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Appendix: RE<C Heliostat Wind Tunnel Experiments

Datafiles

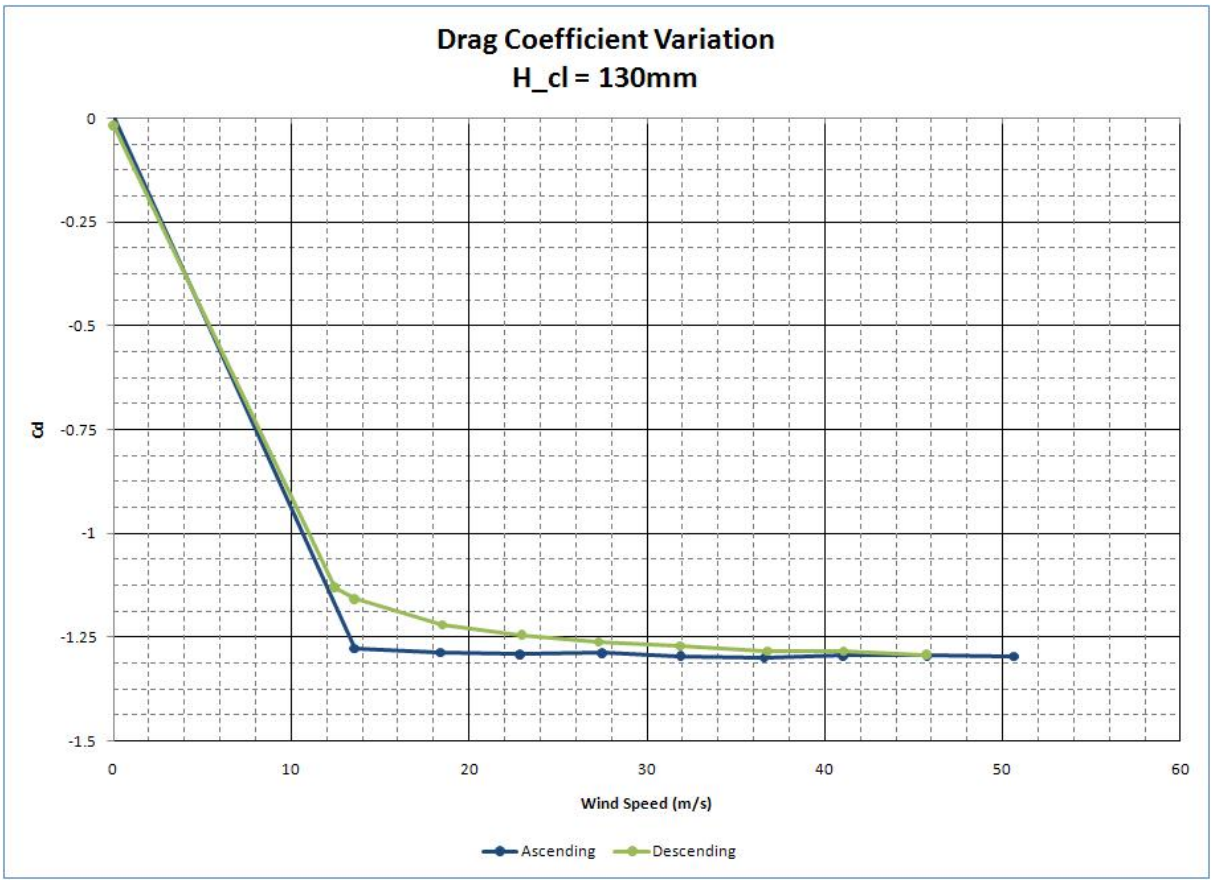
This appendix document presents a large amount of data obtained from our heliostat wind tunnel experiments. The data is divided into three sections: a single heliostat, a field of heliostats, and wind mitigations. The data files are available in the download section of the RE<C project in code.google.com, the files are identified in the comments.

Single Heliostat

The following is a set of plots relevant to the isolated heliostat tests performed in the wind tunnel.

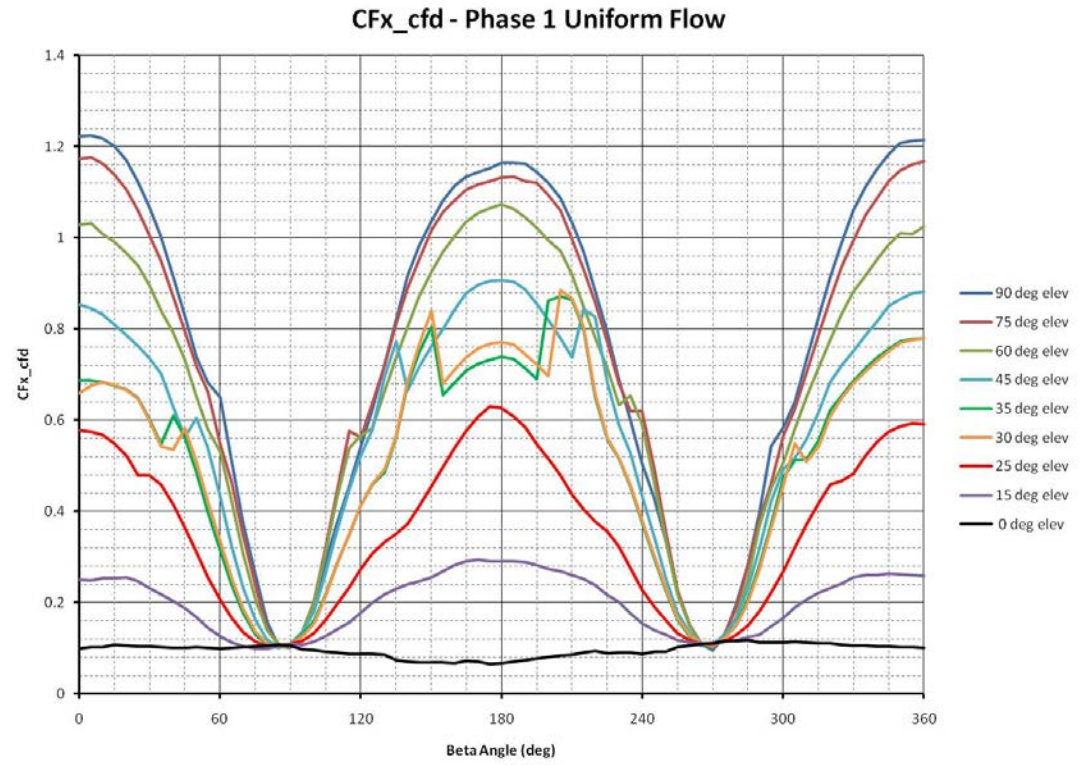
Wind Tunnel and Coefficient Validation

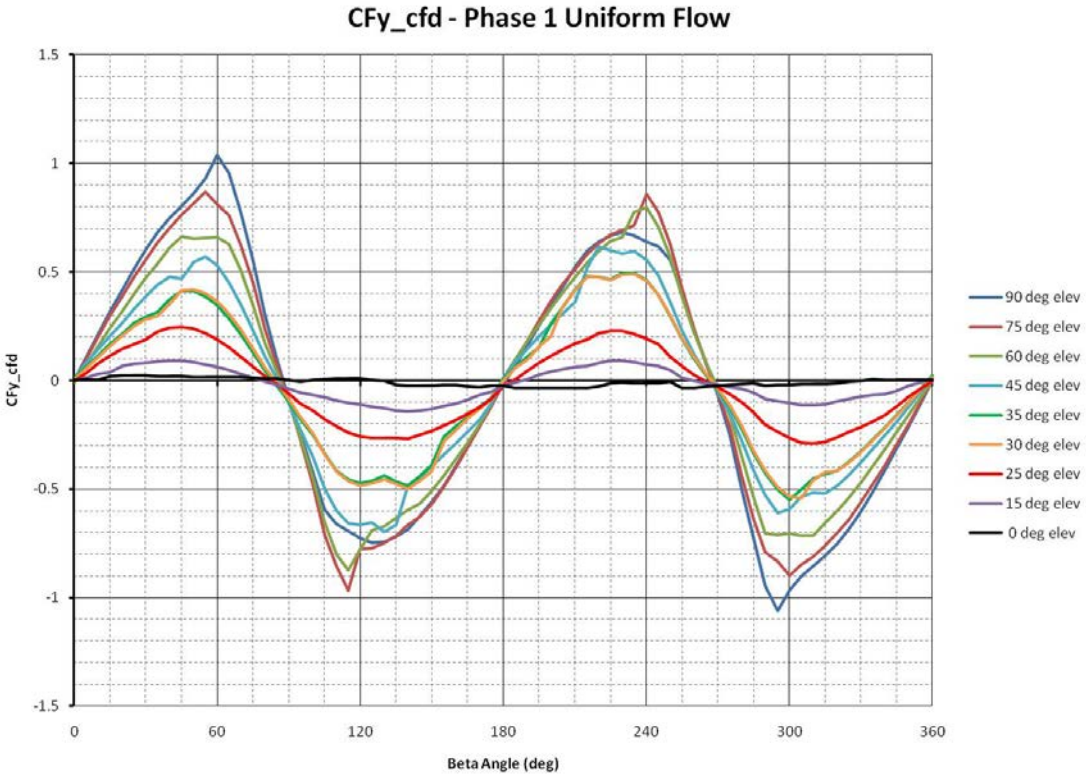
- **Heliostat Model Used:** 200mm x 200mm x 5mm reflector, HCL = 130mm
- **Test conditions were as follows:**
  - Wind Speed = 12 m/s - 50 m/s (39 ft/s - 164 ft/s)
  - Air Temperature = 23 C (74° F)
  - Air Density = 1.20 kg/m^3 (14.85 psia, as reported from tunnel conditions)
  - Elevation angles (α) tested: 90°
  - Wind incidence angles (β) tested: 0°

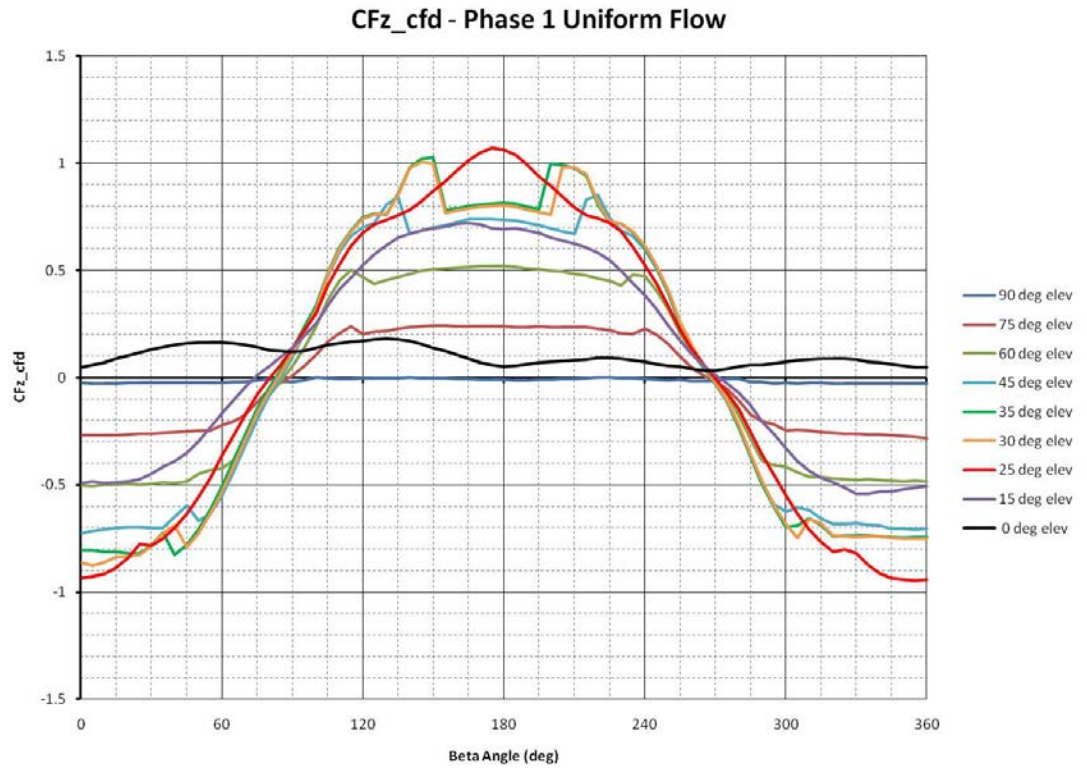


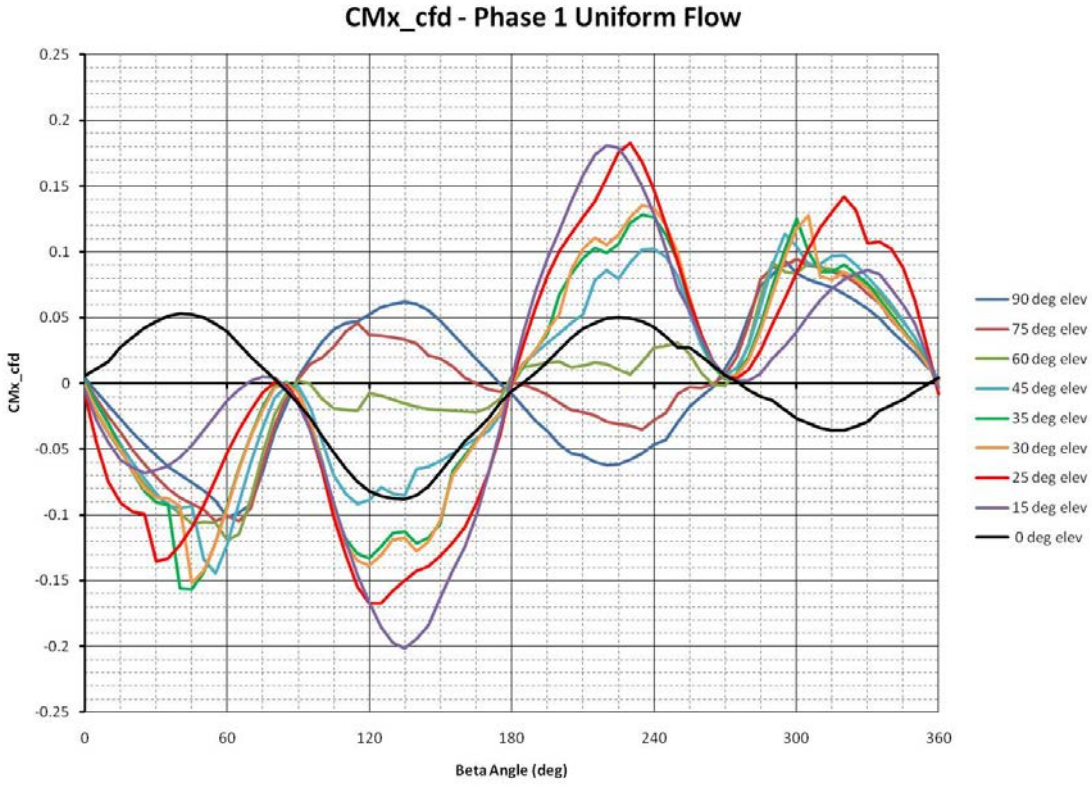
Single Heliostat in Uniform Flow Experiments

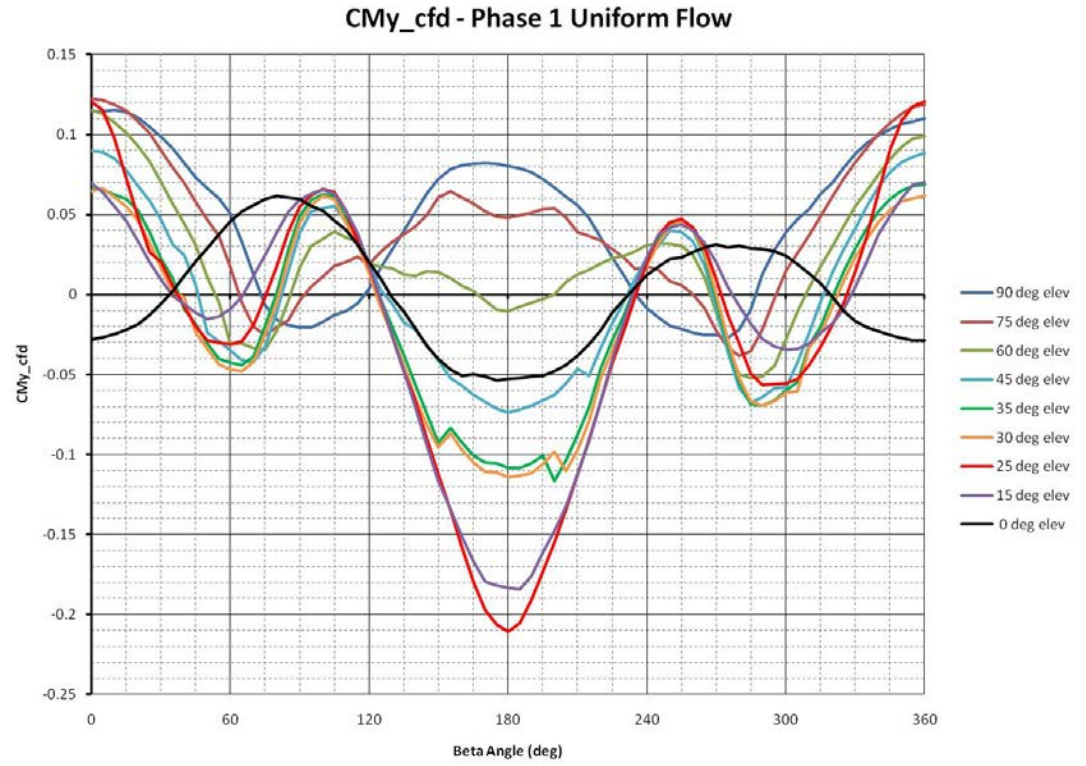
- **Heliostat Model Used:** 200mm x 200mm x 5mm reflector, HCL = 130mm
- **Test conditions were as follows:**
    - Wind Speed = 42.6 m/s (140 ft/s)
    - Air Temperature = 23 C (74° F)
    - Air Density = 1.20 kg/m^3 (14.85 psia, as reported from tunnel conditions)
    - Elevation angles (alpha) tested: 90, 75, 60, 45, 35, 30, 25, 15, 0 degrees
    - Azimuth angles (beta) tested: 0 - 360 deg in 5 degree increments

