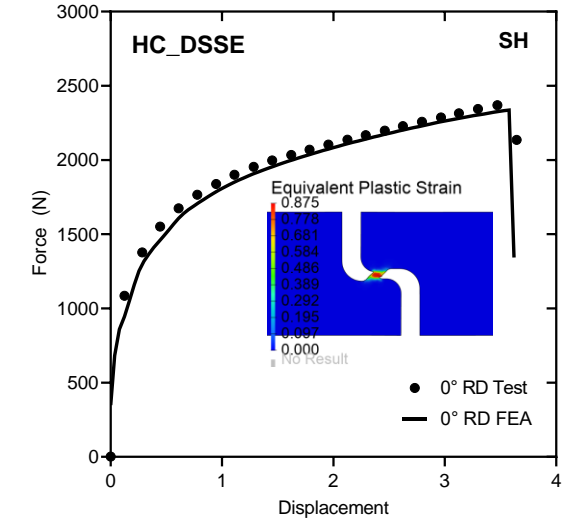
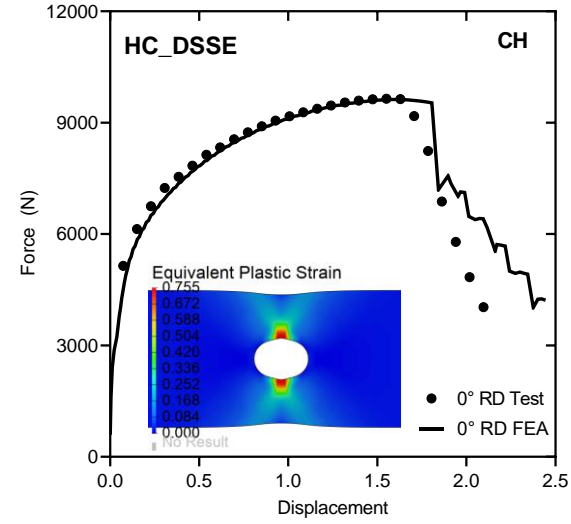
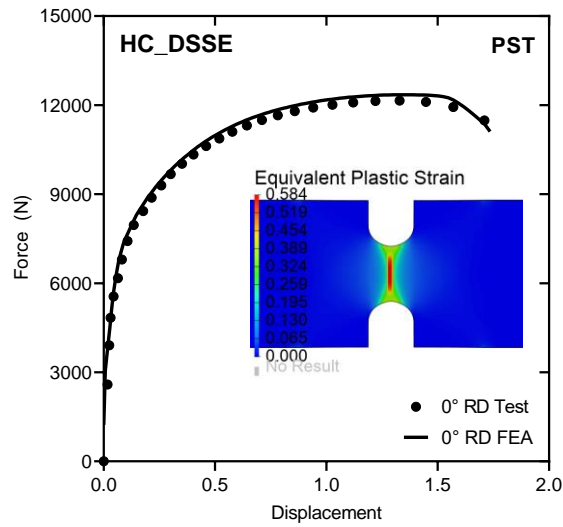
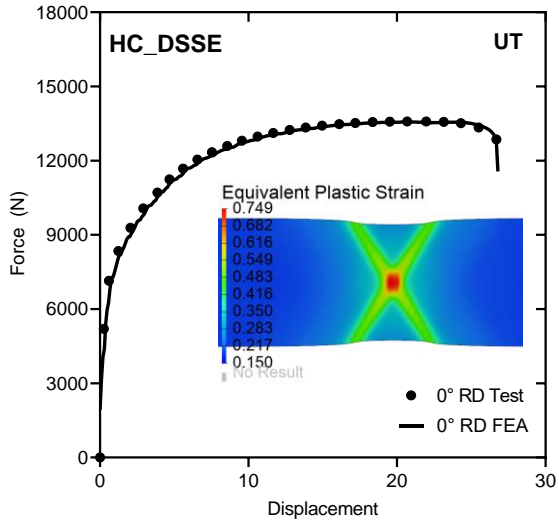
1: Tensile_Test
Loadcase 1 : Time = 0.0000e+00 : Frame 1



