



# Mühendislik Fakültesi Enerji Sistemleri Mühendisliği Bölümü



## RÜZGAR TÜRBİNİ KANADINDA AKIŞ KAYNAKLI DEFORMASYONLARIN SAYISAL VE DENEYSEL ANALİZİ

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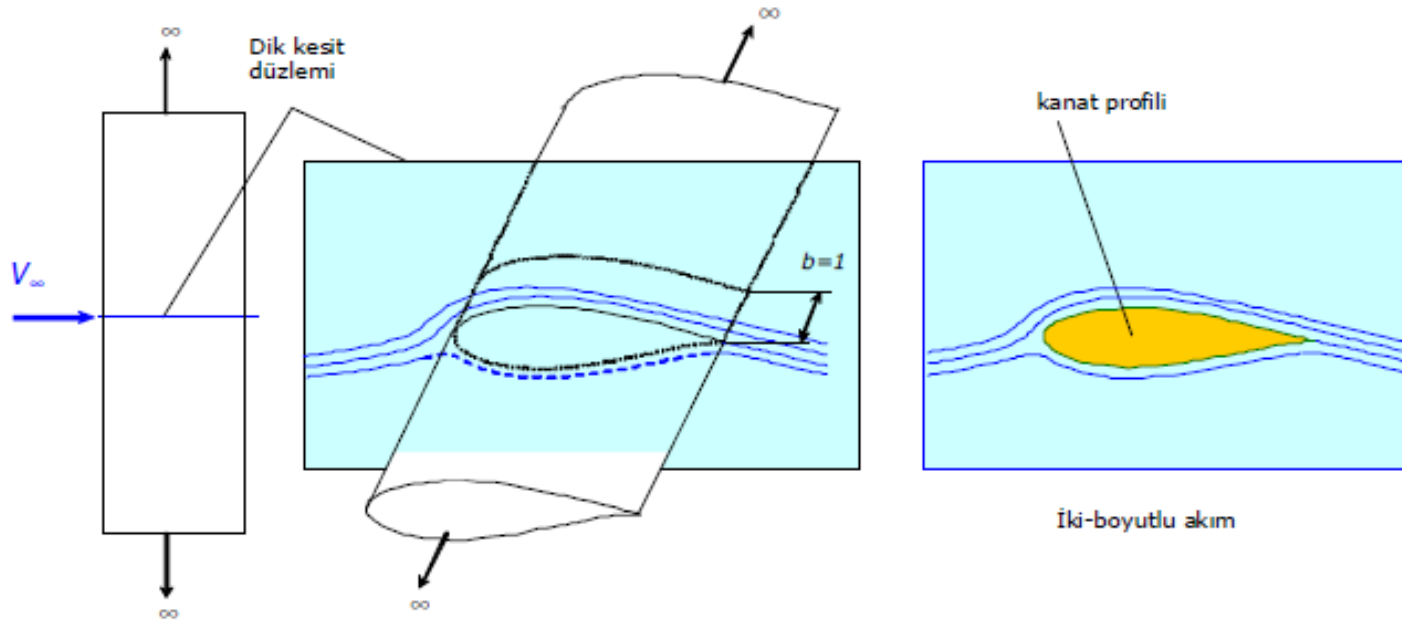
- Giriş
- Rüzgar Türbinleri ve Kanat Profilleri
- Kanat Tasarımı ve Üretimi
- Deney Sistemleri
- Deneyler ile Sayısal Analizin Karşılaştırılması
- Sonuç