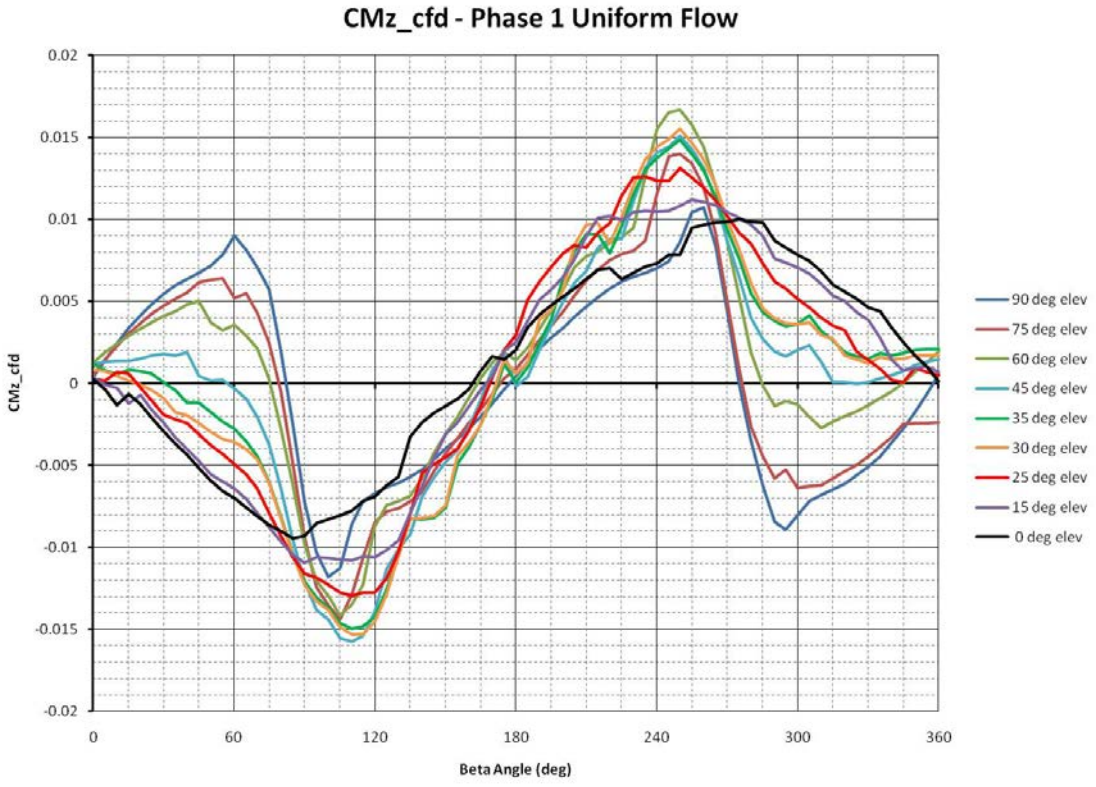

CFx_cfd - Phase 1 Uniform Flow
CFx_cfd
Beta Angle (deg)
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0
60
120
180
240
300
360
90 deg elev
75 deg elev
60 deg elev
45 deg elev
35 deg elev
30 deg elev
25 deg elev
15 deg elev
0 deg elev


CFy_cfd - Phase 1 Uniform Flow
CFy_cfd
Beta Angle (deg)
1.5
1
0.5
0
-0.5
-1
-1.5
0
60
120
180
240
300
360
90 deg elev
75 deg elev
60 deg elev
45 deg elev
35 deg elev
30 deg elev
25 deg elev
15 deg elev
0 deg elev


CFz_cfd - Phase 1 Uniform Flow
CFz_cfd
Beta Angle (deg)
1.5
1
0.5
0
-0.5
-1
-1.5
0
60
120
180
240
300
360
90 deg elev
75 deg elev
60 deg elev
45 deg elev
35 deg elev
30 deg elev
25 deg elev
15 deg elev
0 deg elev

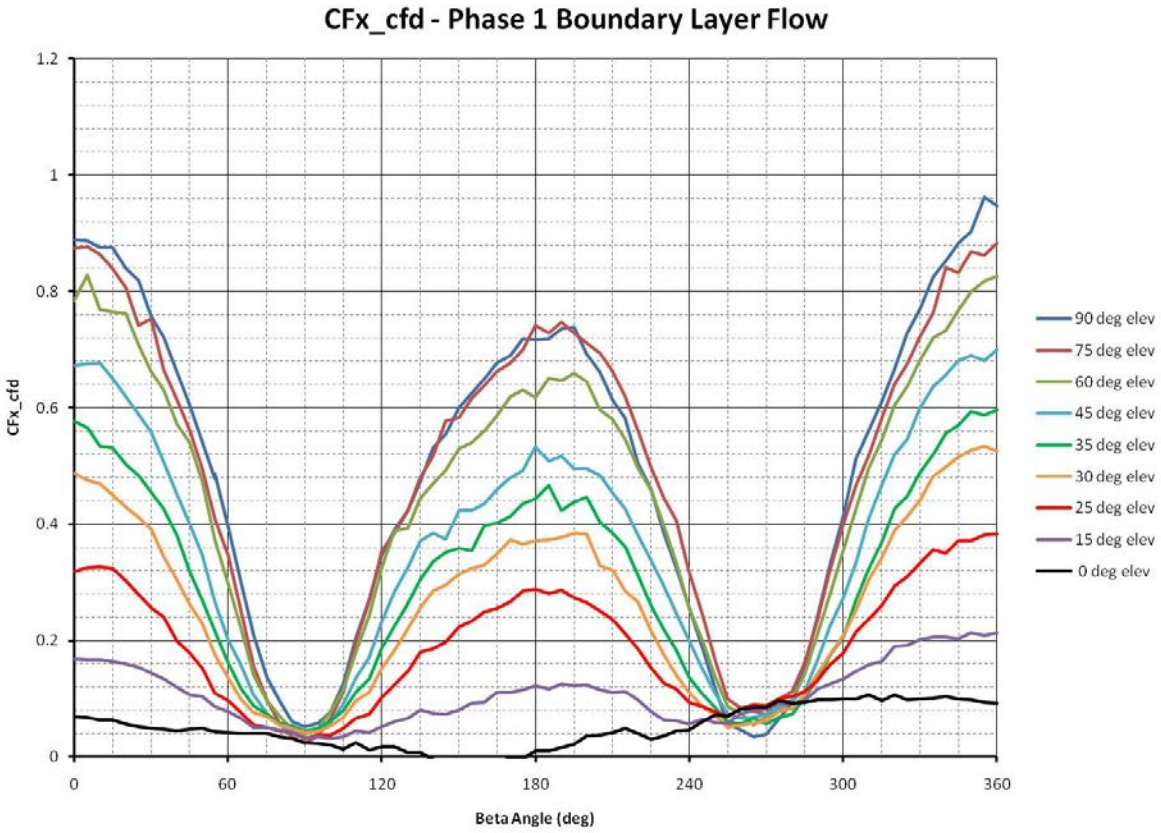

CMx_cfd - Phase 1 Uniform Flow
CMx_cfd
Beta Angle (deg)
0.25
0.2
0.15
0.1
0.05
0
-0.05
-0.1
-0.15
-0.2
-0.25
0
60
120
180
240
300
360
90 deg elev
75 deg elev
60 deg elev
45 deg elev
35 deg elev
30 deg elev
25 deg elev
15 deg elev
0 deg elev


CMy_cfd - Phase 1 Uniform Flow
CMy_cfd
Beta Angle (deg)
0.15
0.1
0.05
0
-0.05
-0.1
-0.15
-0.2
-0.25
0
60
120
180
240
300
360
90 deg elev
75 deg elev
60 deg elev
45 deg elev
35 deg elev
30 deg elev
25 deg elev
15 deg elev
0 deg elev

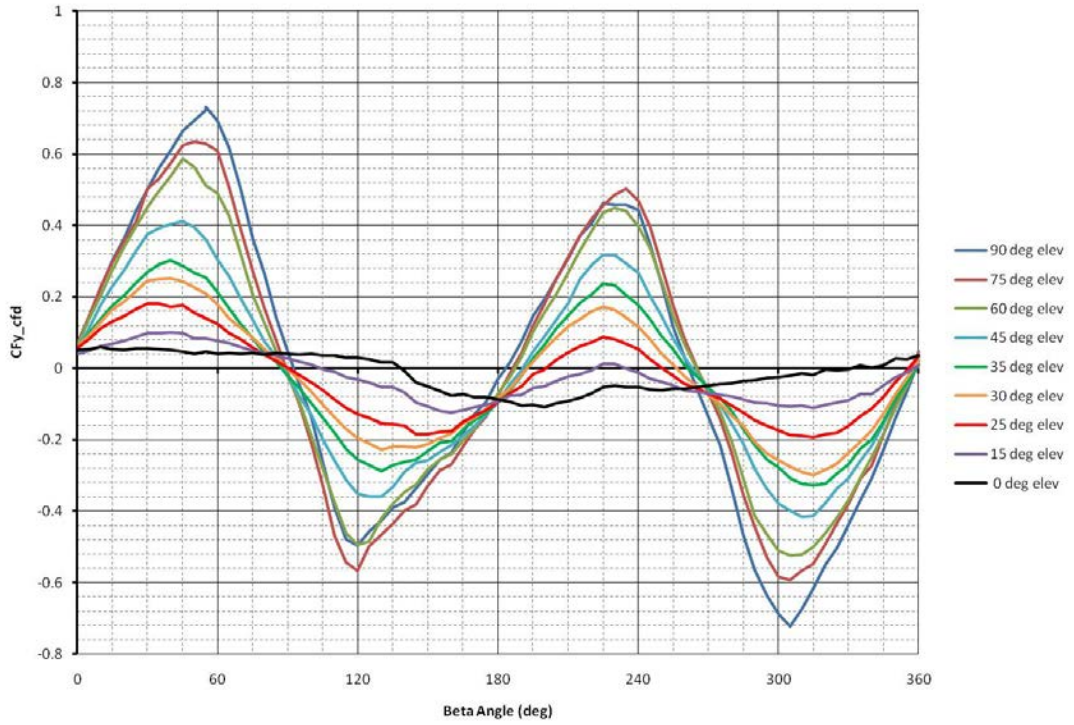

CMz_cfd - Phase 1 Uniform Flow
CMz_cfd
Beta Angle (deg)
0.02
0.015
0.01
0.005
0
-0.005
-0.01
-0.015
-0.02
0
60
120
180
240
300
360
90 deg elev
75 deg elev
60 deg elev
45 deg elev
35 deg elev
30 deg elev
25 deg elev
15 deg elev
0 deg elev

Single Heliostat in Atmospheric Boundary Layer Experiments

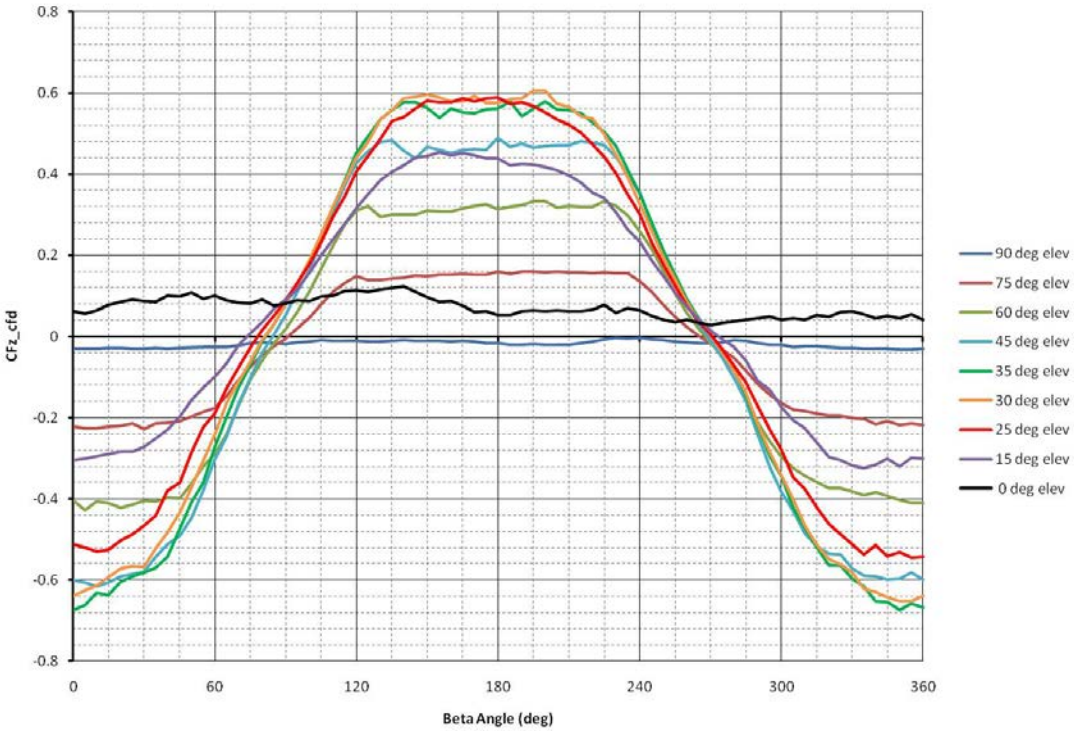
- **Heliostat Model Used:** 200mm x 200mm x 5mm reflector, HCL = 130mm
- **Test conditions were as follows:**
    - Wind Speed = 18.2 m/s (60 ft/s) (41 MPH)
    - Air Temperature = 23 C (74º F)
    - Air Density = 1.20 kg/m^3 (14.85 psia, as reported from tunnel conditions)
    - Elevation angles (α) tested: 90, 75, 60, 45, 35, 30, 25, 15, 0 degrees
    - Wind incidence angles (β) tested: 0 - 360 deg in 5 degree increments