SH Strain patikası



Sonuçlar

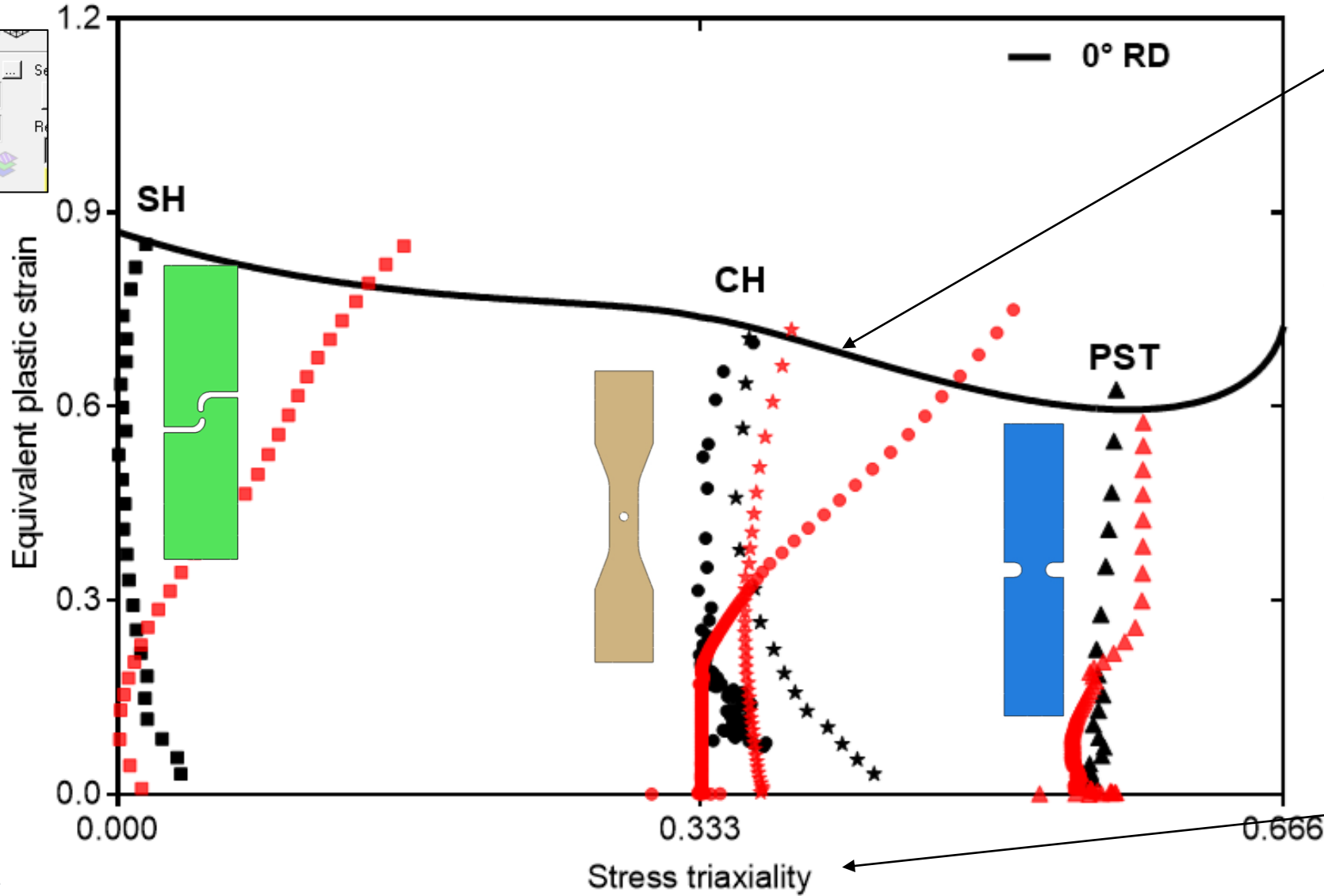


Hasar Eğrisi

H3D

HC Parameters

a	1,7152
b	0,73776
c	0,03411
n	0,1



- UT-0°
- ▲ PST-0°
- ★ CH-0°
- SH-0°
- DIC-UT
- ▲ DIC-PST
- ★ DIC-CH
- DIC-SH

H3D

Result type: Stress (t)

Triaxiality

SignedVonMises

Tresca

Triaxiality

Lode Param xi

Lode Param theta

P1 (major)

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