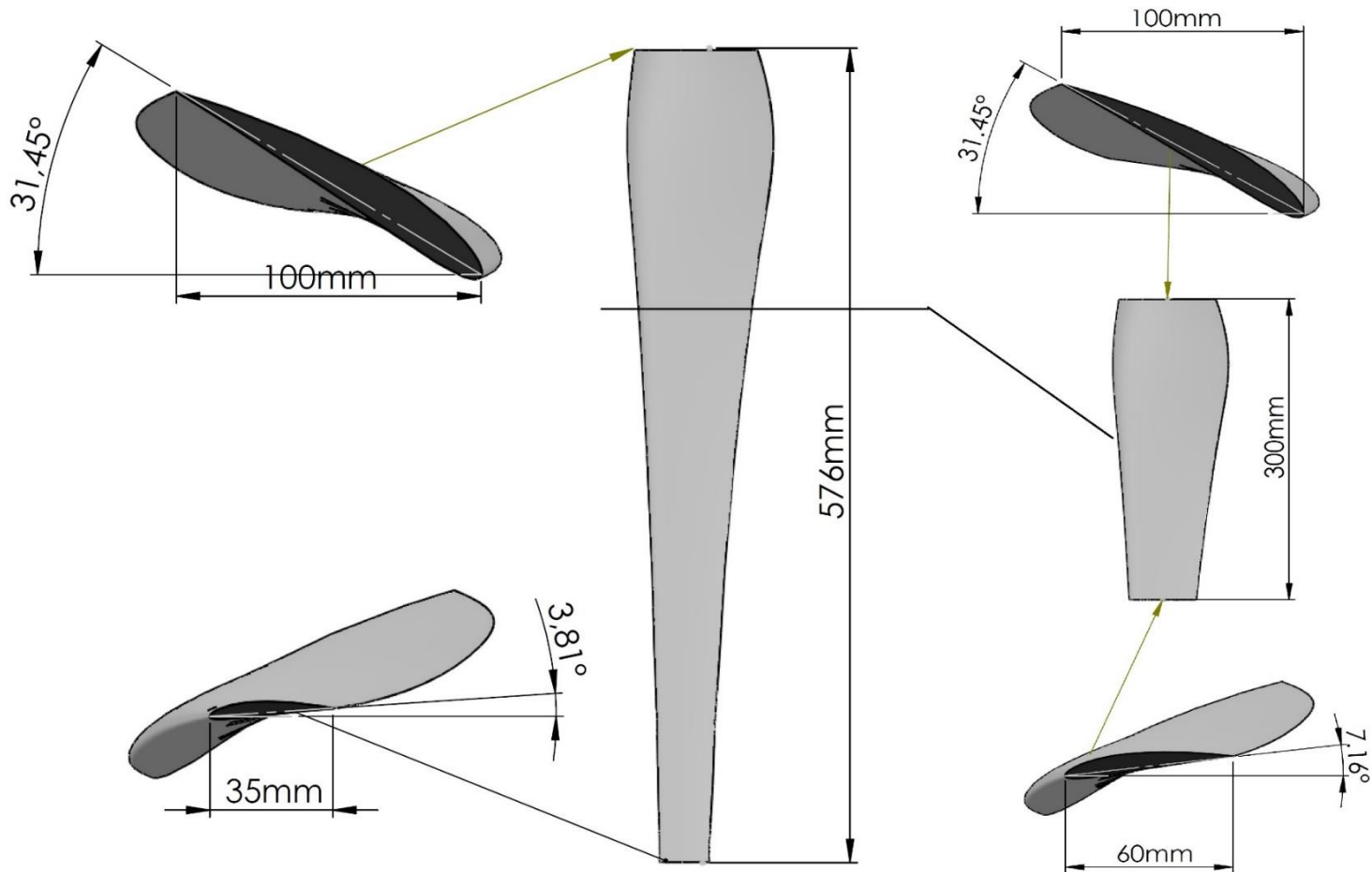
Düşey Eksen Rüzgar Türbinleri

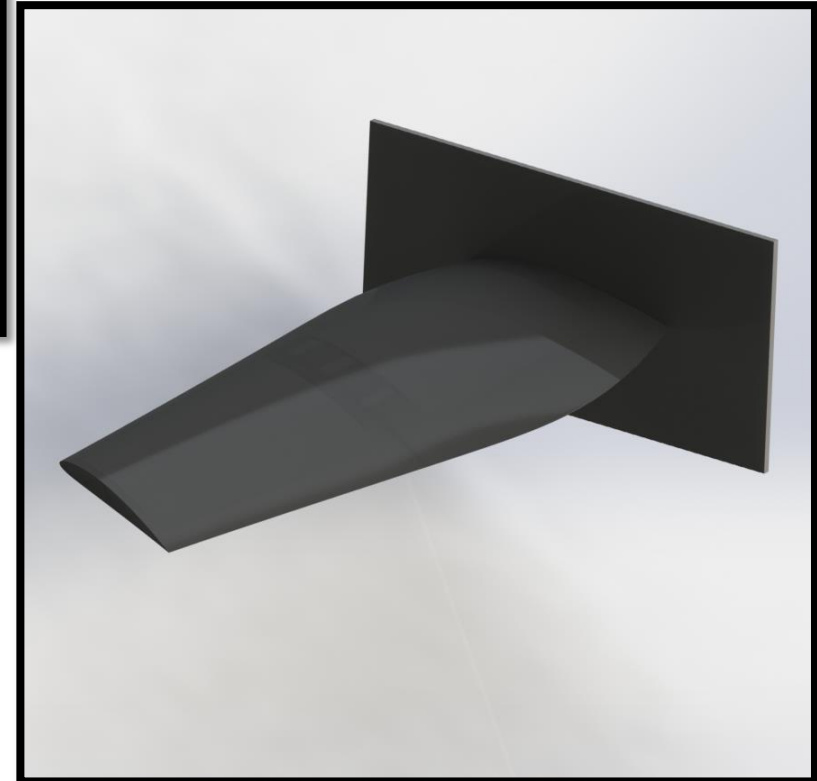
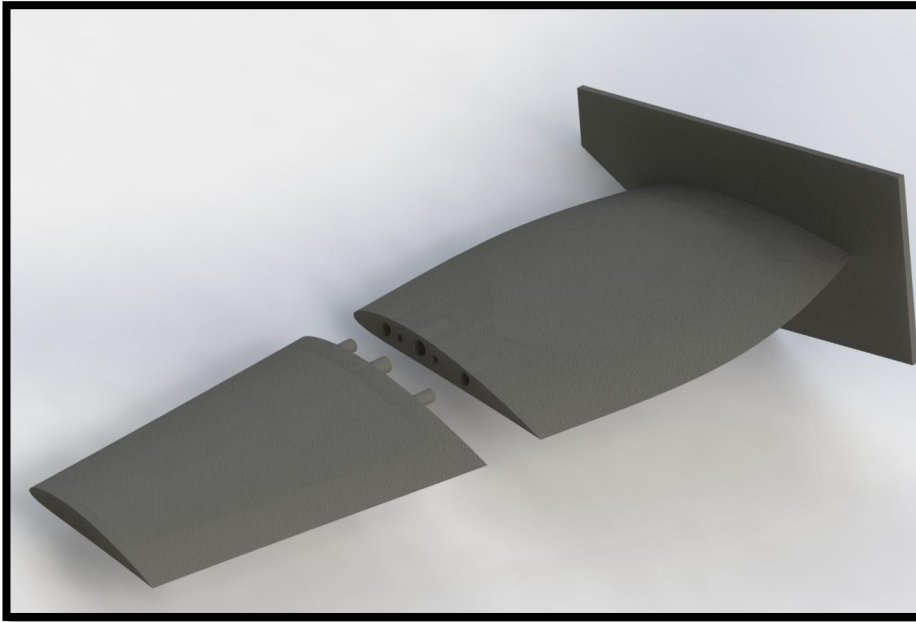


Yatay Eksen Rüzgar Türbinleri



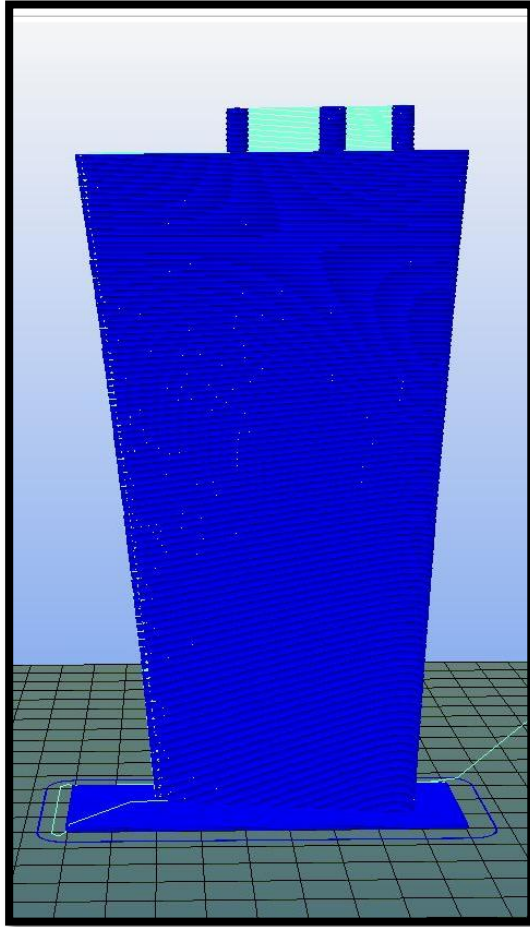
# NACA 4412 RÜZGAR TÜRBİNİ KANADI





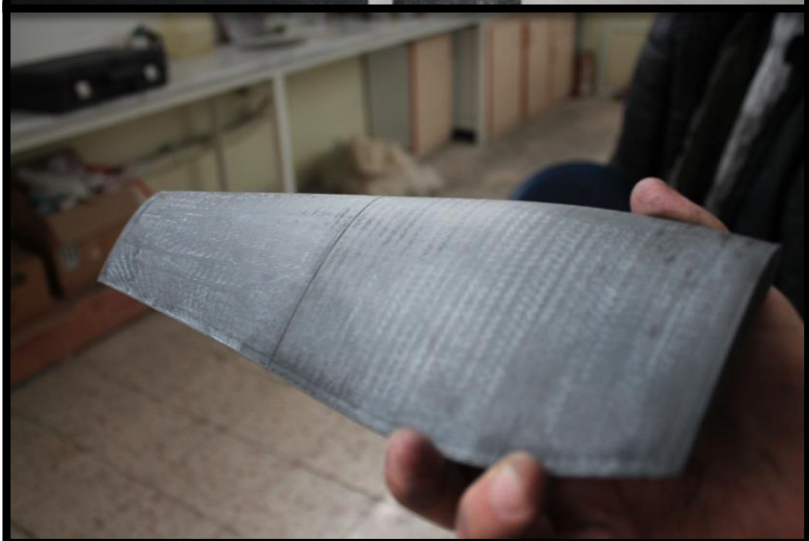
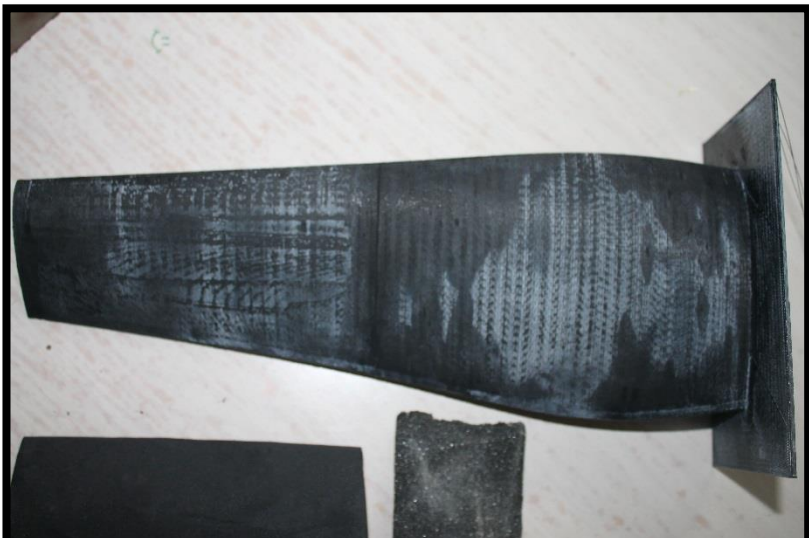
# 3D YAZICI İLE KANAT ÜRETİMİ