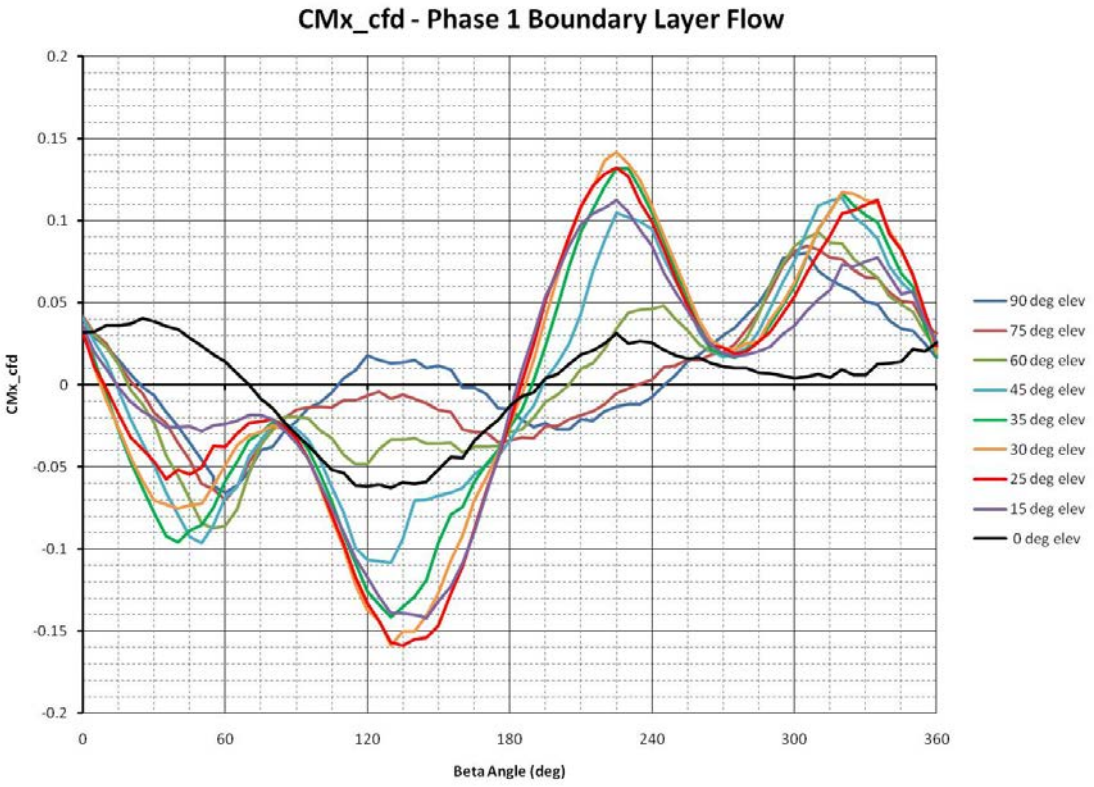


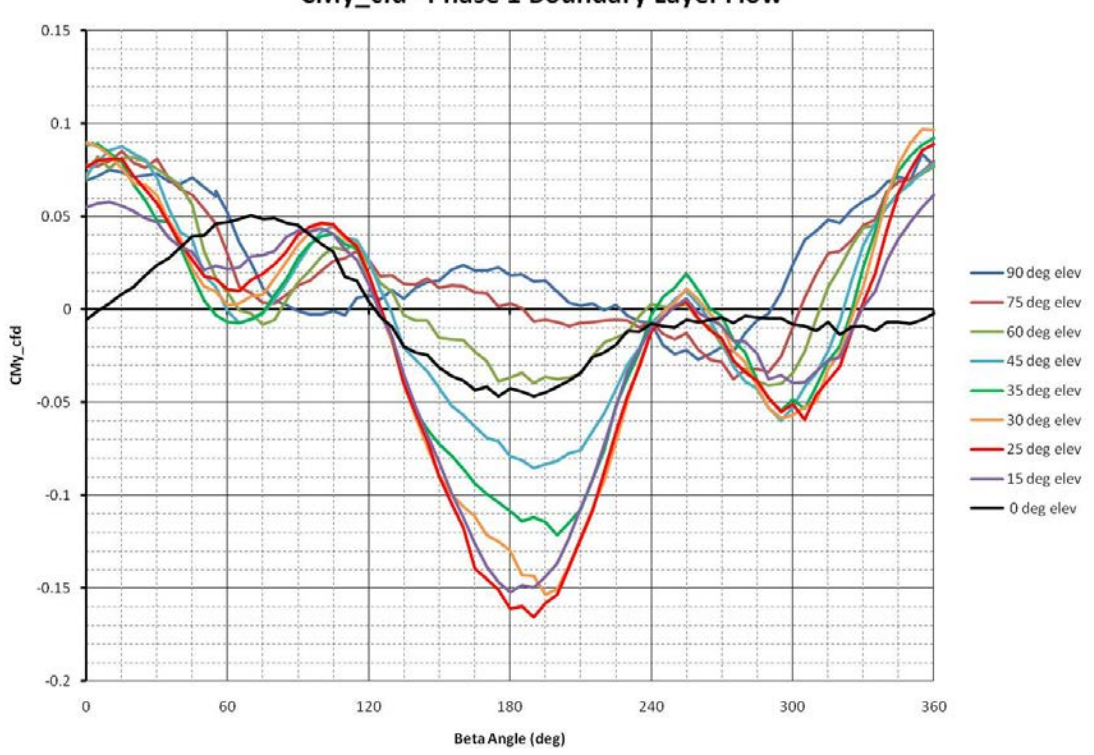
CFy_cfd - Phase 1 Boundary Layer Flow

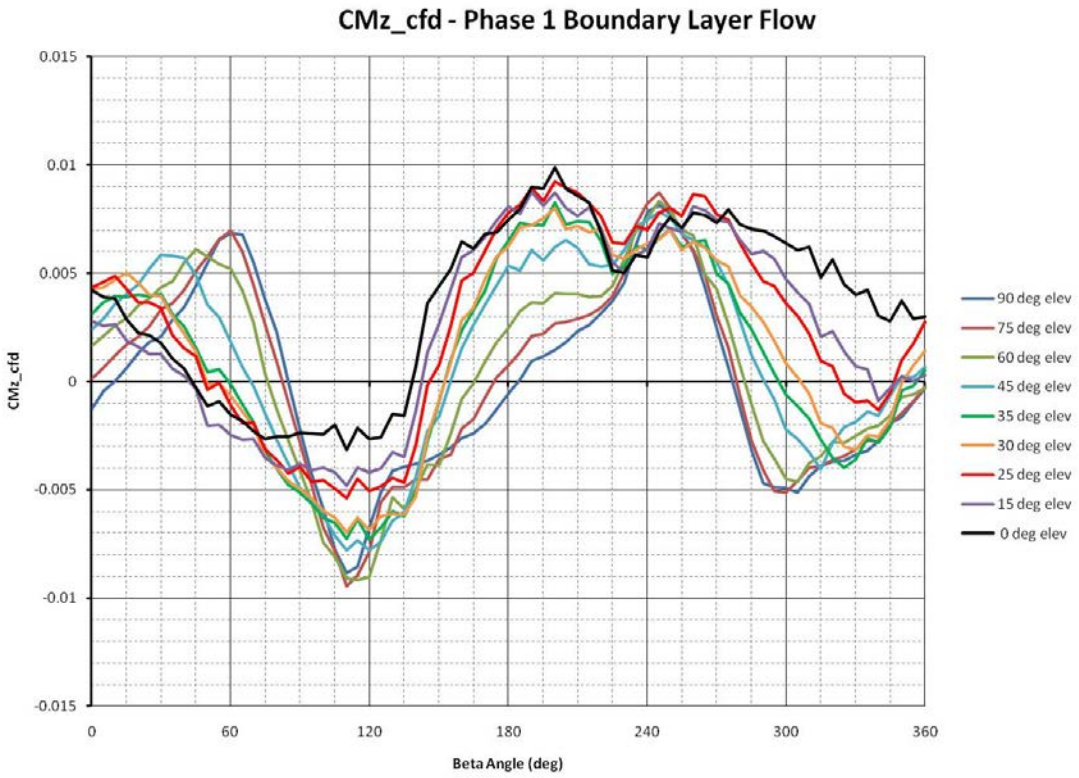


CFz_cfd - Phase 1 Boundary Layer Flow



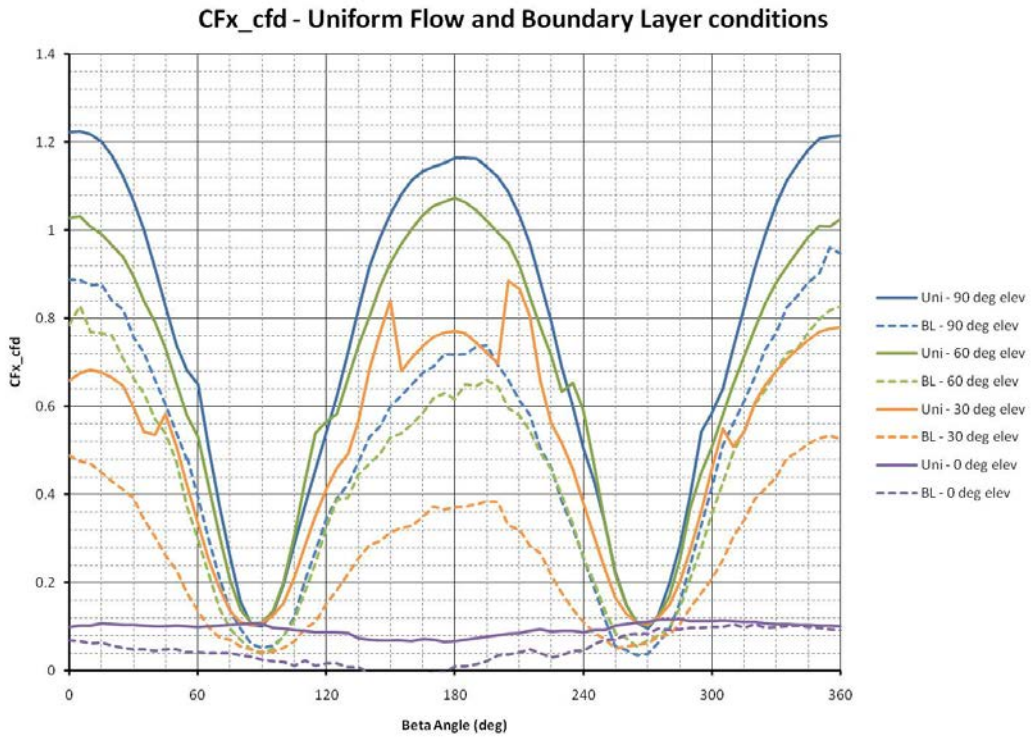

CMx_cfd - Phase 1 Boundary Layer Flow
CMx_cfd
Beta Angle (deg)
0.2
0.15
0.1
0.05
0
-0.05
-0.1
-0.15
-0.2
0
60
120
180
240
300
360
90 deg elev
75 deg elev
60 deg elev
45 deg elev
35 deg elev
30 deg elev
25 deg elev
15 deg elev
0 deg elev

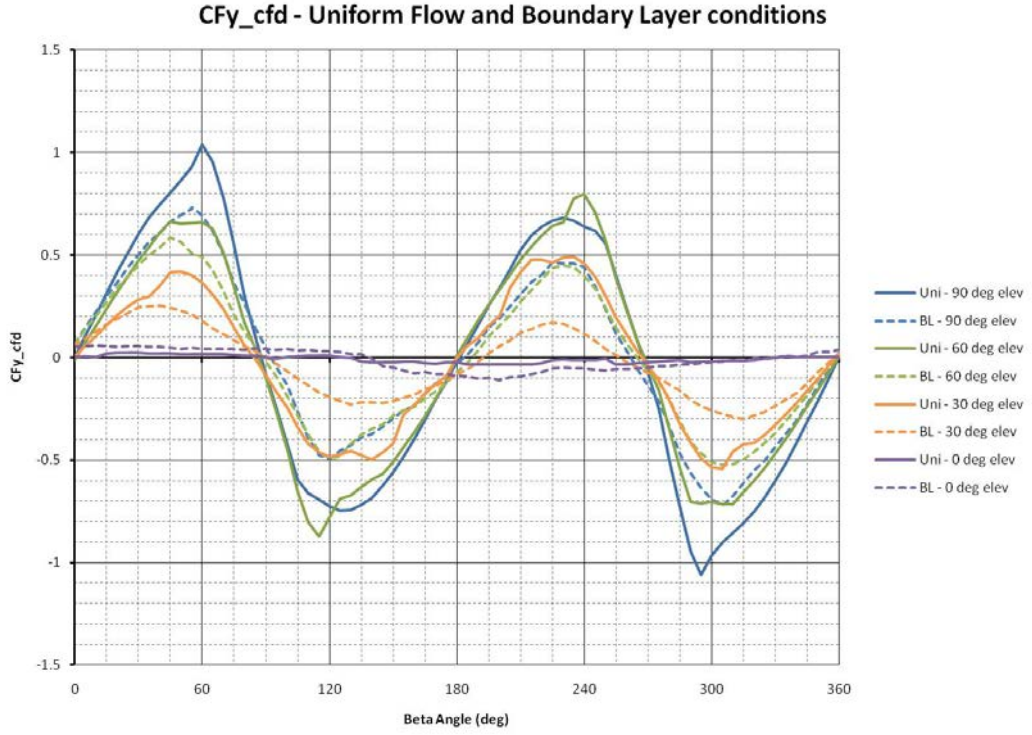

CMy_cfd - Phase 1 Boundary Layer Flow
CMy_cfd
Beta Angle (deg)
0.15
0.1
0.05
0
-0.05
-0.1
-0.15
-0.2
0
60
120
180
240
300
360
90 deg elev
75 deg elev
60 deg elev
45 deg elev
35 deg elev
30 deg elev
25 deg elev
15 deg elev
0 deg elev

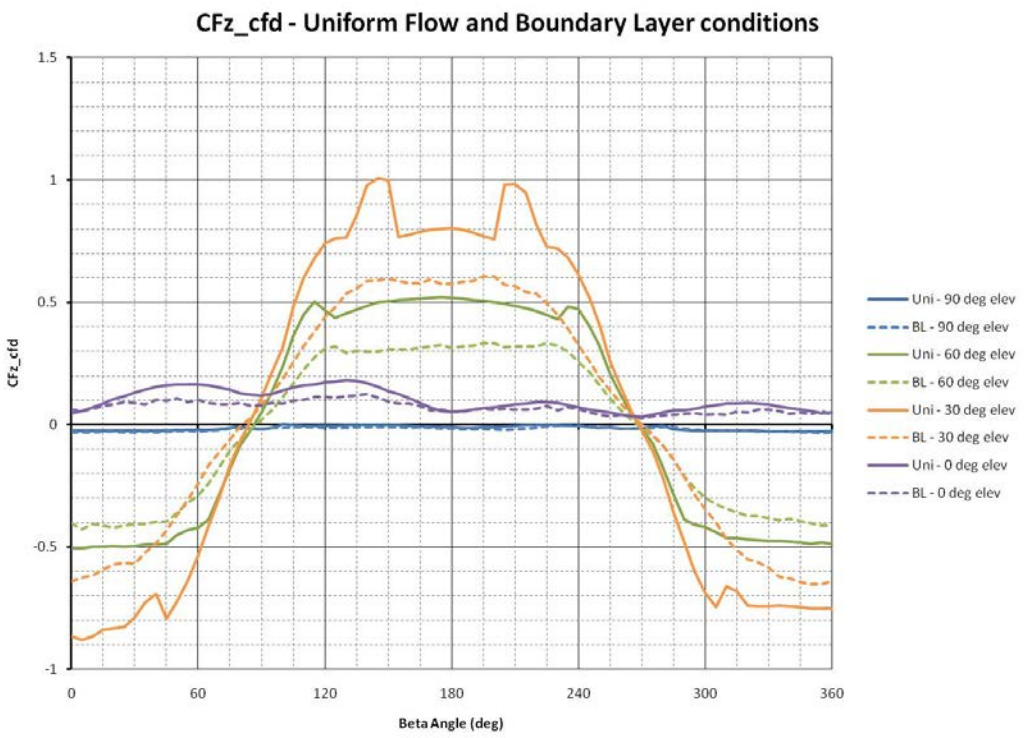


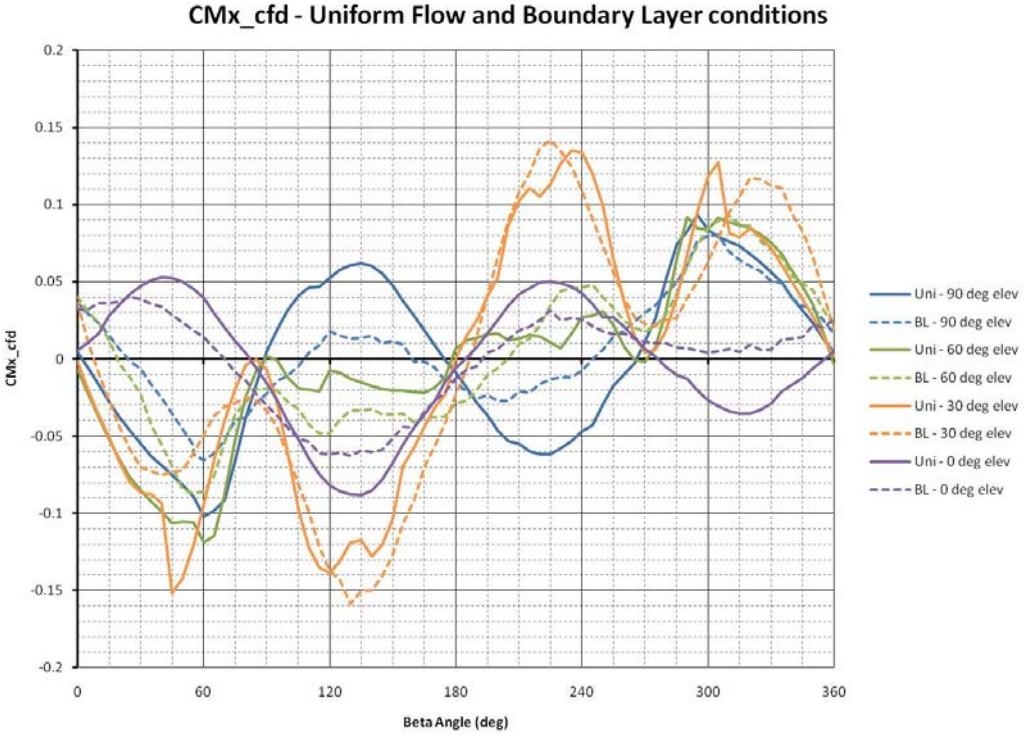
Single Heliostat Comparison between Uniform Flow and Atmospheric Boundary Layer

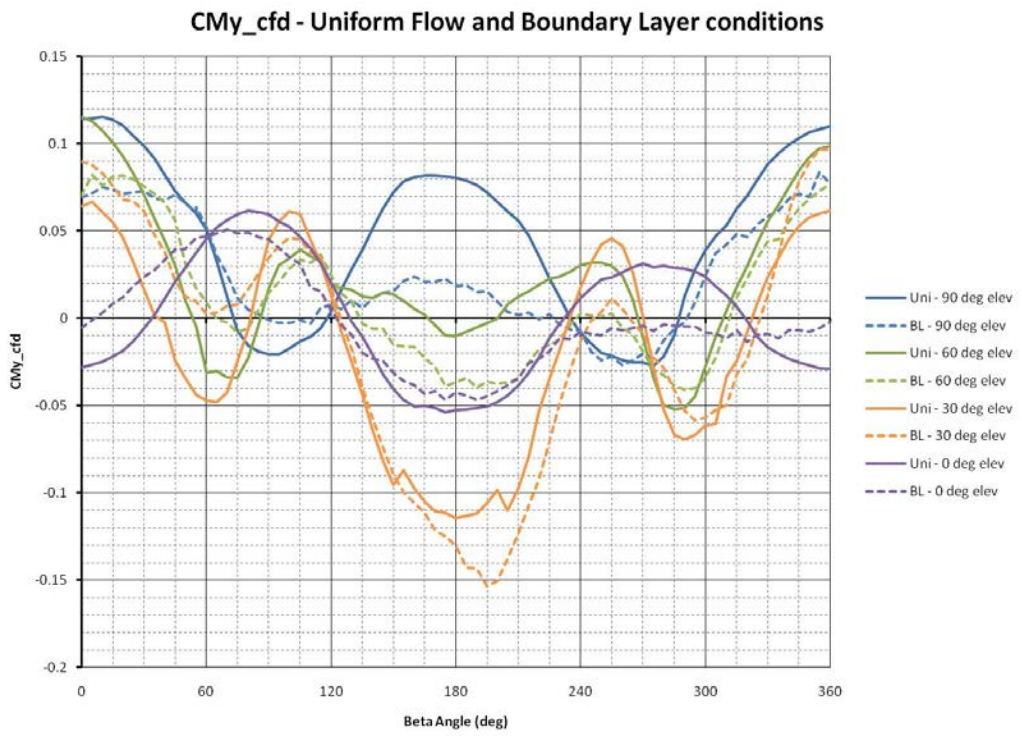
- **Heliostat Model Used:** 200mm x 200mm x 5mm reflector, HCL = 130mm

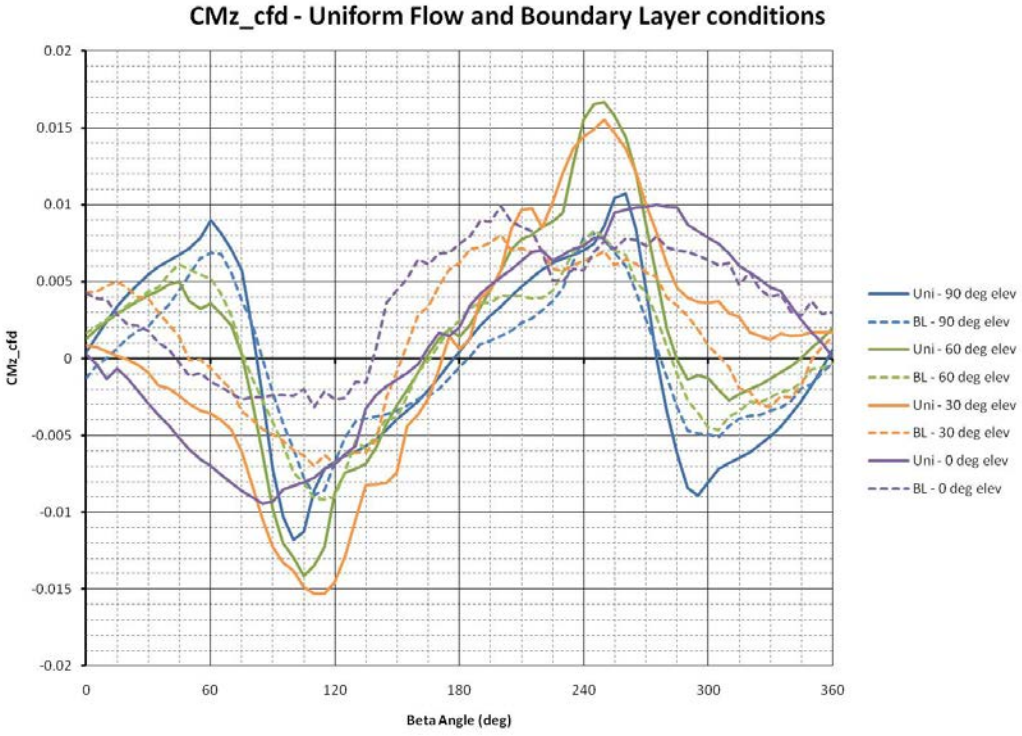

CFx_cfd - Uniform Flow and Boundary Layer conditions
CFx_cfd
Beta Angle (deg)
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0
60
120
180
240
300
360
Uni - 90 deg elev
BL - 90 deg elev
Uni - 60 deg elev
BL - 60 deg elev
Uni - 30 deg elev
BL - 30 deg elev
Uni - 0 deg elev
BL - 0 deg elev


CFy_cfd - Uniform Flow and Boundary Layer conditions
CFy_cfd
Beta Angle (deg)
1.5
1
0.5
0
-0.5
-1
-1.5
0
60
120
180
240
300
360
Uni - 90 deg elev
BL - 90 deg elev
Uni - 60 deg elev
BL - 60 deg elev
Uni - 30 deg elev
BL - 30 deg elev
Uni - 0 deg elev
BL - 0 deg elev


CFz_cfd - Uniform Flow and Boundary Layer conditions
CFz_cfd
1.5
1
0.5
0
-0.5
-1
0
60
120
180
240
300
360
Beta Angle (deg)
Uni - 90 deg elev
BL - 90 deg elev
Uni - 60 deg elev
BL - 60 deg elev
Uni - 30 deg elev
BL - 30 deg elev
Uni - 0 deg elev
BL - 0 deg elev


CMx_cfd - Uniform Flow and Boundary Layer conditions
CMx_cfd
0.2
0.15
0.1
0.05
0
-0.05
-0.1
-0.15
-0.2
0
60
120
180
240
300
360
Beta Angle (deg)
Uni - 90 deg elev
BL - 90 deg elev
Uni - 60 deg elev
BL - 60 deg elev
Uni - 30 deg elev
BL - 30 deg elev
Uni - 0 deg elev
BL - 0 deg elev

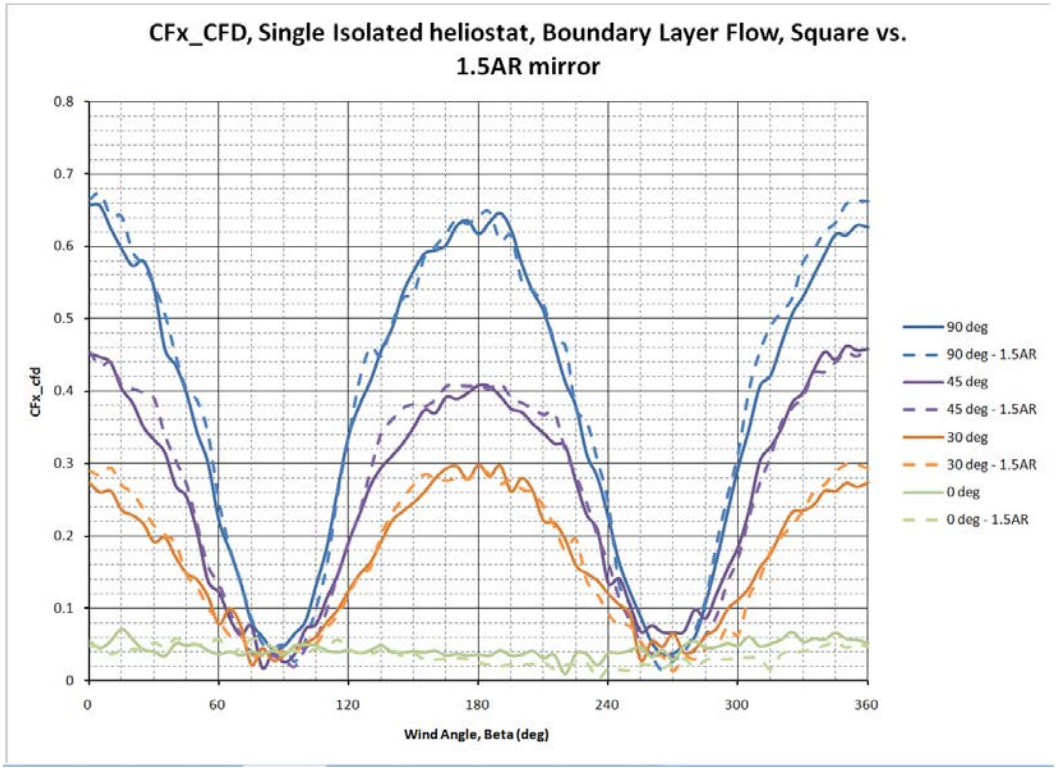

CMy_cfd - Uniform Flow and Boundary Layer conditions
0.15
0.1
0.05
0
-0.05
-0.1
-0.15
-0.2
CMy_cfd
0
60
120
180
240
300
360
Beta Angle (deg)
Uni - 90 deg elev
BL - 90 deg elev
Uni - 60 deg elev
BL - 60 deg elev
Uni - 30 deg elev
BL - 30 deg elev
Uni - 0 deg elev
BL - 0 deg elev

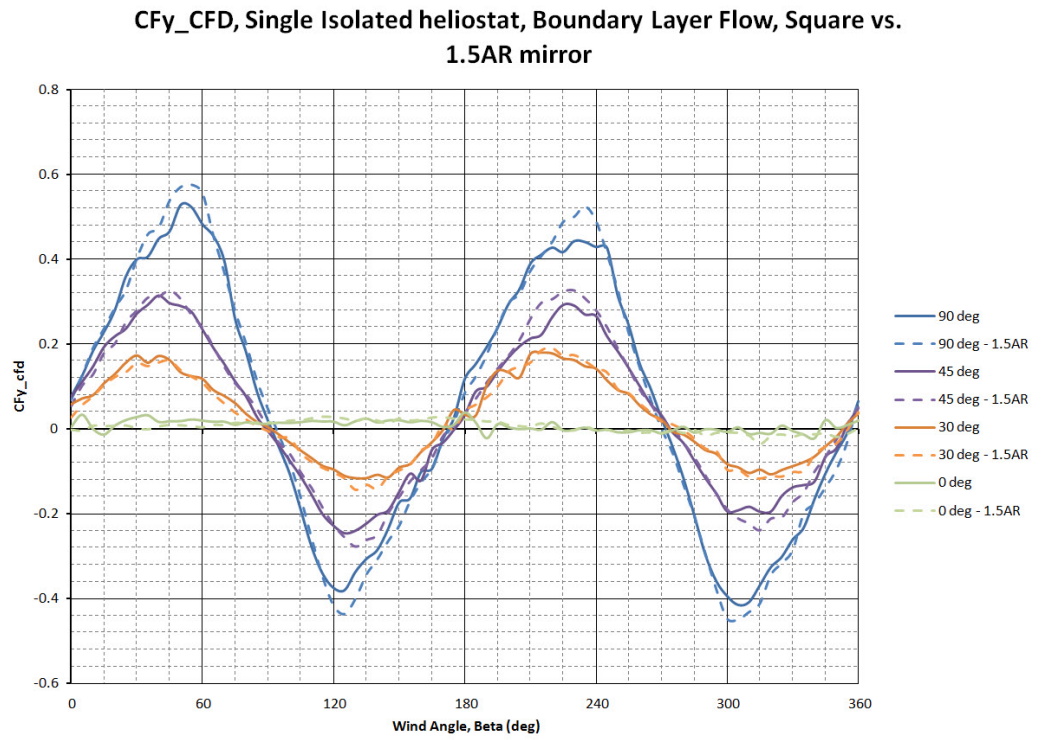

CMz_cfd - Uniform Flow and Boundary Layer conditions
0.02
0.015
0.01
0.005
0
-0.005
-0.01
-0.015
-0.02
CMz_cfd
0
60
120
180
240
300
360
Beta Angle (deg)
Uni - 90 deg elev
BL - 90 deg elev
Uni - 60 deg elev
BL - 60 deg elev
Uni - 30 deg elev
BL - 30 deg elev
Uni - 0 deg elev
BL - 0 deg elev

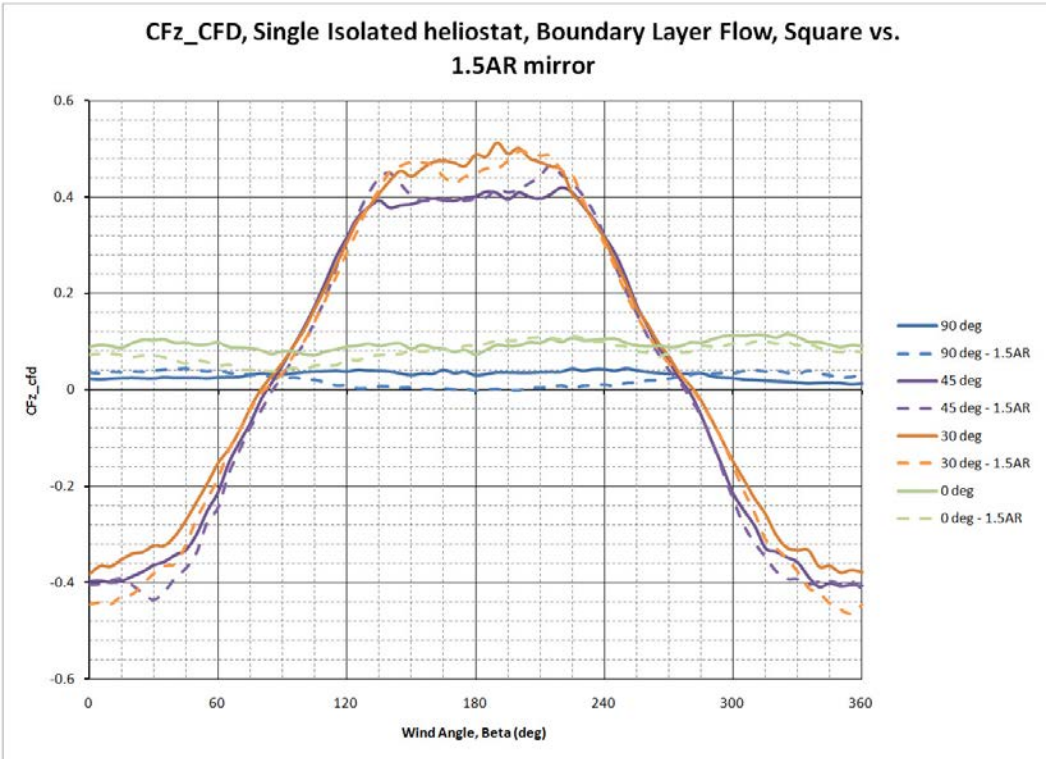
Single Heliostat with 1.5 Aspect Ratio Reflector

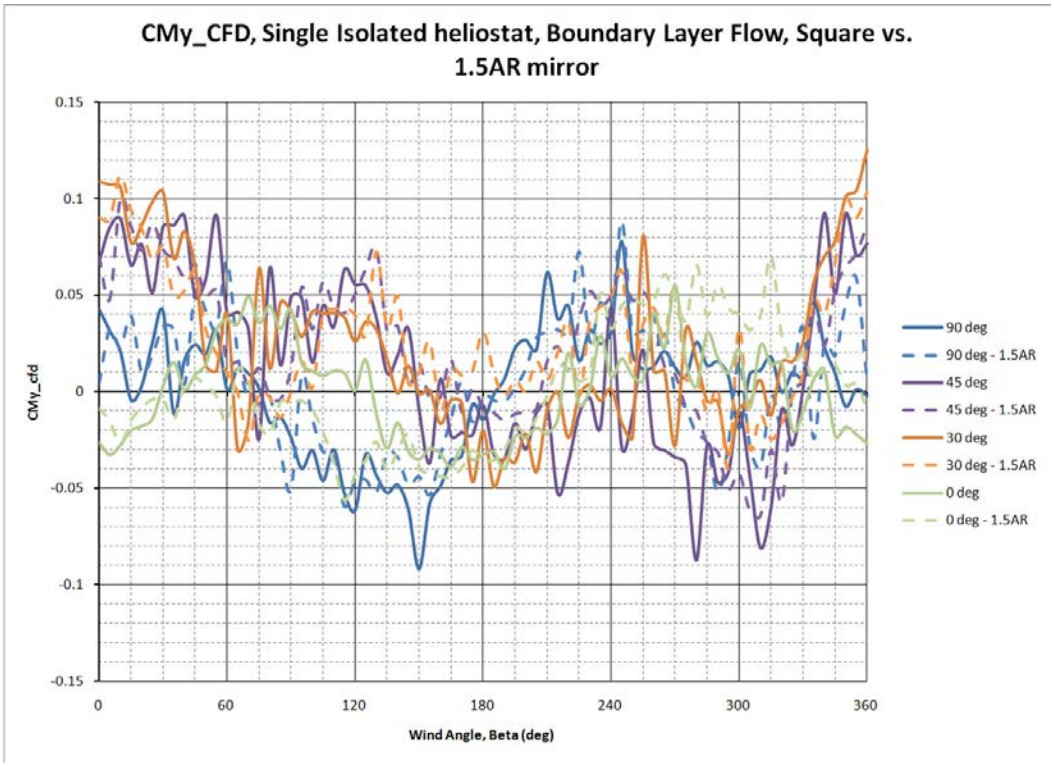
- **Heliostat Model Used:** 100mm x 100mm x 3mm reflector, HCL = 75mm
- **Test conditions were as follows (square 1.0AR reflector)**
    - Q = 1.38 kPa (29 psf)
    - Wind Speed = 48 m/s (158 ft/s)
    - Air Temperature = 8.3C (47º F)
    - Air Density = 1.20 kg/m^3 (14.85 psia, as reported from tunnel conditions)
    - Elevation angles (α) tested: 90,45, 30, 0 degrees
    - Wind incidence angles (β) tested: 0 - 360 deg in 5 degree increments