# RÜZGAR TÜRBİN KANADININ HAZIRLANMASI

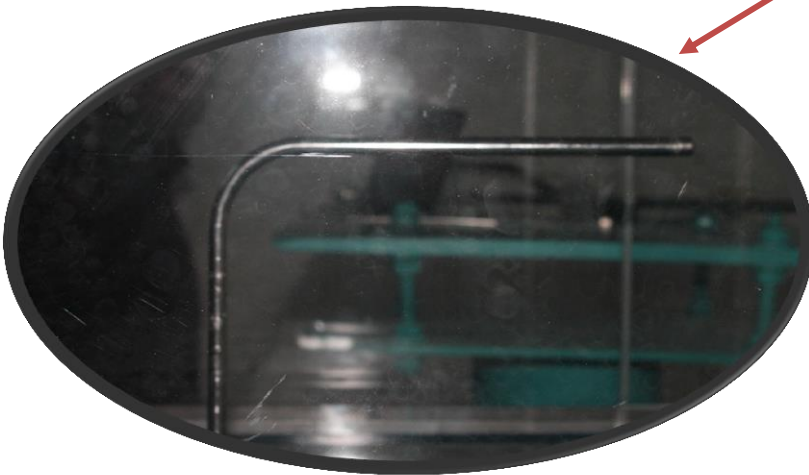
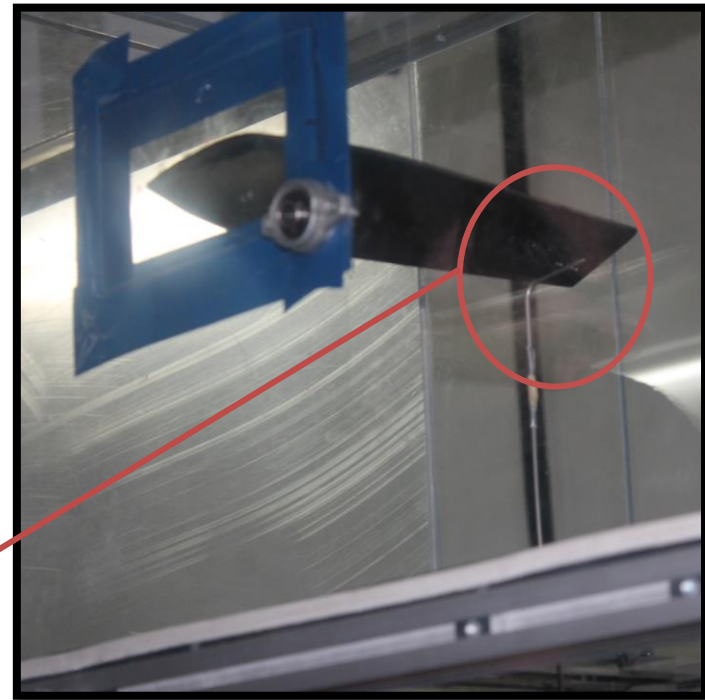
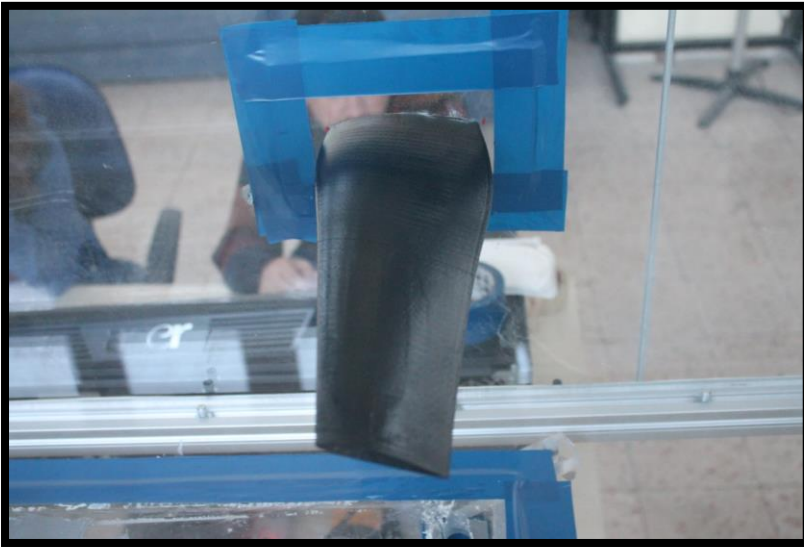