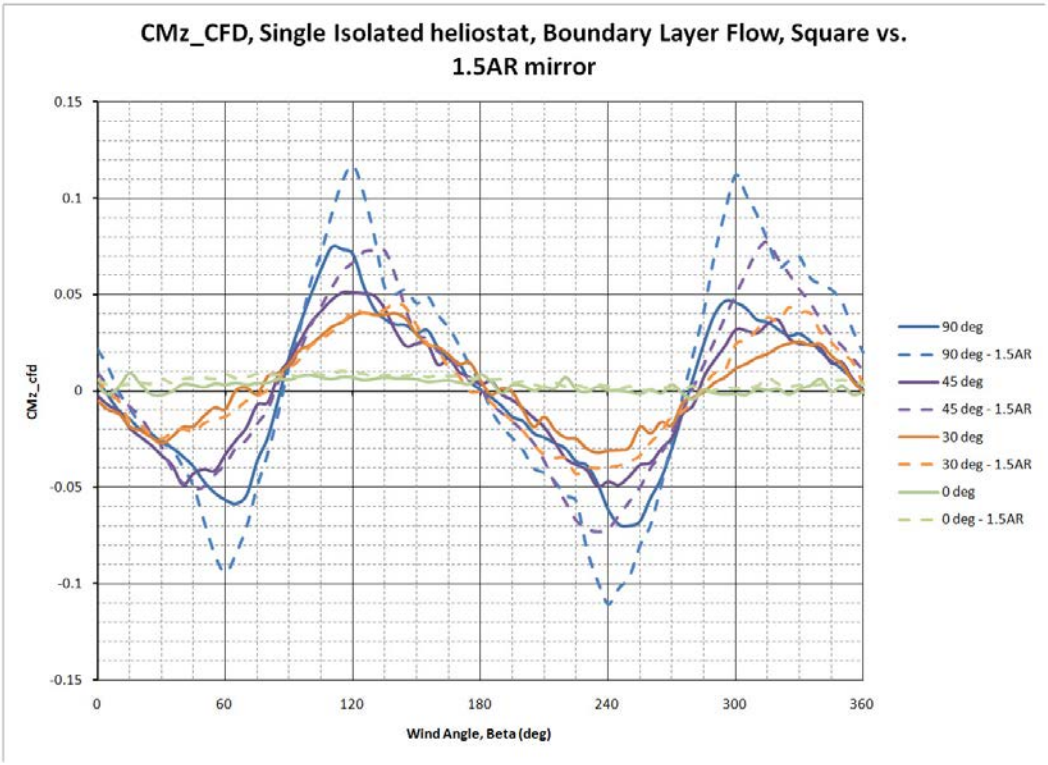
- **Heliostat Model Used:** 150mm x 100mm x 3mm reflector, HCL = 75mm
- **Test conditions were as follows (square 1.5AR reflector)**
    - Q = 0.95 kPa (20 psf)
    - Wind Speed = 40 m/s (131 ft/s)
    - Air Temperature = 13.9C (57º F)
    - Air Density = 1.20 kg/m^3 (14.85 psia, as reported from tunnel conditions)
    - Elevation angles (α) tested: 90,45, 30, 0 degrees
    - Wind incidence angles (β) tested: 0 - 360 deg in 5 degree increments




CFy_CFD, Single Isolated heliostat, Boundary Layer Flow, Square vs. 1.5AR mirror
CFy_cfd
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
0
60
120
180
240
300
360
Wind Angle, Beta (deg)
90 deg
90 deg - 1.5AR
45 deg
45 deg - 1.5AR
30 deg
30 deg - 1.5AR
0 deg
0 deg - 1.5AR


CFz_CFD, Single Isolated heliostat, Boundary Layer Flow, Square vs. 1.5AR mirror
CFz_cfd
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
0
60
120
180
240
300
360
Wind Angle, Beta (deg)
90 deg
90 deg - 1.5AR
45 deg
45 deg - 1.5AR
30 deg
30 deg - 1.5AR
0 deg
0 deg - 1.5AR

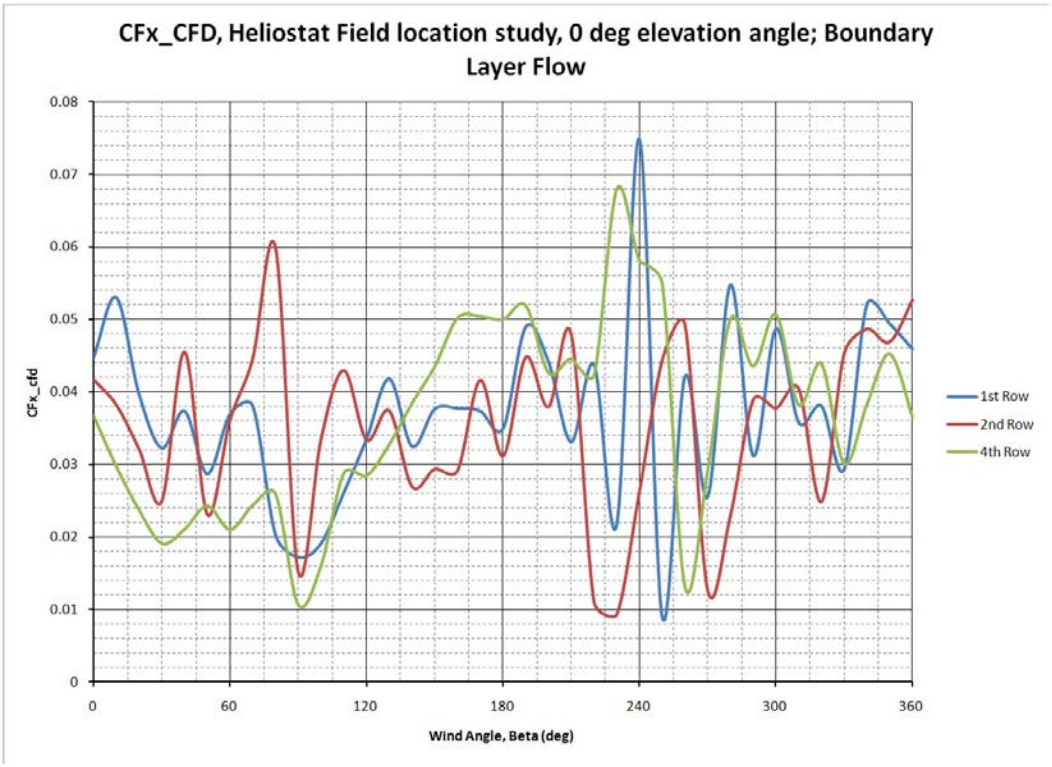


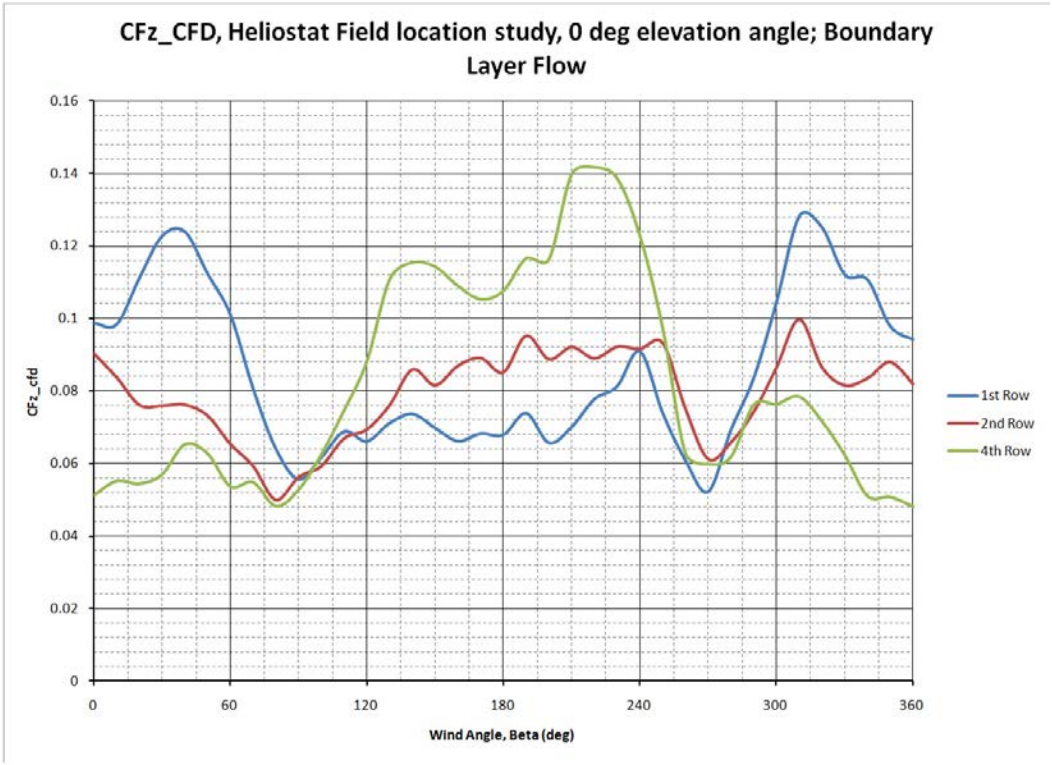


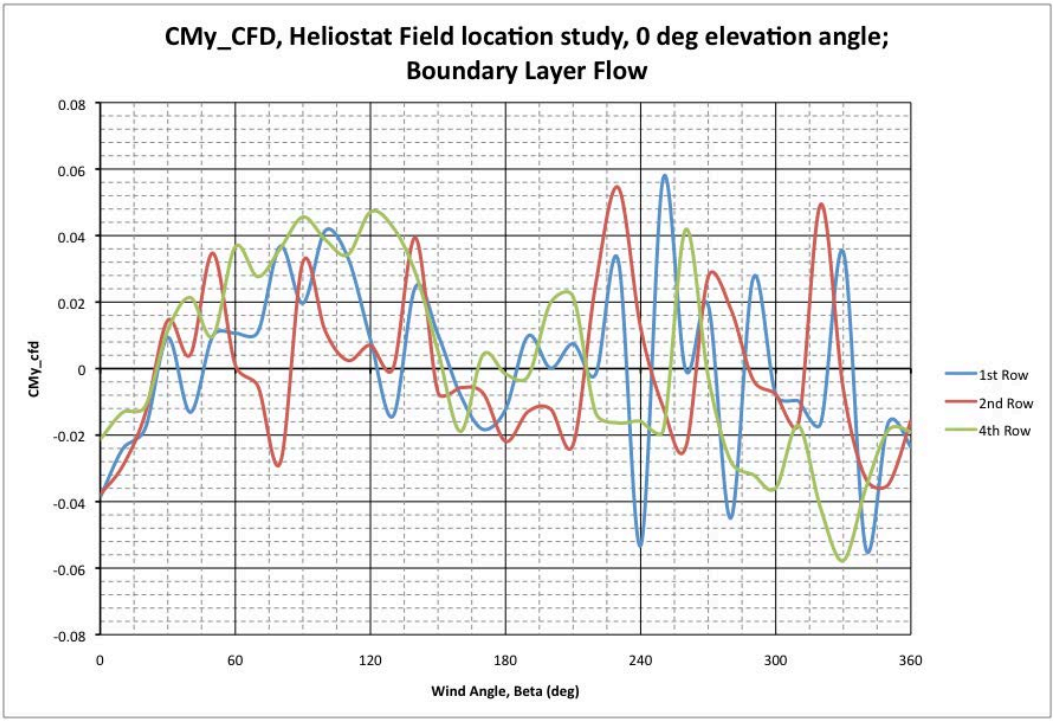
Heliostat Field

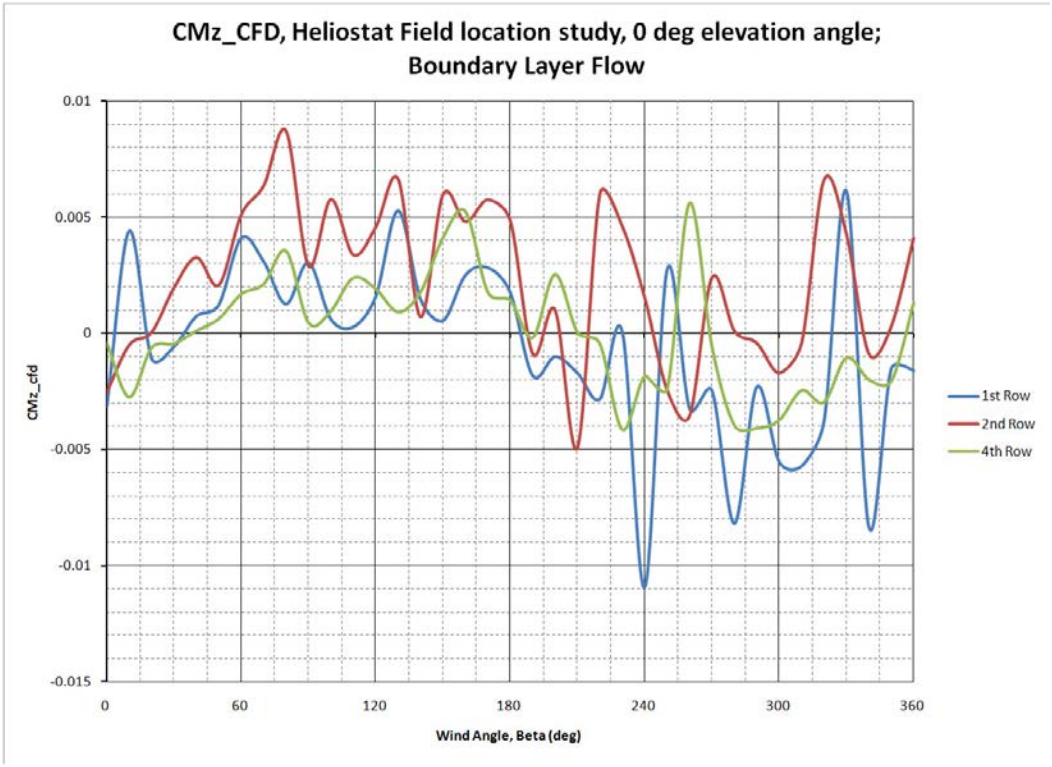
- **Heliostat Model Used:** 100mm x 100mm x 3mm reflector, HCL = 75mm
- **Test conditions were as follows:**
    - Q = 0.95 kPa (20psf)
    - Wind Speed = 40 m/s (132 ft/s)
    - Air Temperature = 23 C (74° F)
    - Air Density = 1.20 kg/m^3 (14.85 psia, as reported from tunnel conditions)
    - Elevation angles (alpha) tested: 90, 45, 30, 3, 0 degrees
    - Azimuth angles (beta) tested: 0 - 360 deg in 5 degree increments
    - Instrumented field positions: 1st row, 2nd row, 4th row

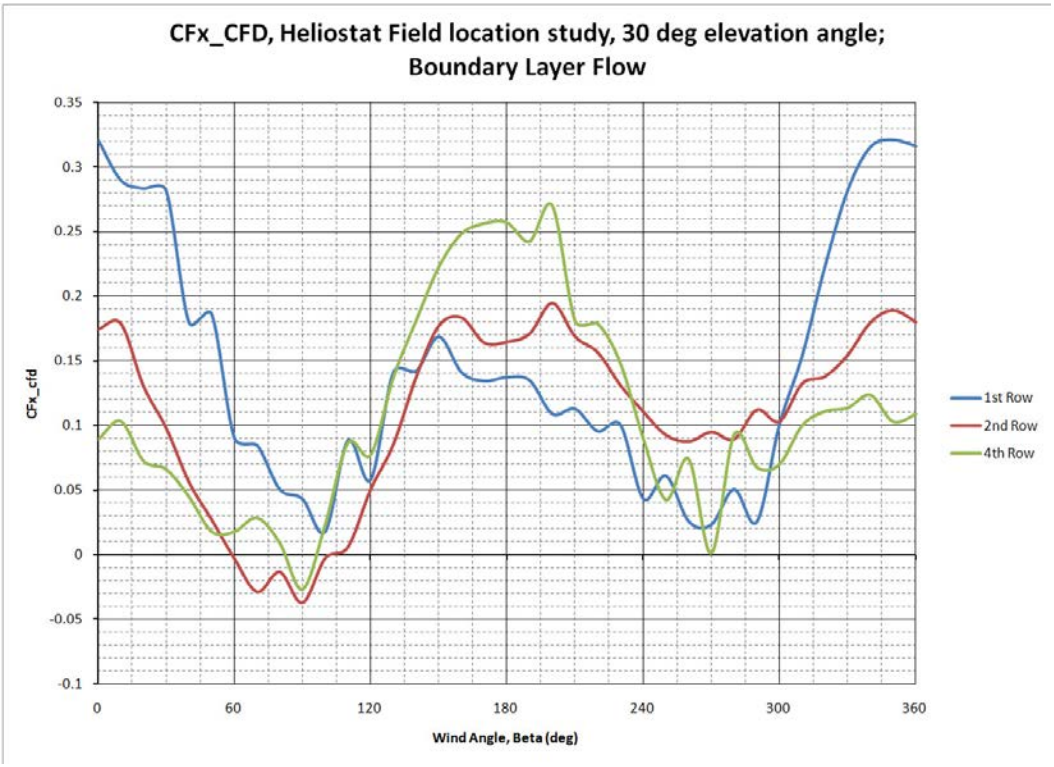
Heliostat Field Position Experiments

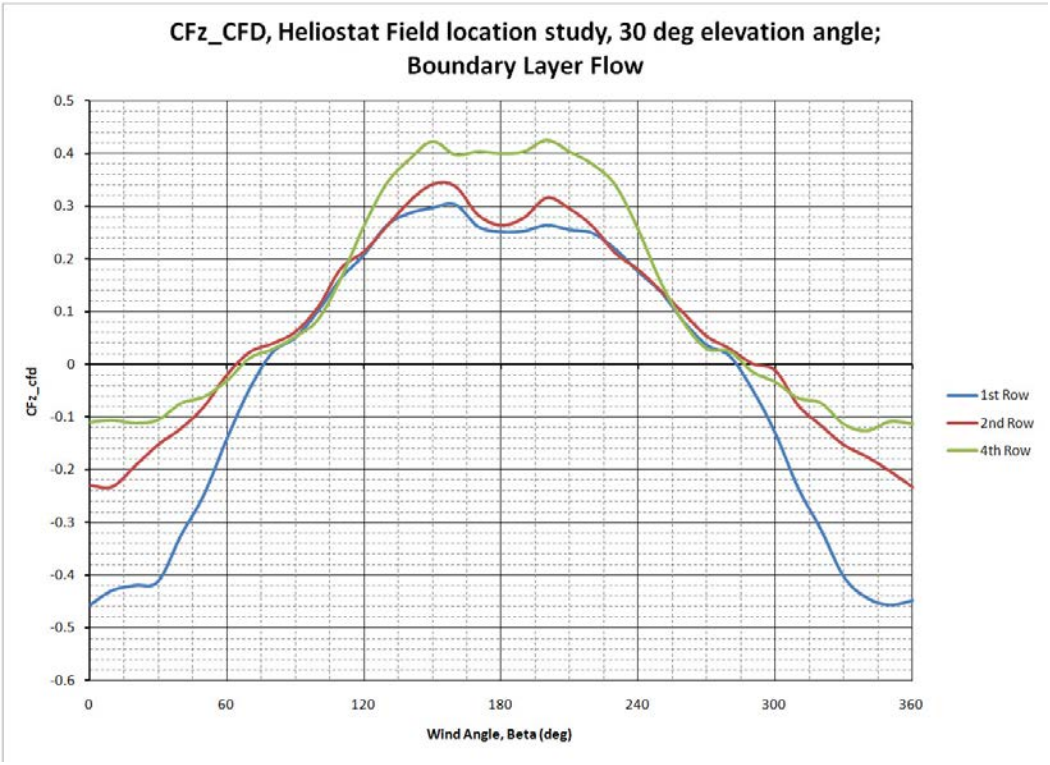


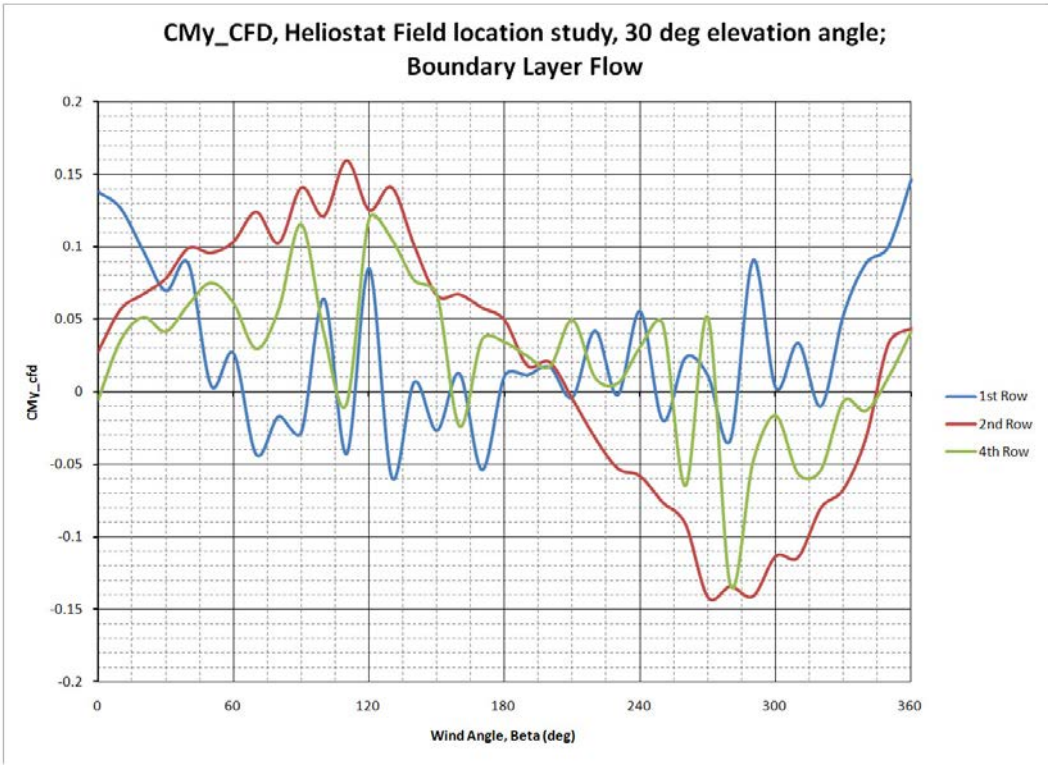

CFz_CFD, Heliostat Field location study, 0 deg elevation angle; Boundary Layer Flow
CFz_cfd
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
0
60
120
180
240
300
360
Wind Angle, Beta (deg)
1st Row
2nd Row
4th Row

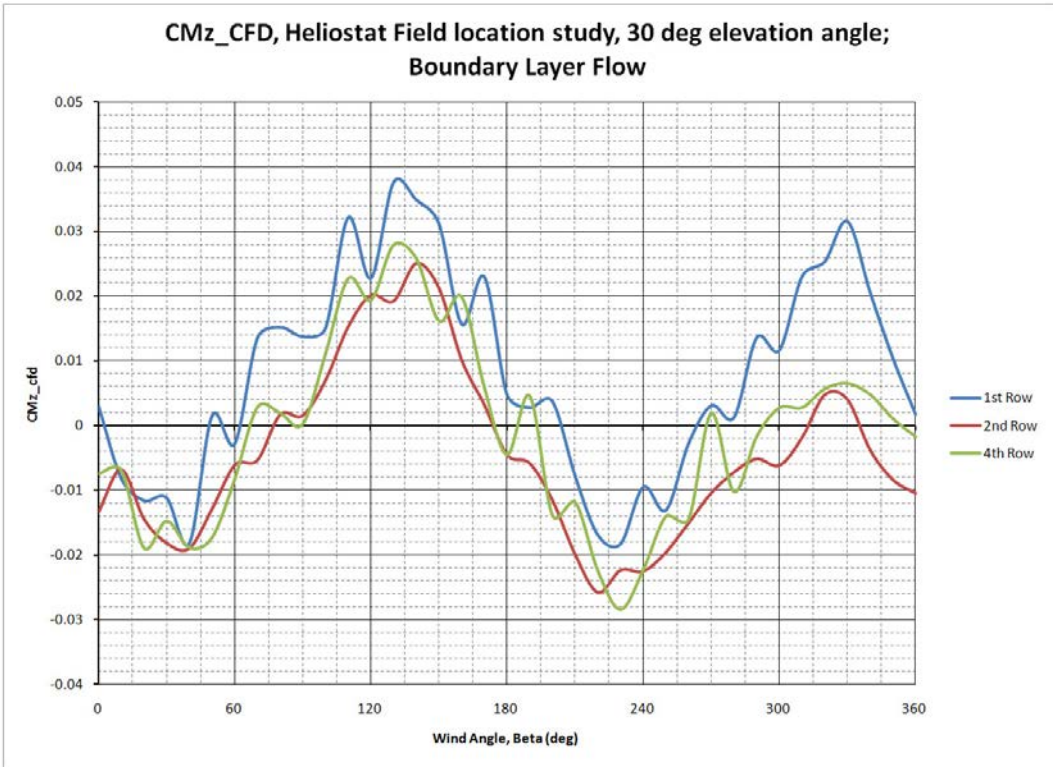

CMy_CFD, Heliostat Field location study, 0 deg elevation angle; Boundary Layer Flow
CMy_cfd
0.08
0.06
0.04
0.02
0
-0.02
-0.04
-0.06
-0.08
0
60
120
180
240
300
360
Wind Angle, Beta (deg)
1st Row
2nd Row
4th Row

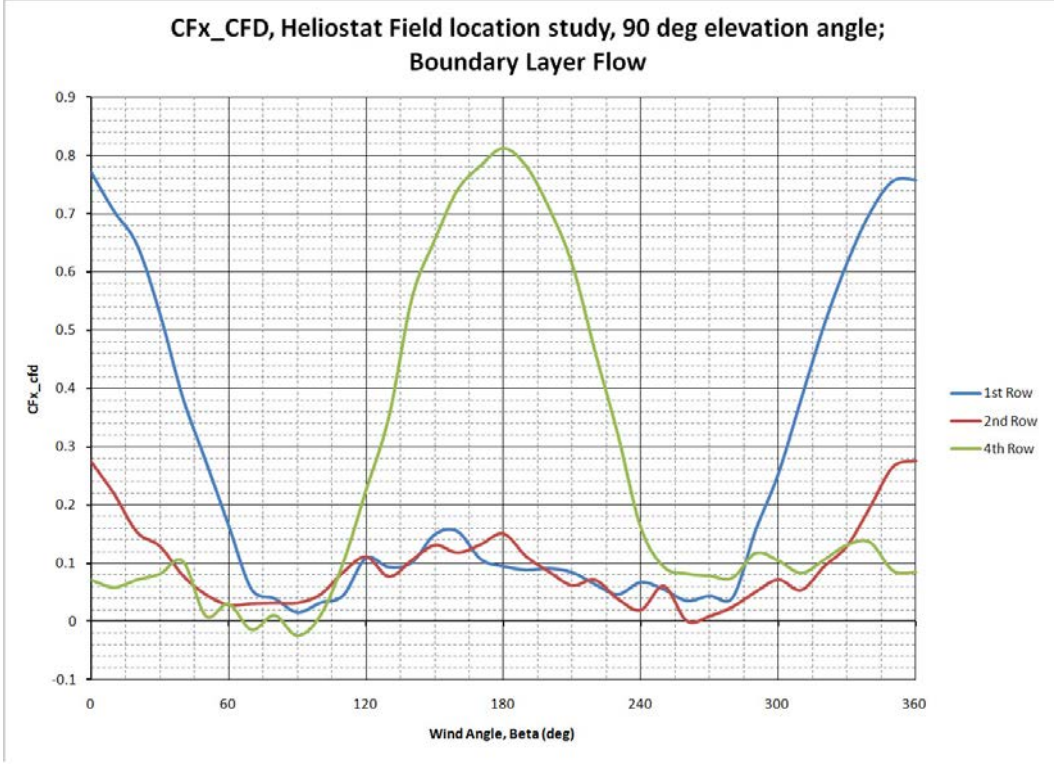

CMz_CFD, Heliostat Field location study, 0 deg elevation angle;
Boundary Layer Flow
0.01
0.005
0
-0.005
-0.01
-0.015
CMz_cfd
0
60
120
180
240
300
360
Wind Angle, Beta (deg)
1st Row
2nd Row
4th Row

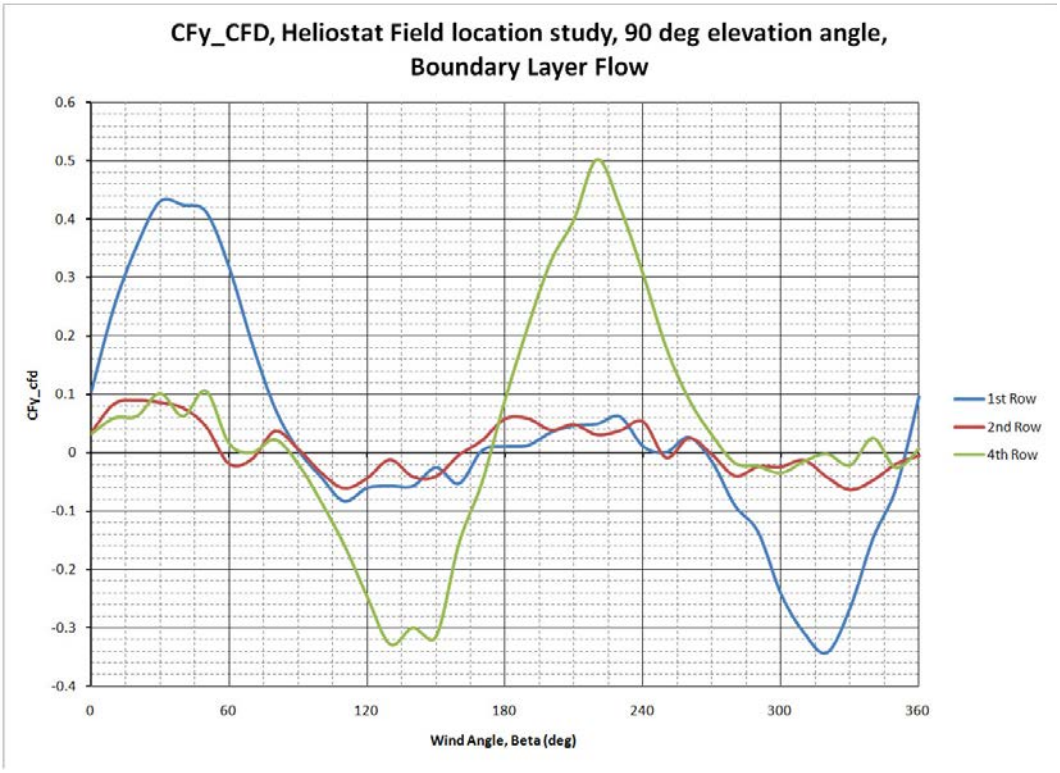

CFx_CFD, Heliostat Field location study, 30 deg elevation angle;
Boundary Layer Flow
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
-0.05
-0.1
CFx_cfd
0
60
120
180
240
300
360
Wind Angle, Beta (deg)
1st Row
2nd Row
4th Row

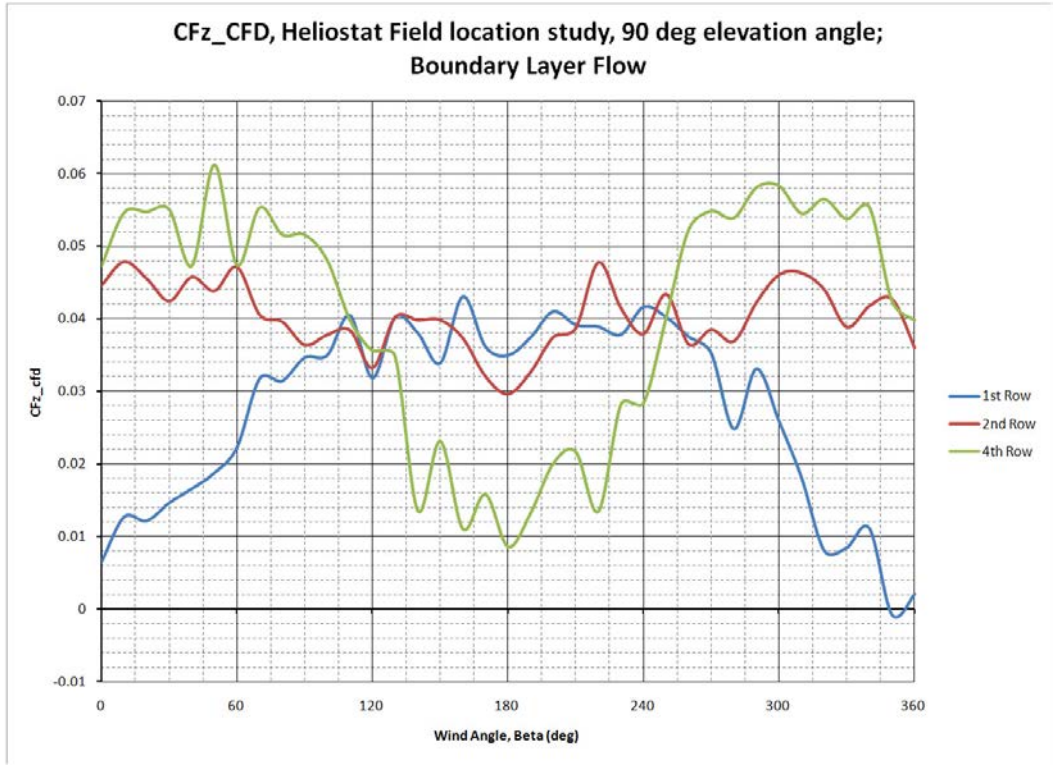

CFz_CFD, Heliostat Field location study, 30 deg elevation angle;
Boundary Layer Flow
CFz_cfd
0.5
0.4
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
-0.4
-0.5
-0.6
0
60
120
180
240
300
360
Wind Angle, Beta (deg)
1st Row
2nd Row
4th Row

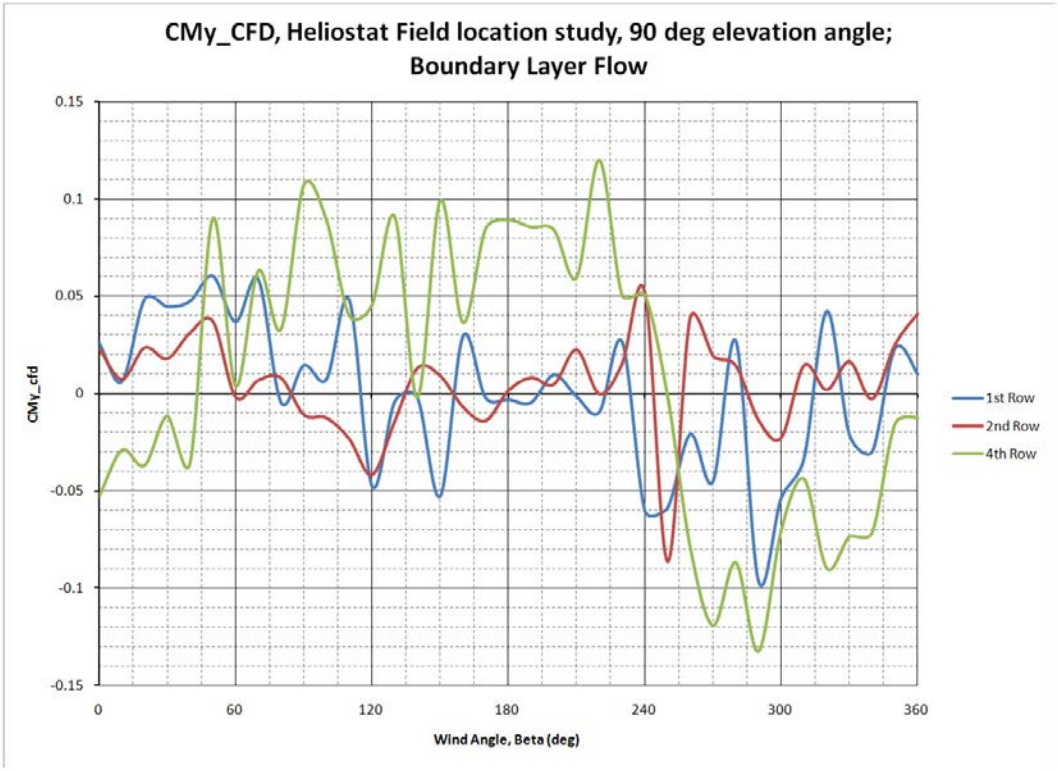

CMy_CFD, Heliostat Field location study, 30 deg elevation angle;
Boundary Layer Flow
CMy_cfd
0.2
0.15
0.1
0.05
0
-0.05
-0.1
-0.15
-0.2
0
60
120
180
240
300
360
Wind Angle, Beta (deg)
1st Row
2nd Row
4th Row