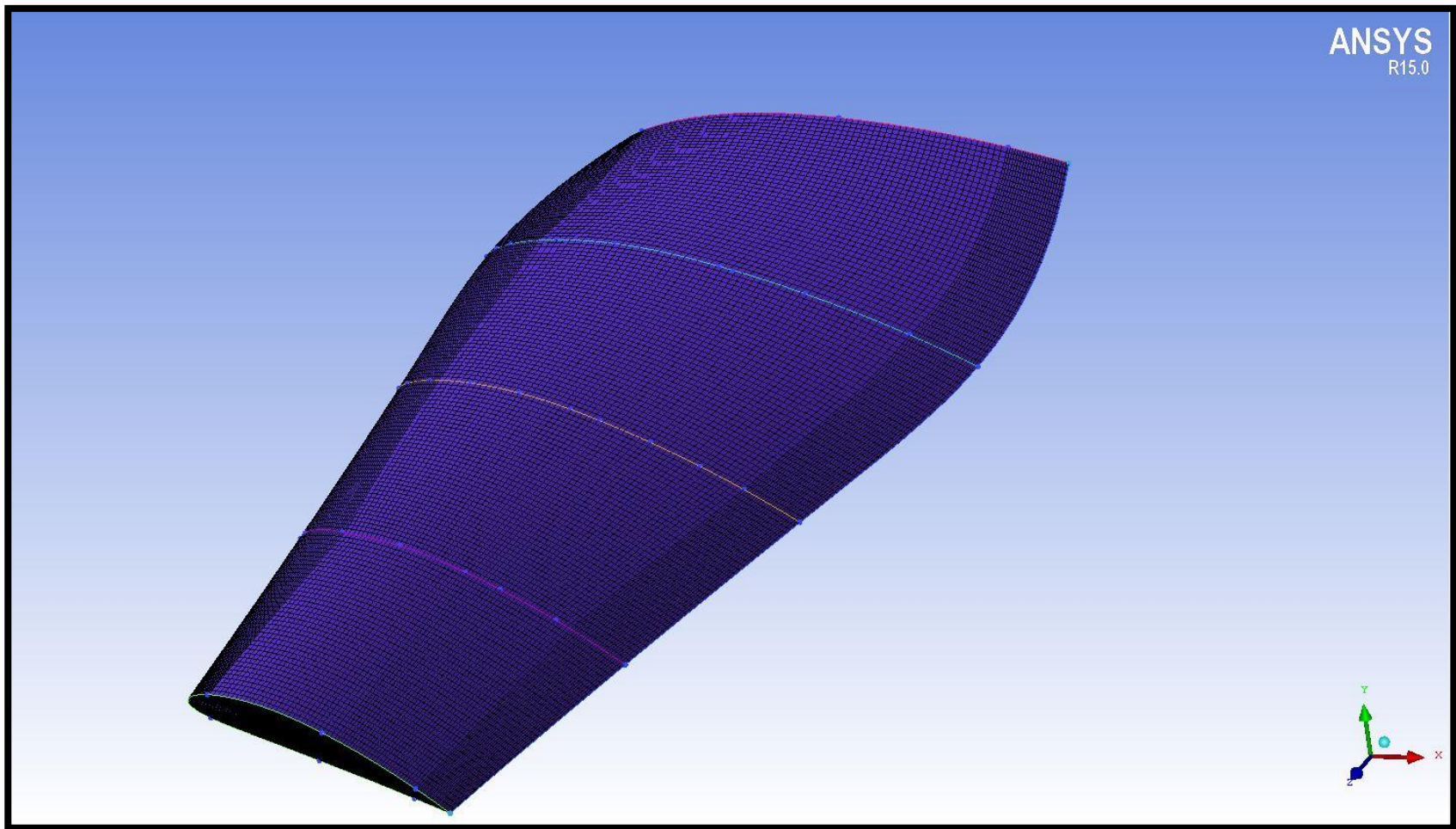


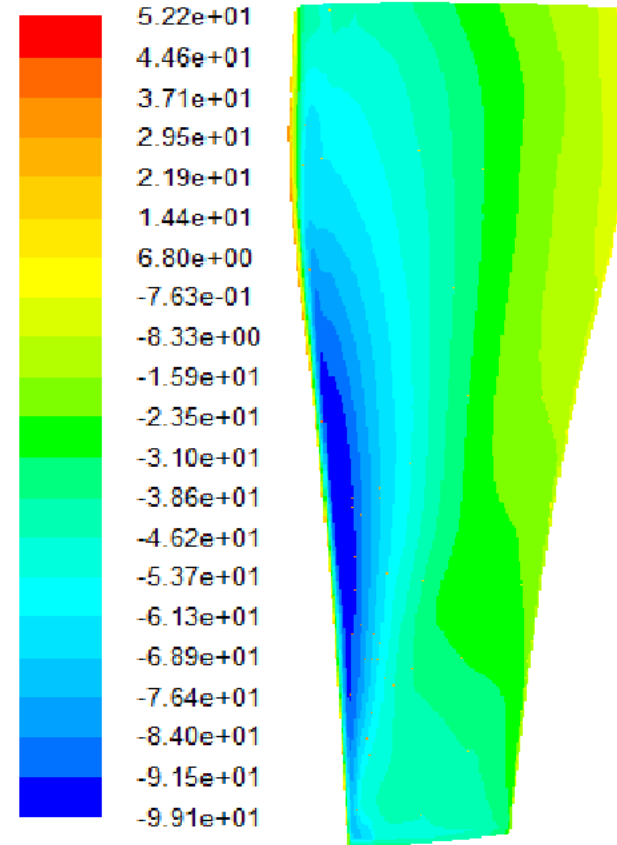
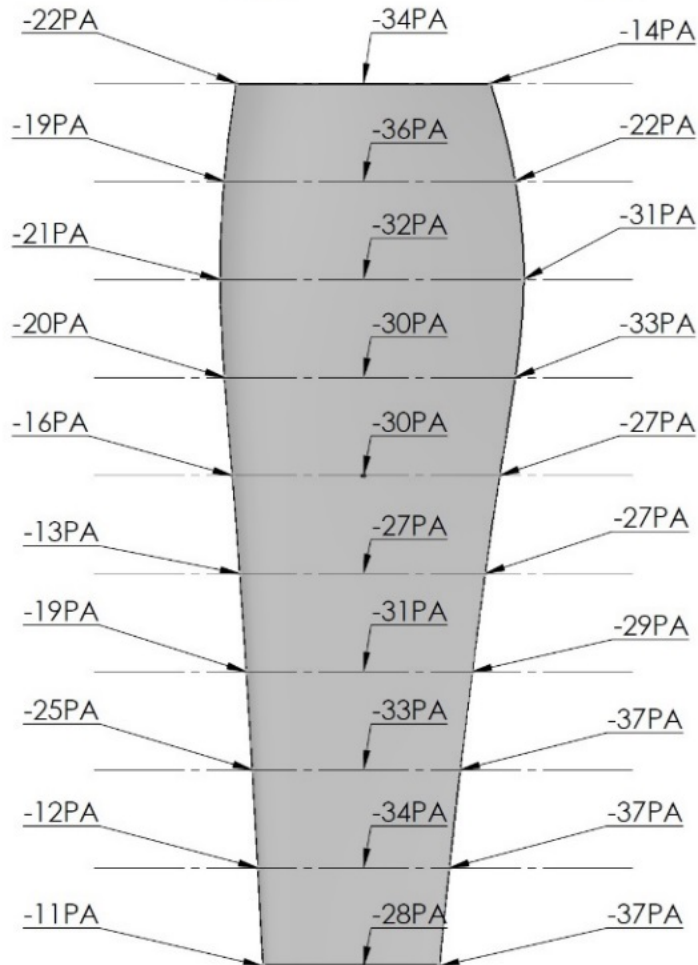
*Erciyes Üniversitesi Mühendislik Fakültesi*

*Enerji Sistemleri Mühendisliği Bölümü, Rüzgar Enerjisi ve Aerodinamik Araştırma Laboratuvarı*

# PİTOT STATİK TÜPÜ İLE BASINÇ DENEYİ

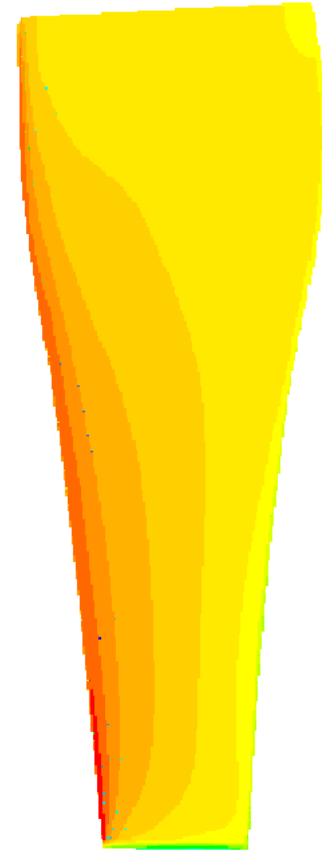
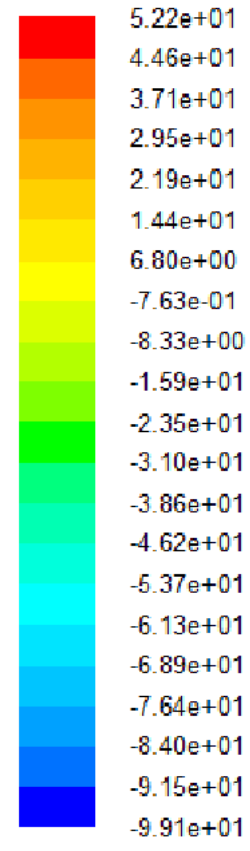
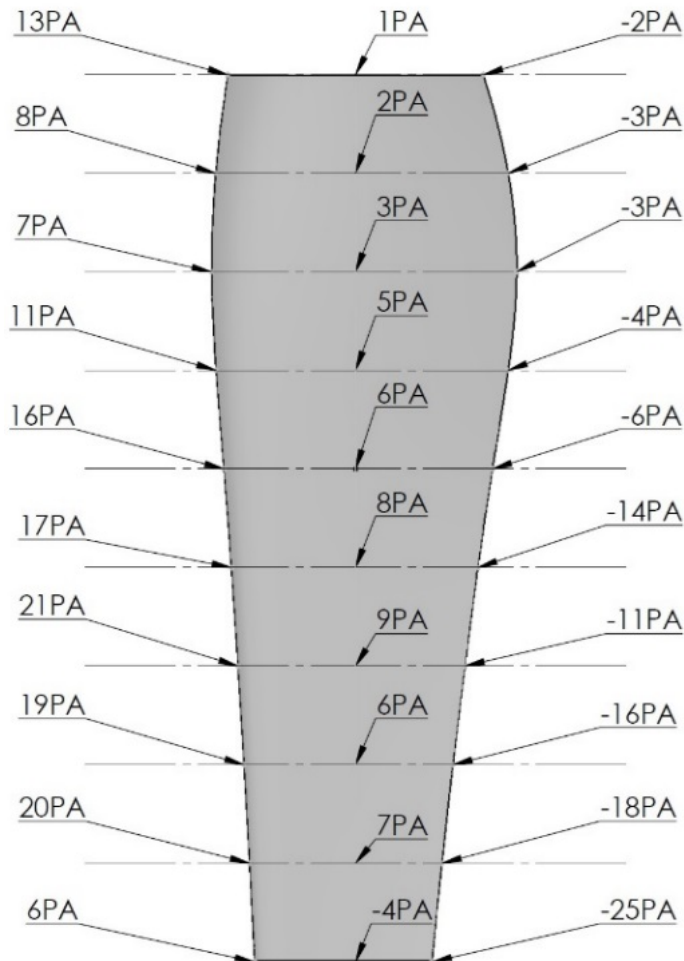






Contours of Static Pressure (pascal)

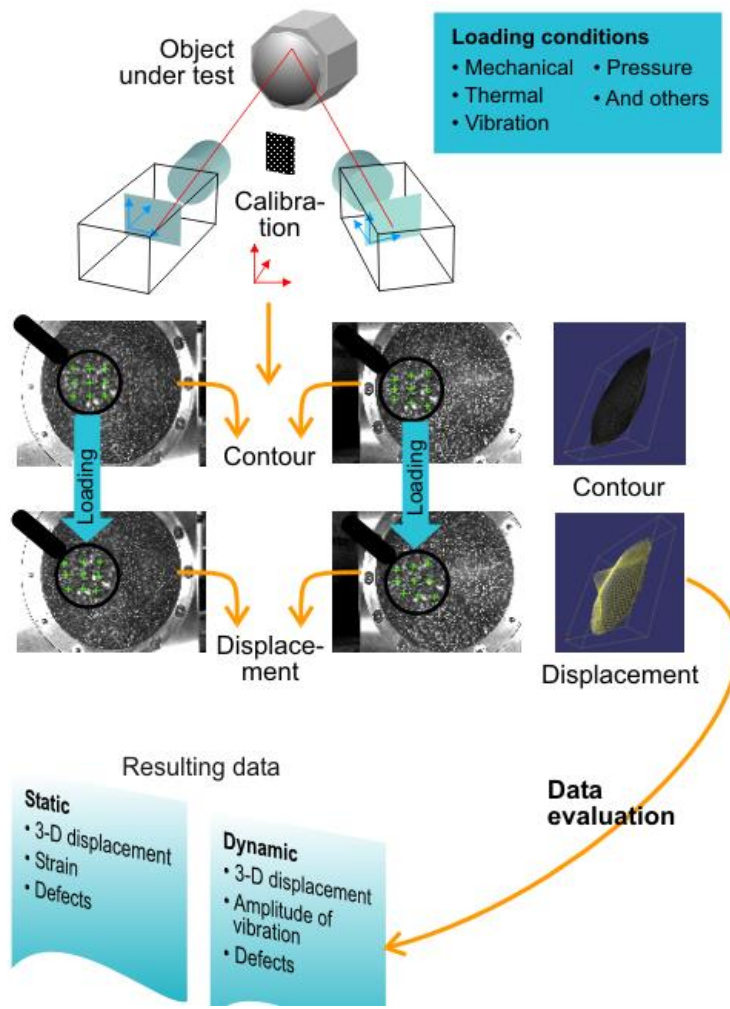
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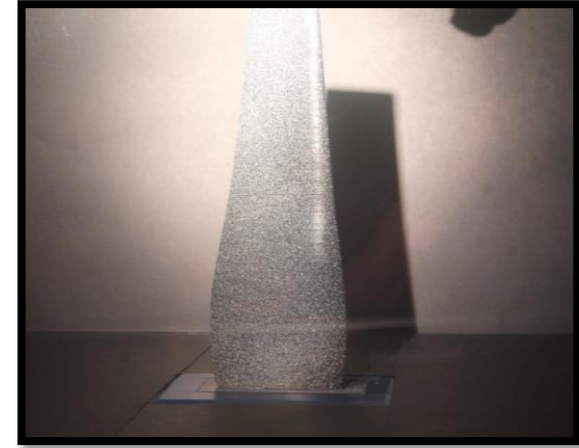
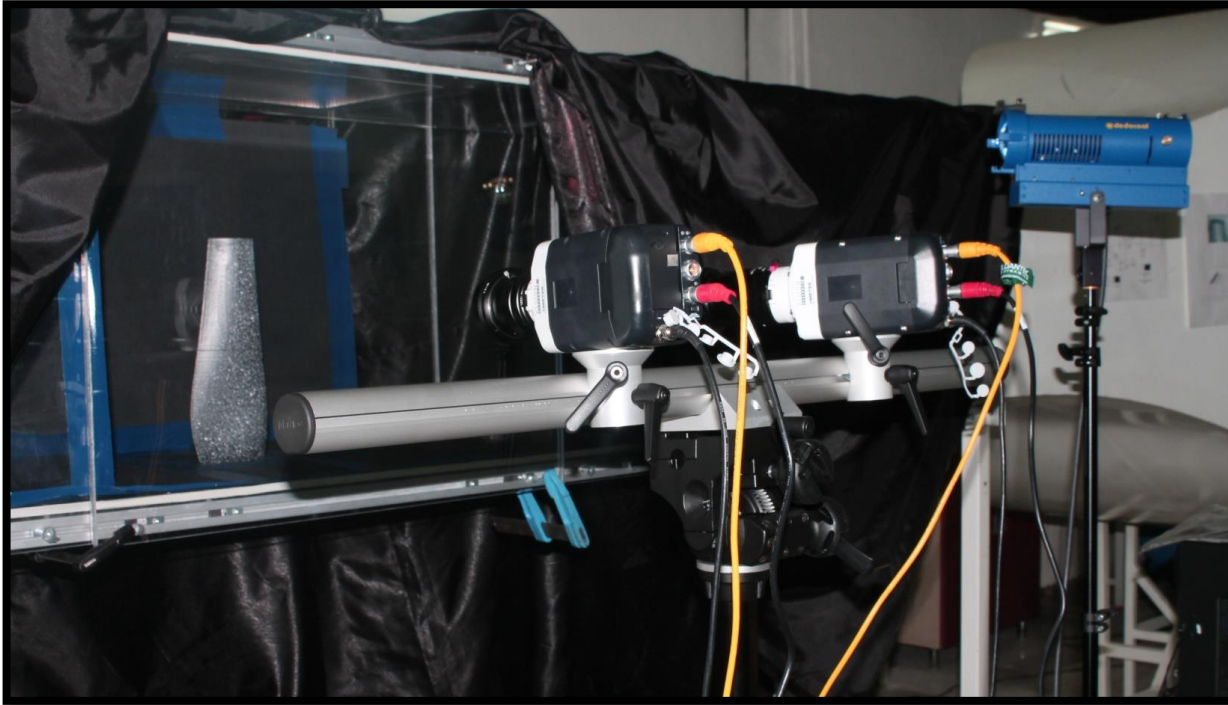


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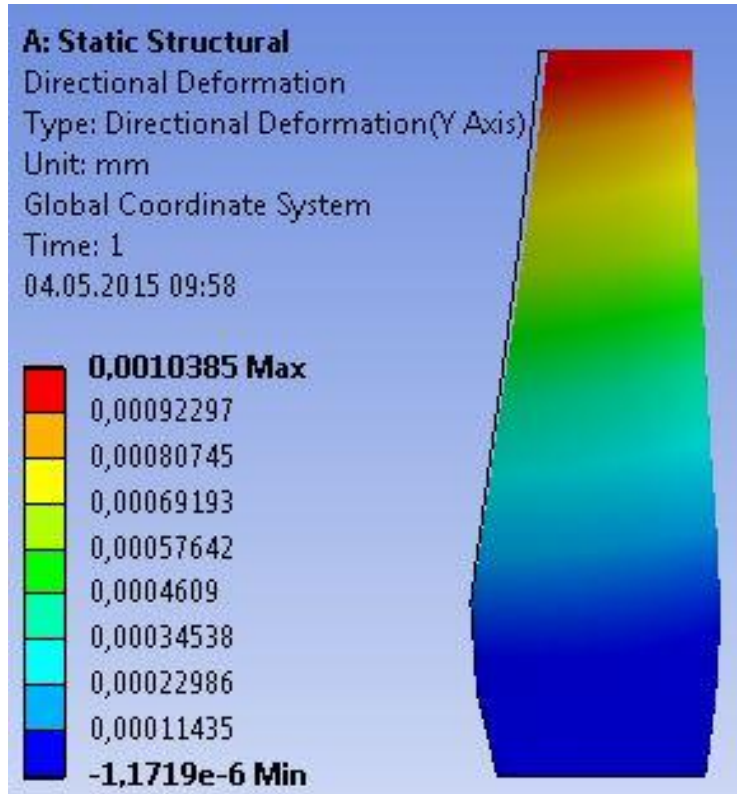
**RE=50000 Alt Yüzey**