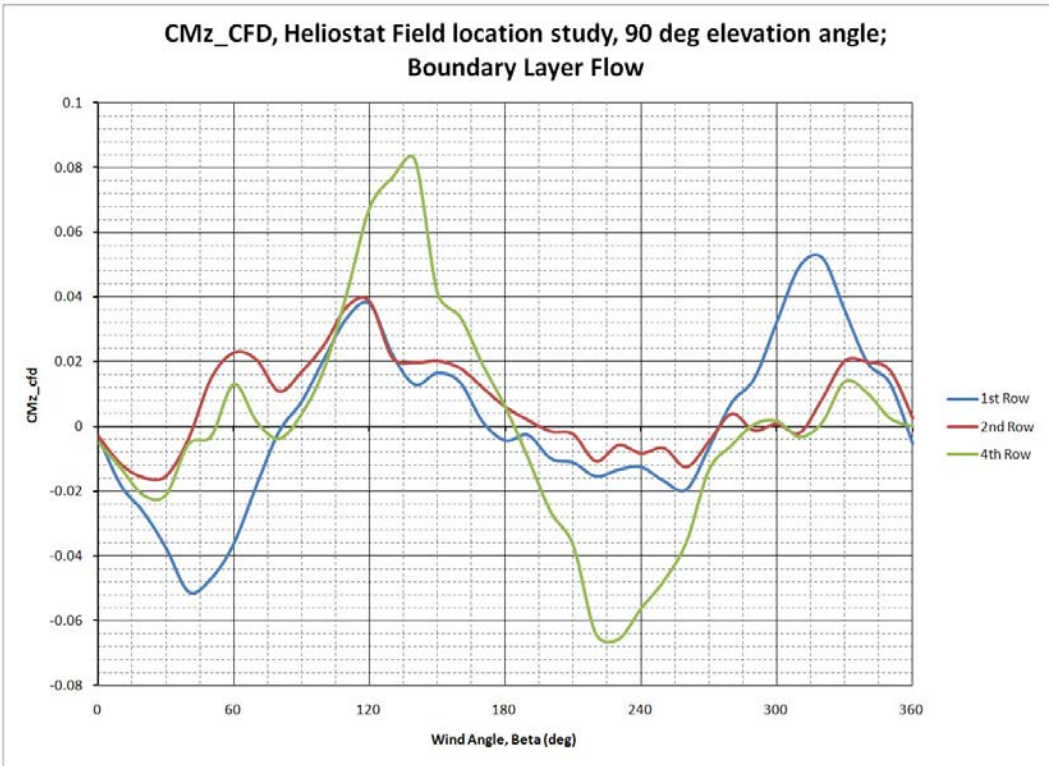

CMz_CFD, Heliostat Field location study, 30 deg elevation angle;
Boundary Layer Flow
CMz_cfd
0.05
0.04
0.03
0.02
0.01
0
-0.01
-0.02
-0.03
-0.04
0
60
120
180
240
300
360
Wind Angle, Beta (deg)
1st Row
2nd Row
4th Row


CFx_CFD, Heliostat Field location study, 90 deg elevation angle;
Boundary Layer Flow
CFx_cfd
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
-0.1
0
60
120
180
240
300
360
Wind Angle, Beta (deg)
1st Row
2nd Row
4th Row


CFy_CFD, Heliostat Field location study, 90 deg elevation angle,
Boundary Layer Flow
CFy_cfd
0.6
0.5
0.4
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
-0.4
0
60
120
180
240
300
360
Wind Angle, Beta (deg)
1st Row
2nd Row
4th Row

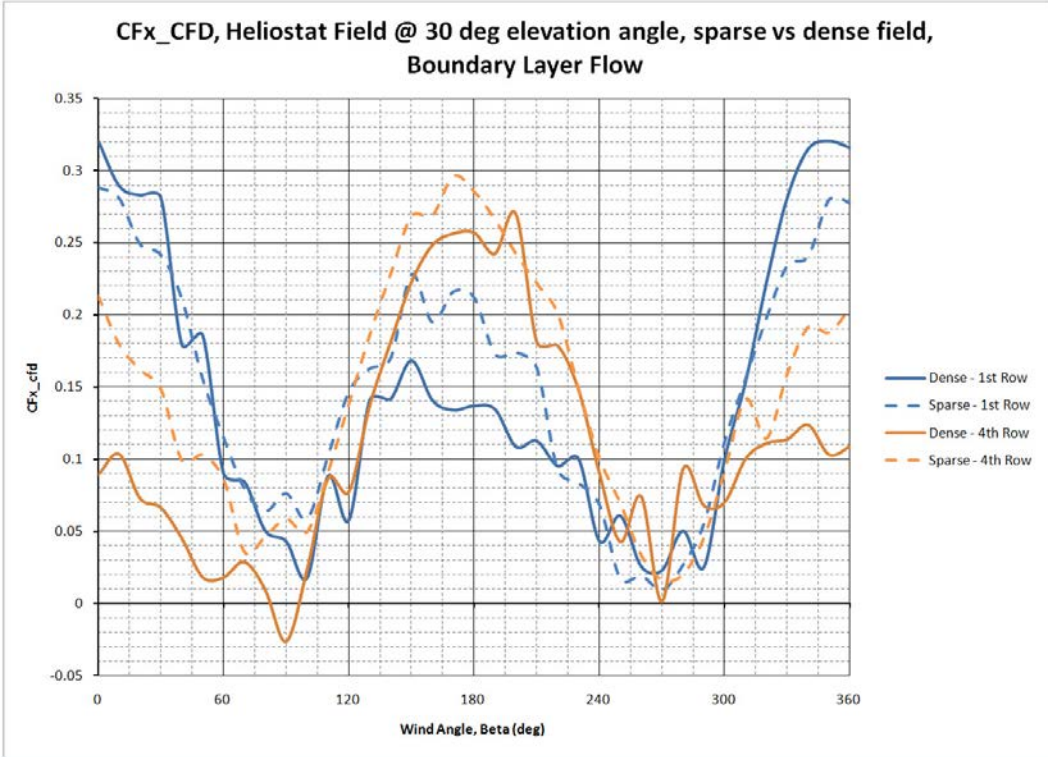

CFz_CFD, Heliostat Field location study, 90 deg elevation angle;
Boundary Layer Flow
CFz_cfd
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
-0.01
0
60
120
180
240
300
360
Wind Angle, Beta (deg)
1st Row
2nd Row
4th Row

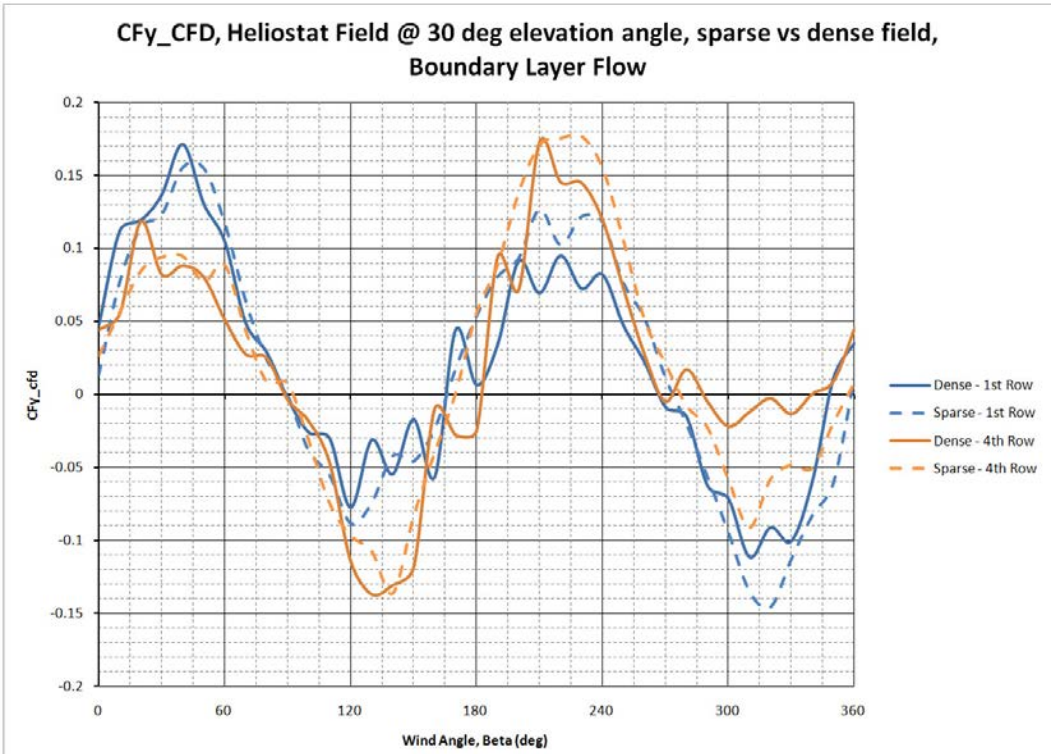


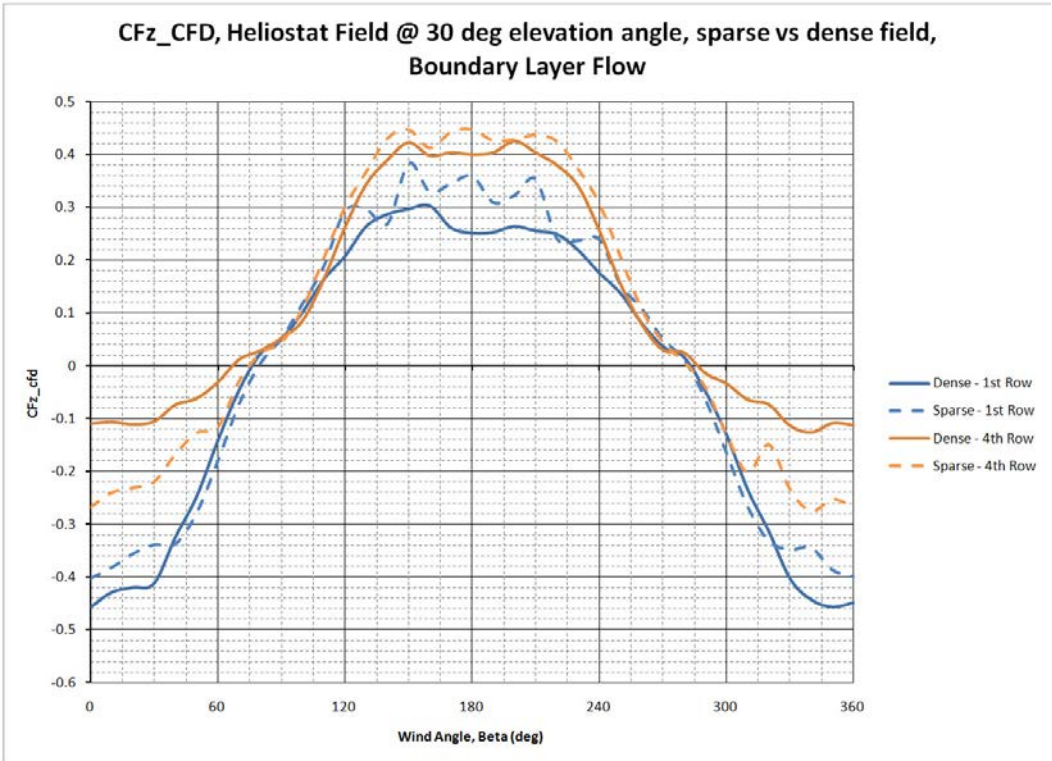


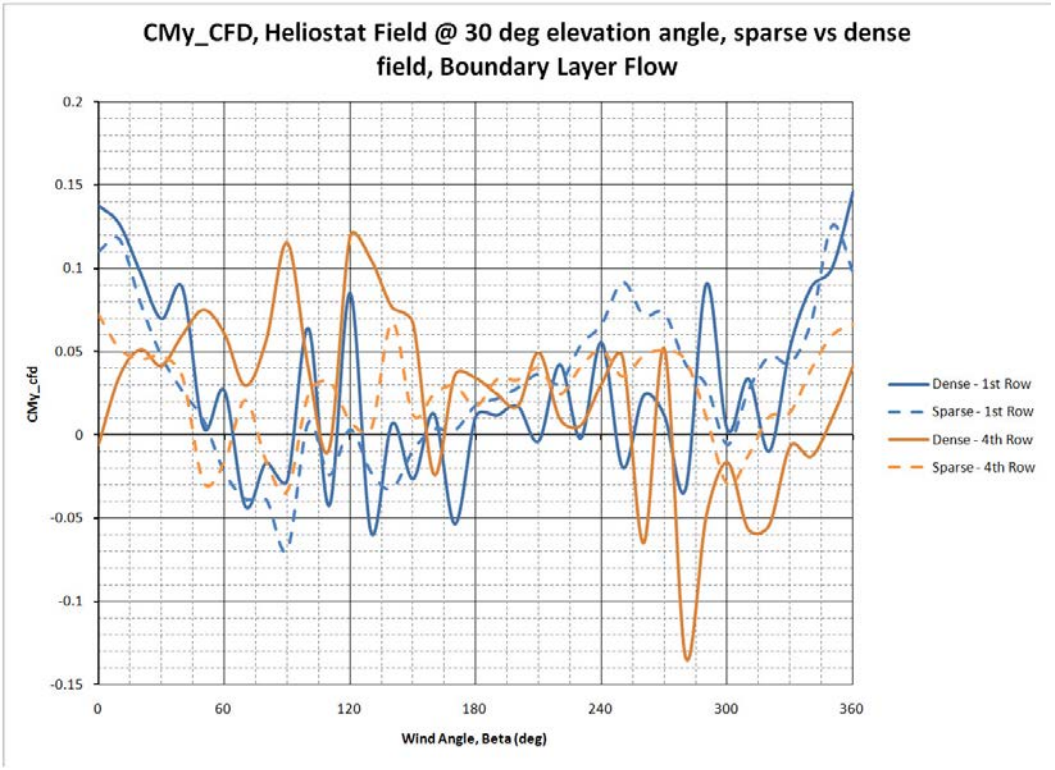
Heliostat Field Packing Density (25% vs 50%)

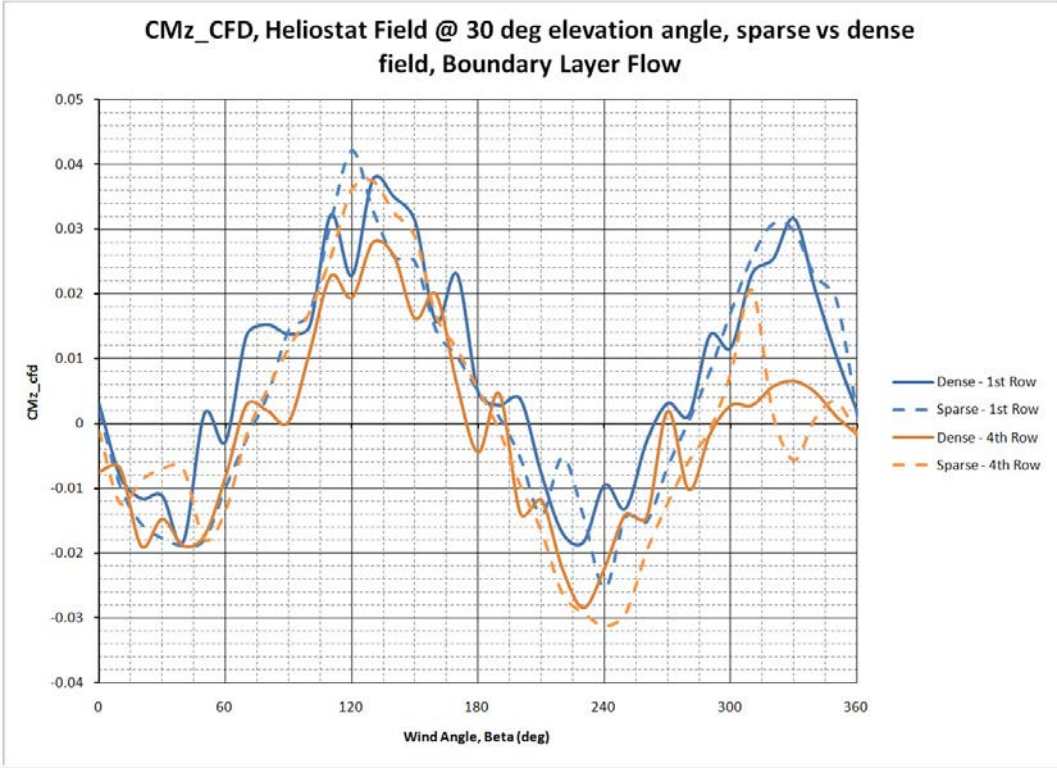
- **Heliostat Model Used:** 100mm x 100mm x 3mm reflector, HCL = 75mm
- **Test conditions were as follows:**
    - Q = 0.95 kPa (20psf)
    - Wind Speed = 40 m/s (132 ft/s)
    - Air Temperature = 23 C (74° F)
    - Air Density = 1.20 kg/m^3 (14.85 psia, as reported from tunnel conditions)
    - Elevation angles (alpha) tested: 90, 30, 0 degrees
    - Azimuth angles (beta) tested: 0 - 360 deg in 5 degree increments
    - Instrumented field positions: 1st row, 4th row