# DIGITAL IMAGE CORRELATION (DIC)

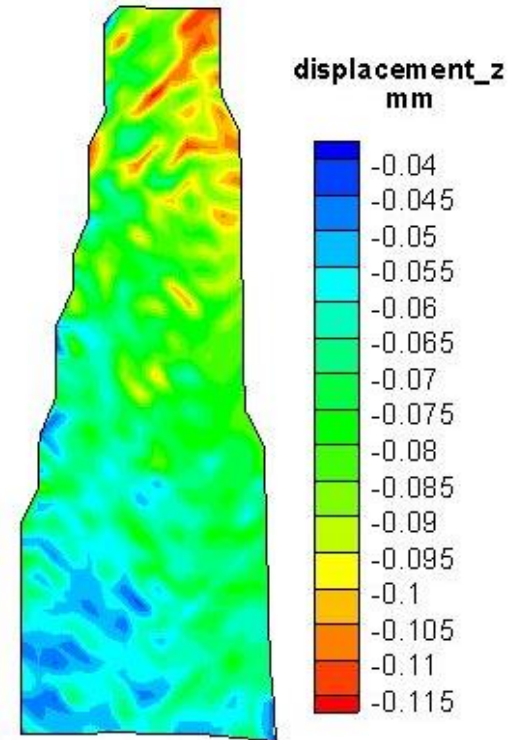






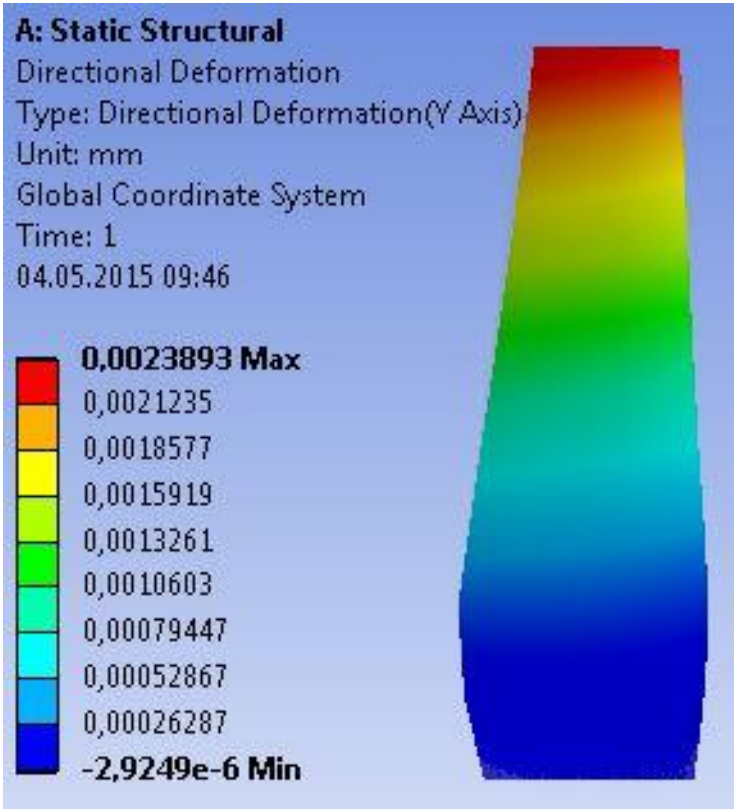


SAYISAL SONUÇ

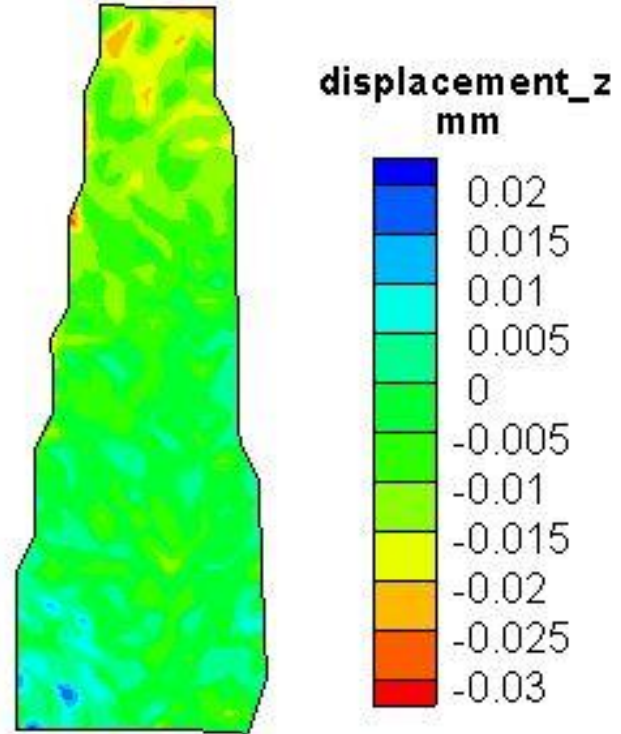


DİGİTAL İMAGE CORRELATION

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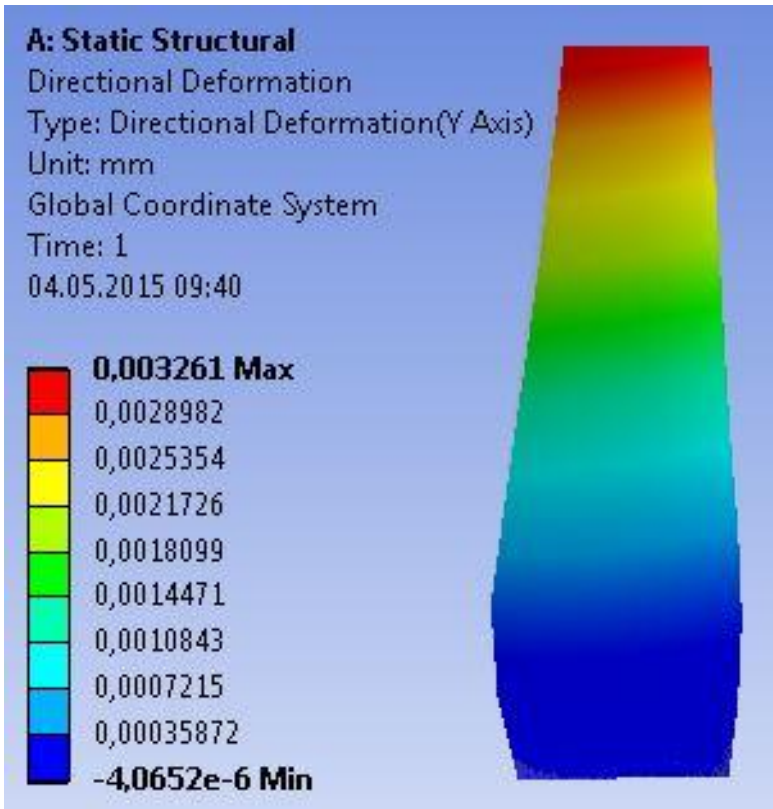


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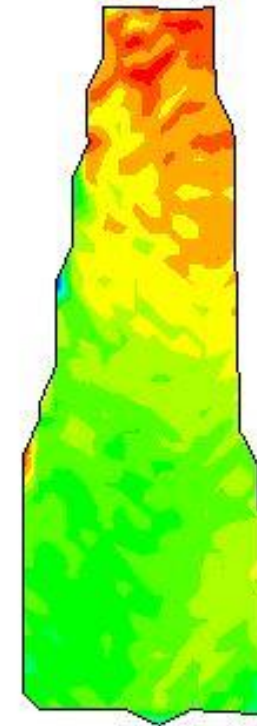


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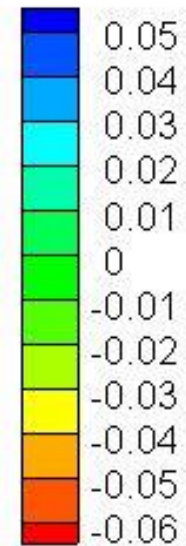
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SAYISAL SONUÇ

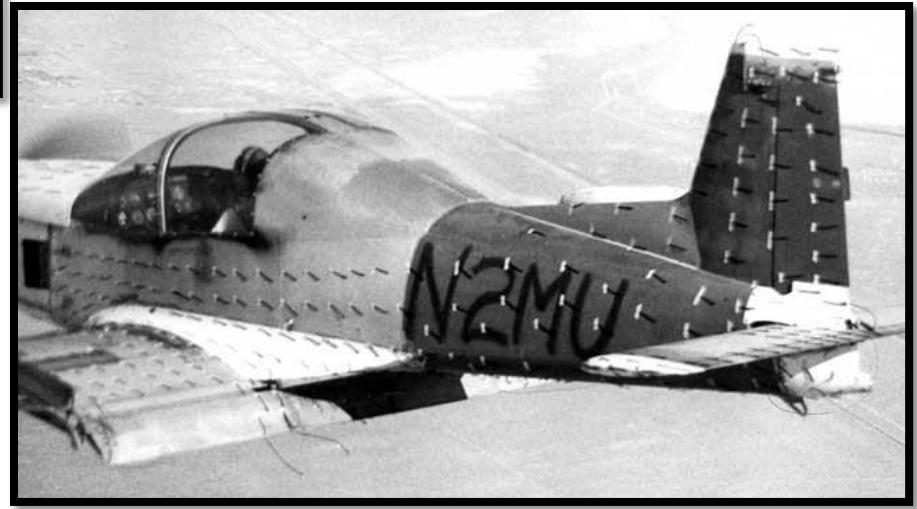


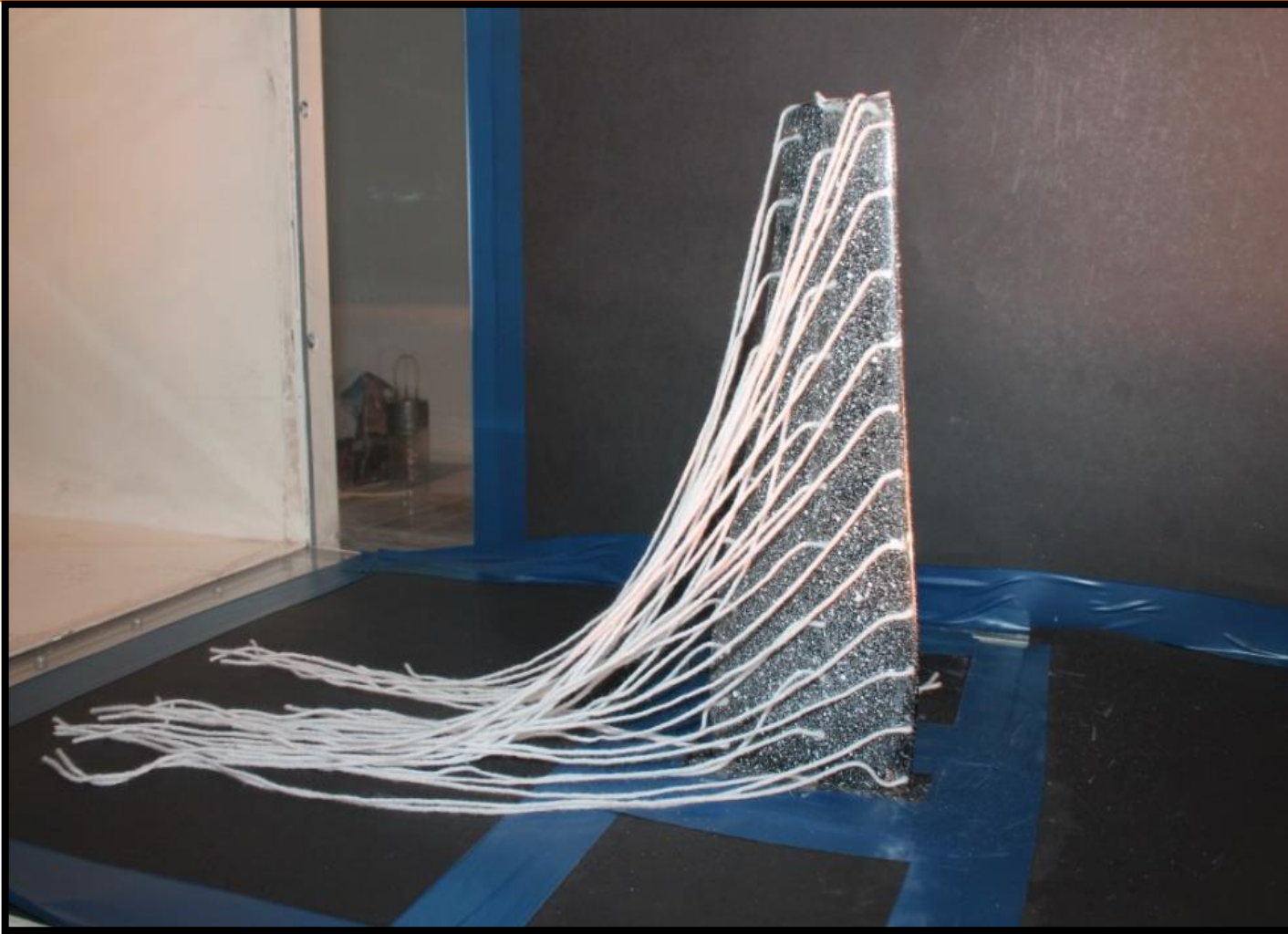
displacement\_z  
mm

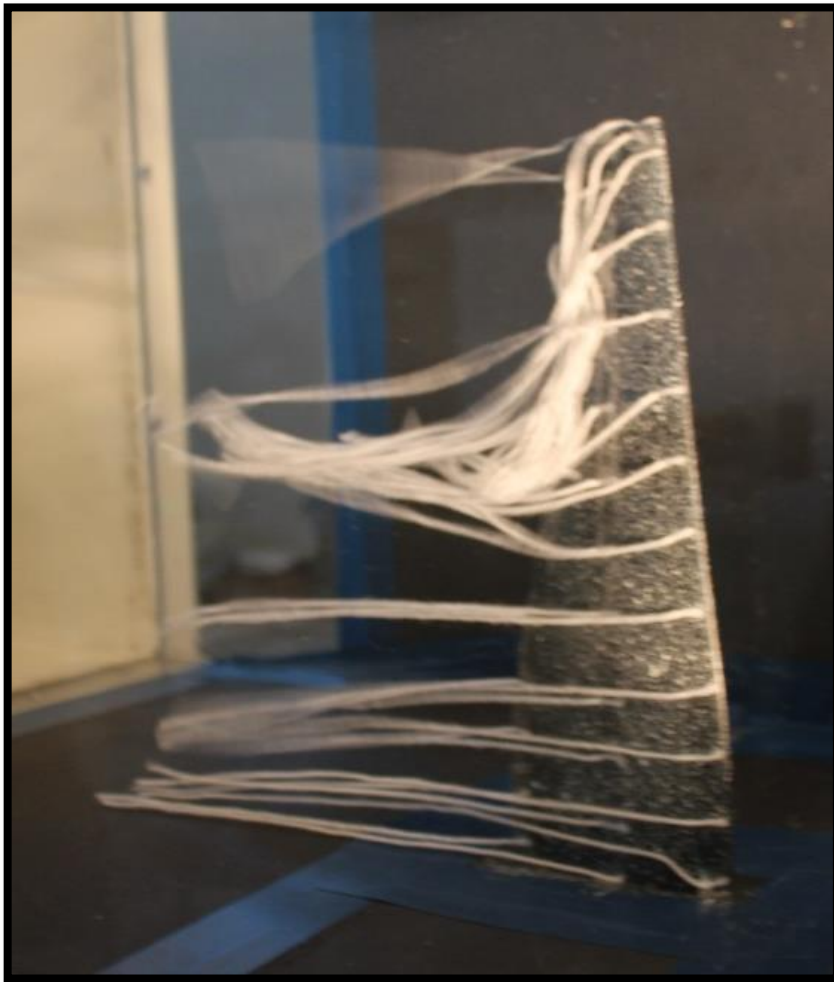


DİĞİTAL İMAGE CORRELATION

Re=85000



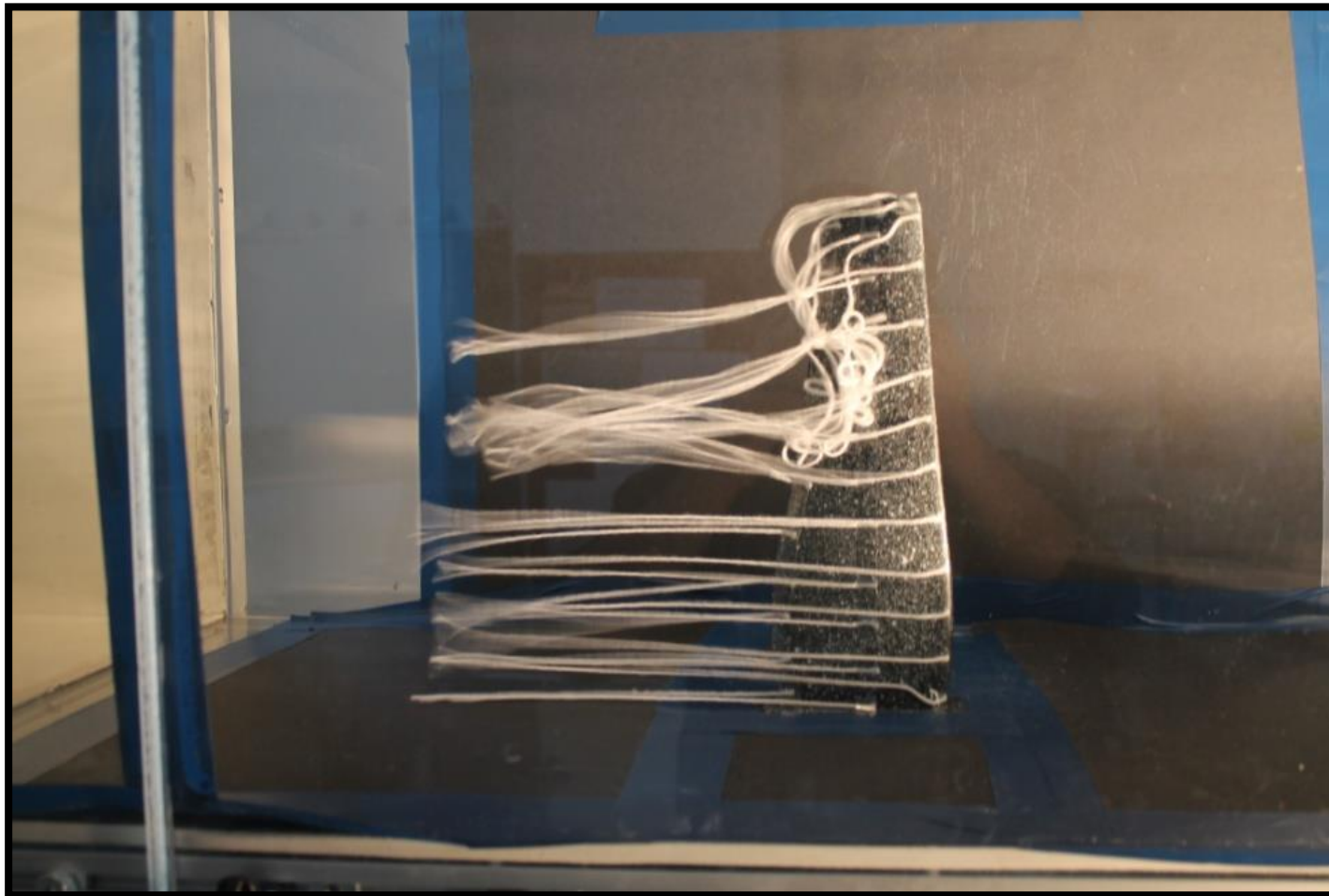




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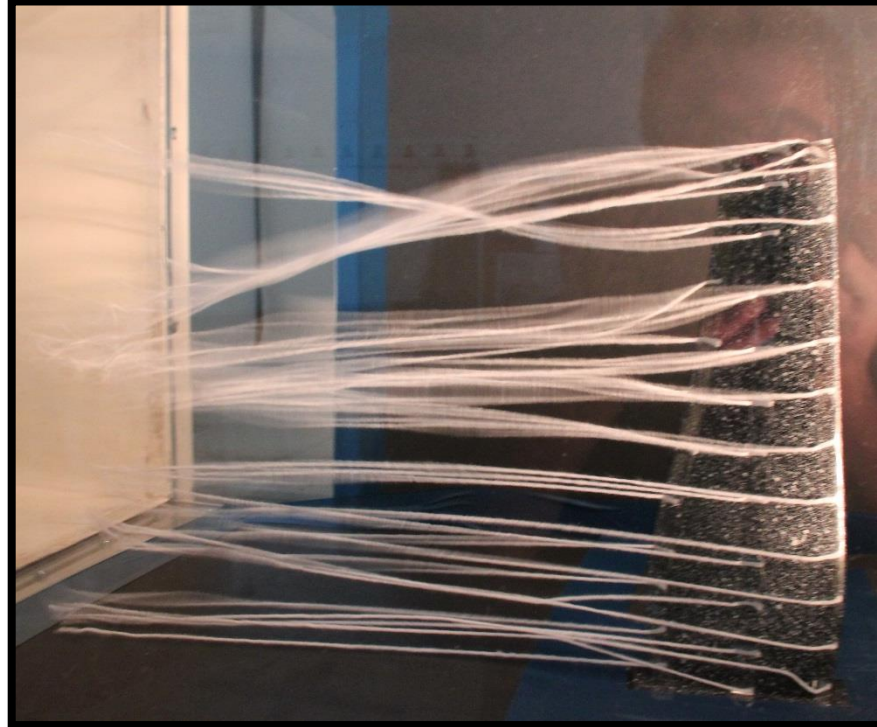


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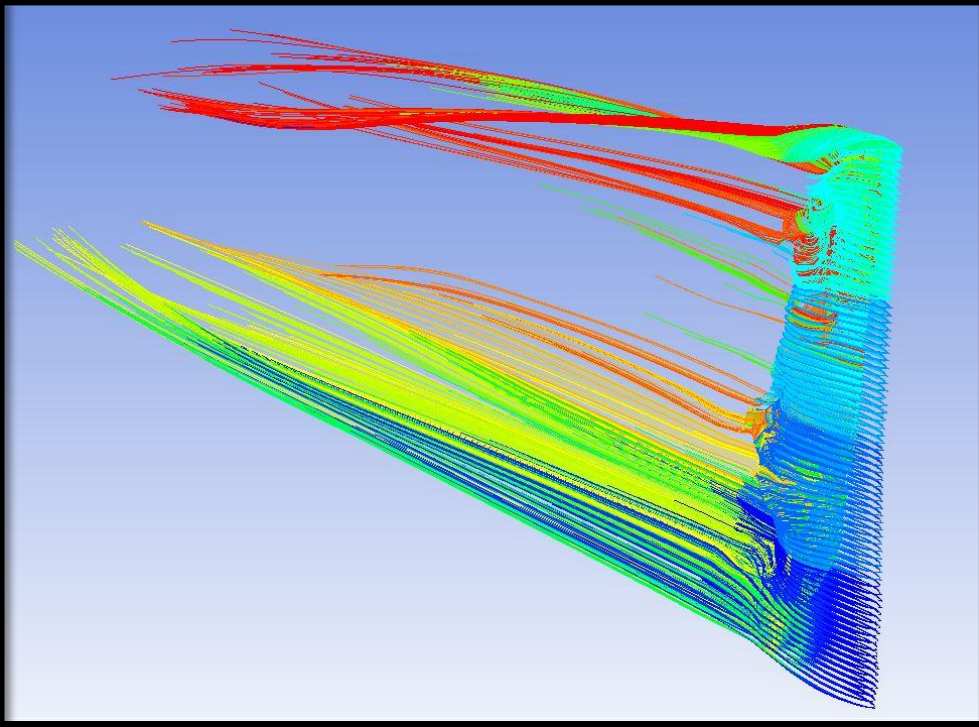


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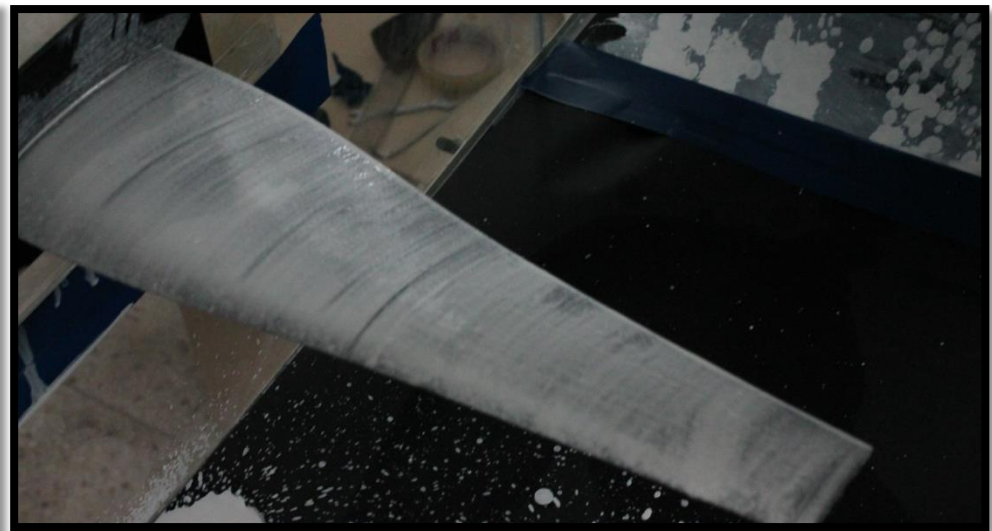




DENEYSSEL SONUÇ

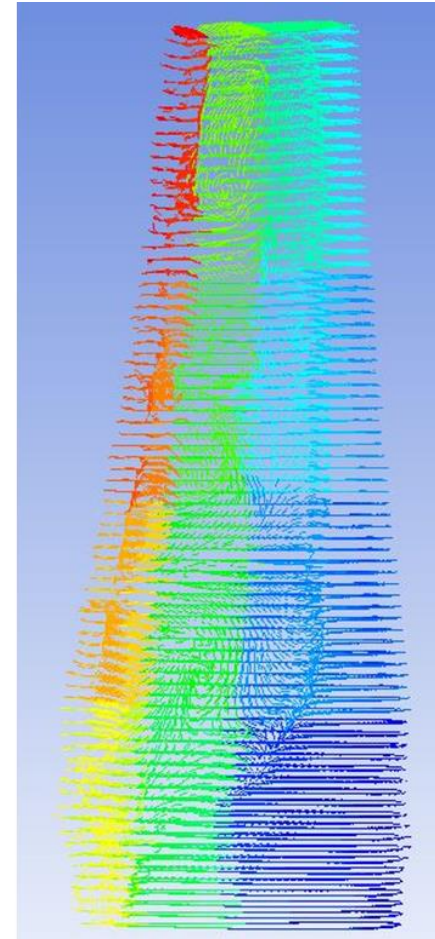


SAYISAL SONUÇ





YAĞ DENEYİ



SAYISAL SONUÇ

- Yapılan deneysel ve sayısal çalışmalar sonucunda kanadın üzerindeki akış ve deformasyonlar incelenmiş.
- Tuft ve yağ deneyleri ile kanadın üzerindeki akışın karakteristiği görselleştirilmiş ve incelenmiştir.
- Kanadın aerodinamik yapısına bağlı olarak akışın kanat üzerinde meydana getirdiği deformasyonların DIC deneyi ve Sayısal sonuçları incelenmiş deformasyonun kanat uç kısmında fazla olduğu görülmüştür.
- Tuft deneyi sonuçlarında kanadın uç kısmında oluştuğu görülen uç girdaplarının etkileri kanat uçlarında deformasyona sebep olmaktadır.
- Sonuç olarak mühendislik uygulamalarında sayısal analizlerin kullanılabilir olduğu görülmüştür. Sayısal analizleri kullanırken mutlaka deneysel verilerle başlangıçta doğrulama yapılmalı ve çözüm algoritmalarının testleri gerçekleştirildikten sonra analizlere güvenilmelidir.

# Sorular ?

- [1] Rong Wu (13-17 January, 2014) Determination of three-dimensional movement for rotary blades using digital image correlation Shanghai CHINA
- [2] Jan Winstroth (29 April, 2014) Wind turbine rotor blade monitoring using digital image correlation. Assessment on a scaled model Hanover, GERMANY
- [3] Yeni Enerji, Rüzgar Türbinlerinin Tarihsel Gelişimi-3,  
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- [4] Yenilenebilir Enerji, Rüzgar Enerjisi, Yenilenebilir Enerji Müdürlüğü 2012,  
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- [7] Yunus A. ÇENGEL, John M. CIMBALA Akışkanlar Mekaniği Temelleri Ve Uygulamaları Palme Yayıncılık, Ankara, 2013.