CFy_CFD, Heliostat Field @ 30 deg elevation angle, sparse vs dense field, Boundary Layer Flow
CFy_cfd
0.2
0.15
0.1
0.05
0
-0.05
-0.1
-0.15
-0.2
0
60
120
180
240
300
360
Wind Angle, Beta (deg)
Dense - 1st Row
Sparse - 1st Row
Dense - 4th Row
Sparse - 4th Row


CFz_CFD, Heliostat Field @ 30 deg elevation angle, sparse vs dense field, Boundary Layer Flow
CFz_cfd
0.5
0.4
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
-0.4
-0.5
-0.6
0
60
120
180
240
300
360
Wind Angle, Beta (deg)
Dense - 1st Row
Sparse - 1st Row
Dense - 4th Row
Sparse - 4th Row

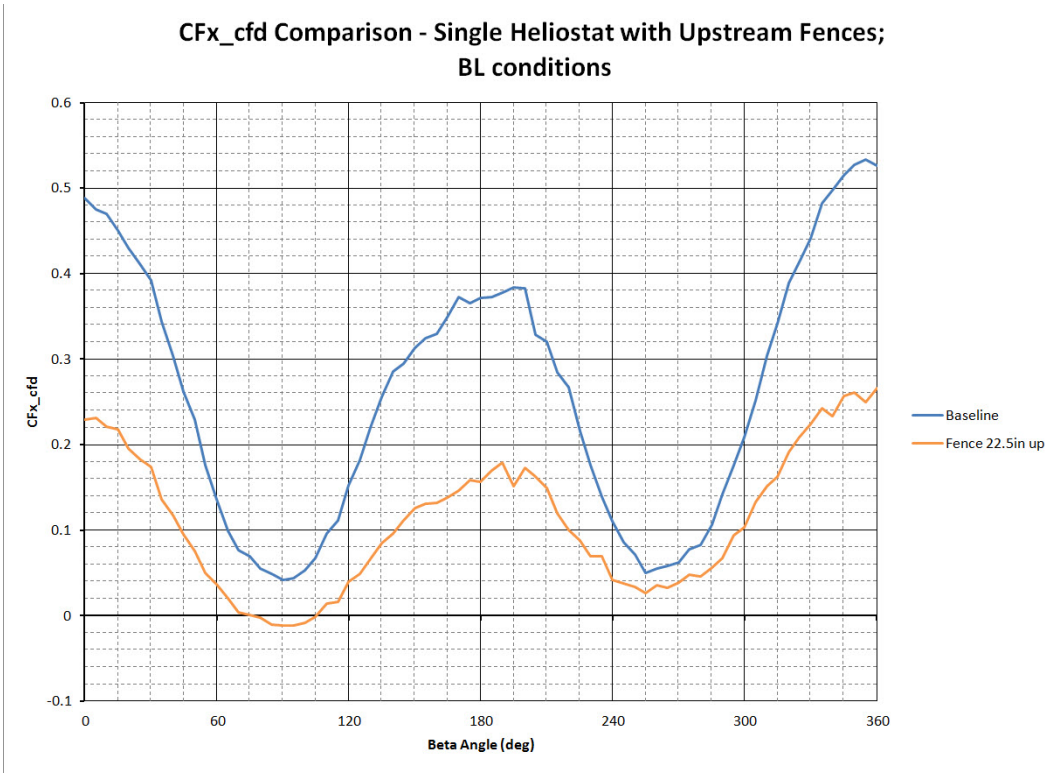

CMy_CFD, Heliostat Field @ 30 deg elevation angle, sparse vs dense field, Boundary Layer Flow
CMy_cfd
0.2
0.15
0.1
0.05
0
-0.05
-0.1
-0.15
0
60
120
180
240
300
360
Wind Angle, Beta (deg)
Dense - 1st Row
Sparse - 1st Row
Dense - 4th Row
Sparse - 4th Row

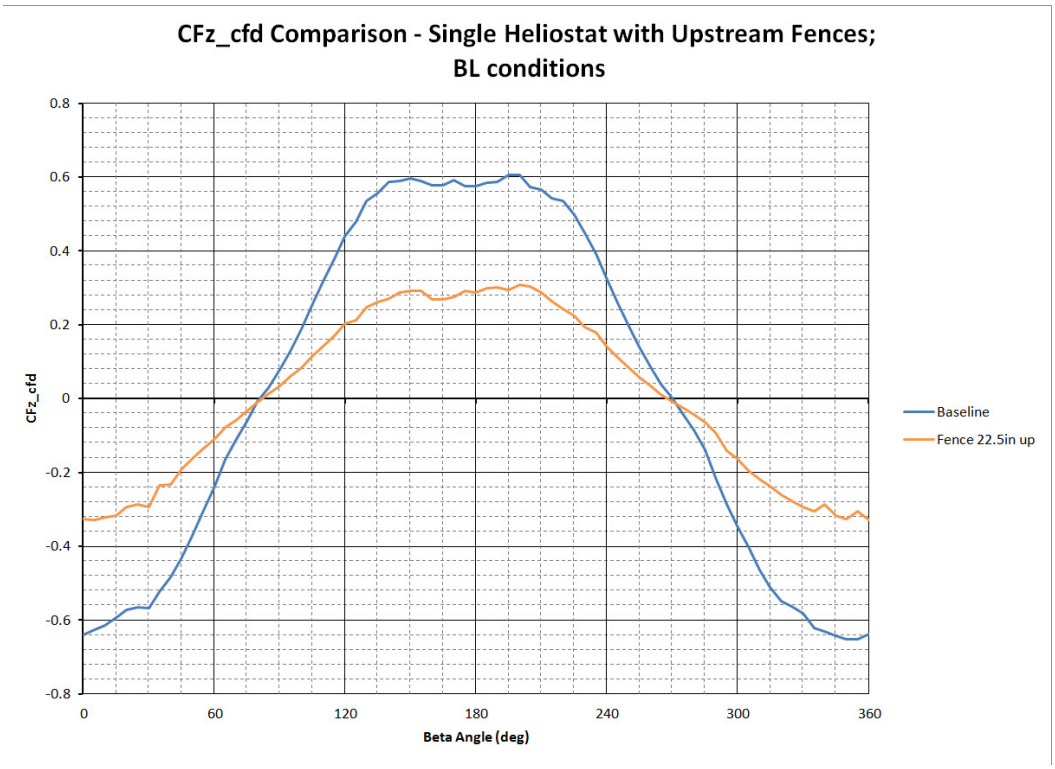

CMz_CFD, Heliostat Field @ 30 deg elevation angle, sparse vs dense field, Boundary Layer Flow
CMz_cfd
0.05
0.04
0.03
0.02
0.01
0
-0.01
-0.02
-0.03
-0.04
0
60
120
180
240
300
360
Wind Angle, Beta (deg)
Dense - 1st Row
Sparse - 1st Row
Dense - 4th Row
Sparse - 4th Row

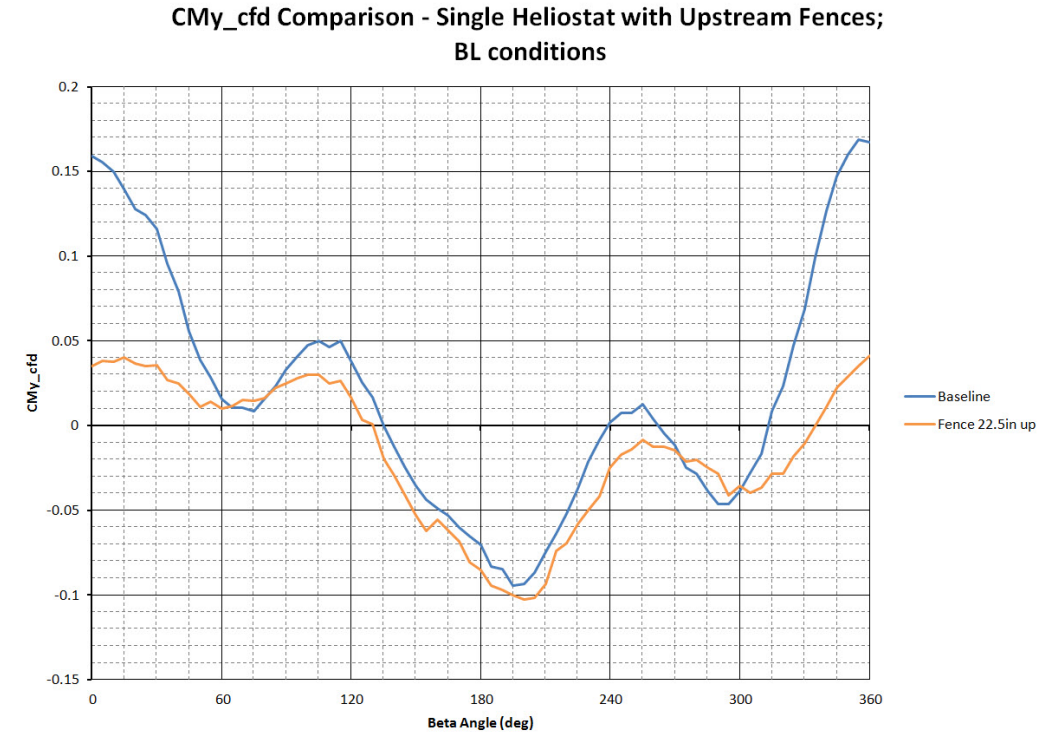
Mitigations

Single Heliostat with Upstream Fence

- **Heliostat Model Used:** 200mm x 200mm x 5mm reflector, HCL = 130mm
- **Fence model used:** 114mm tall, 47% open area, installed 571mm (2.85*H) upstream of the heliostat model
- **Test conditions were as follows:**
  - Wind Speed = 18.2 m/s (60 ft/s) (41 MPH)
  - Air Temperature = 23 C (74º F)
  - Air Density = 1.20 kg/m^3 (14.85 psia, as reported from tunnel conditions)
  - Elevation angles (α) tested: 30degrees
  - Wind incidence angles (β) tested: 0 - 360 deg in 5 degree increments

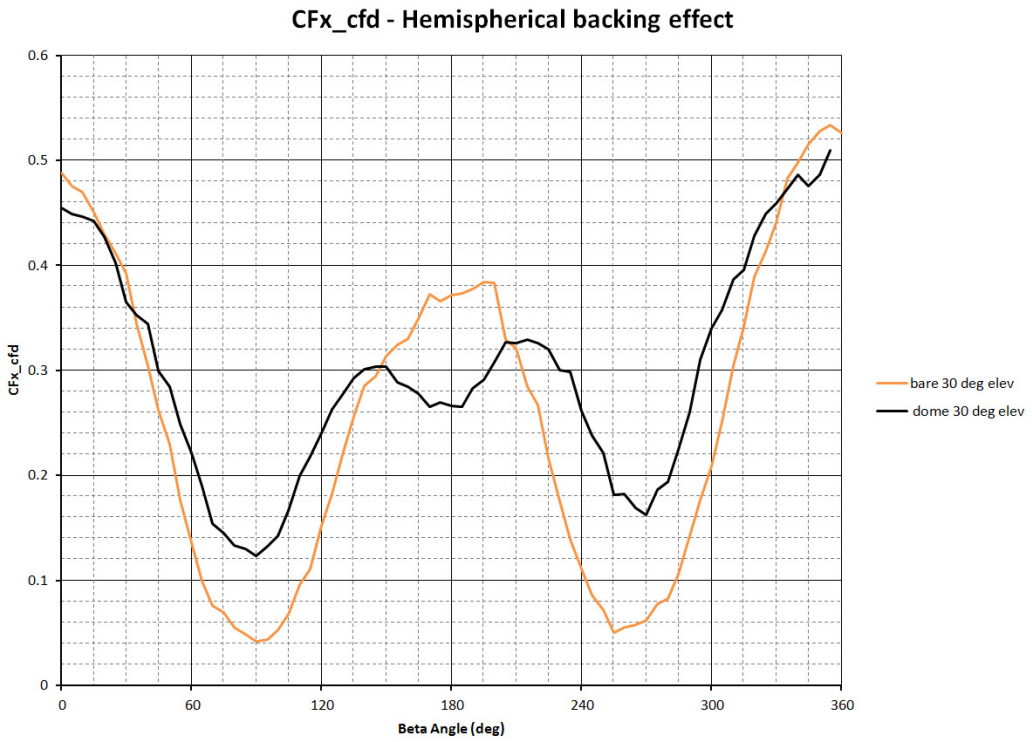


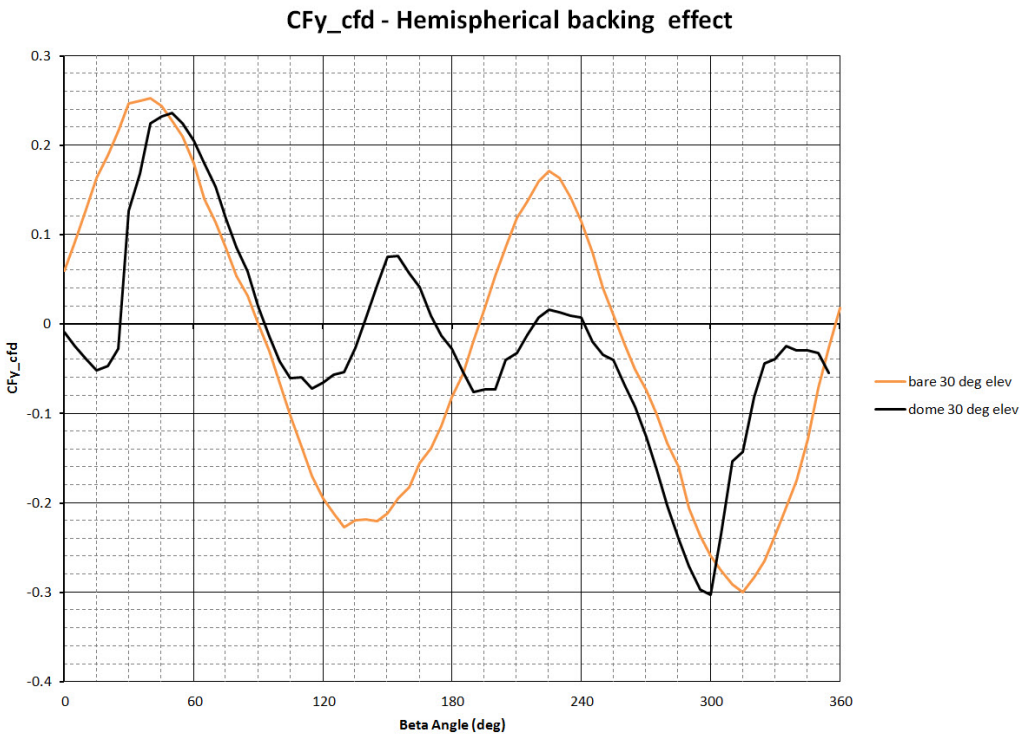


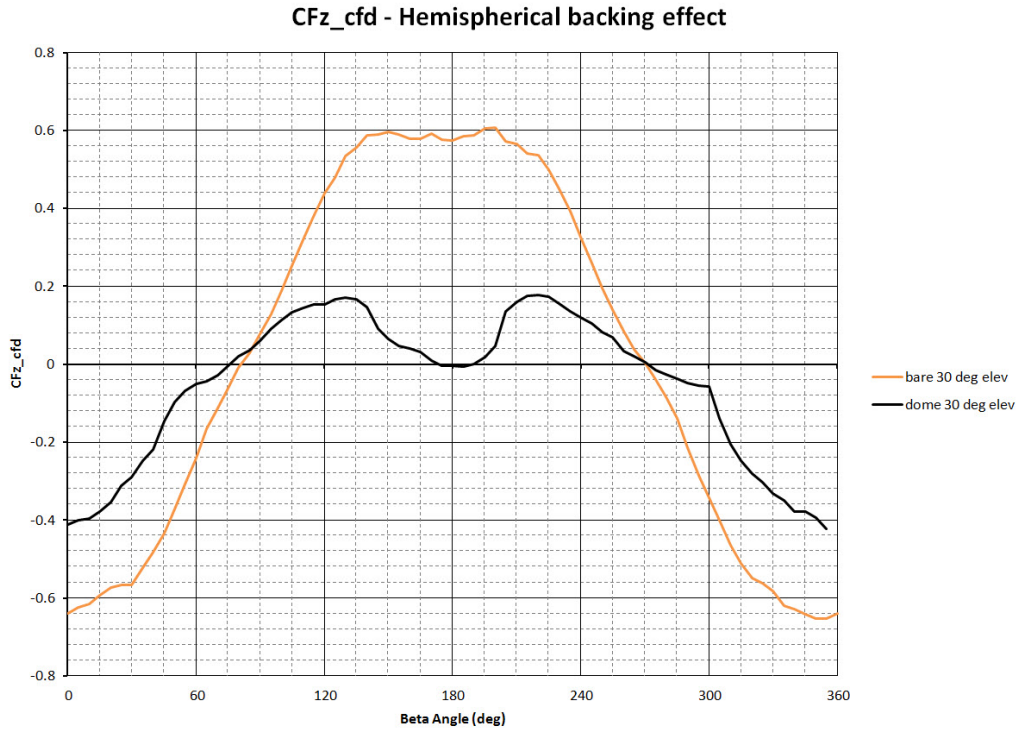


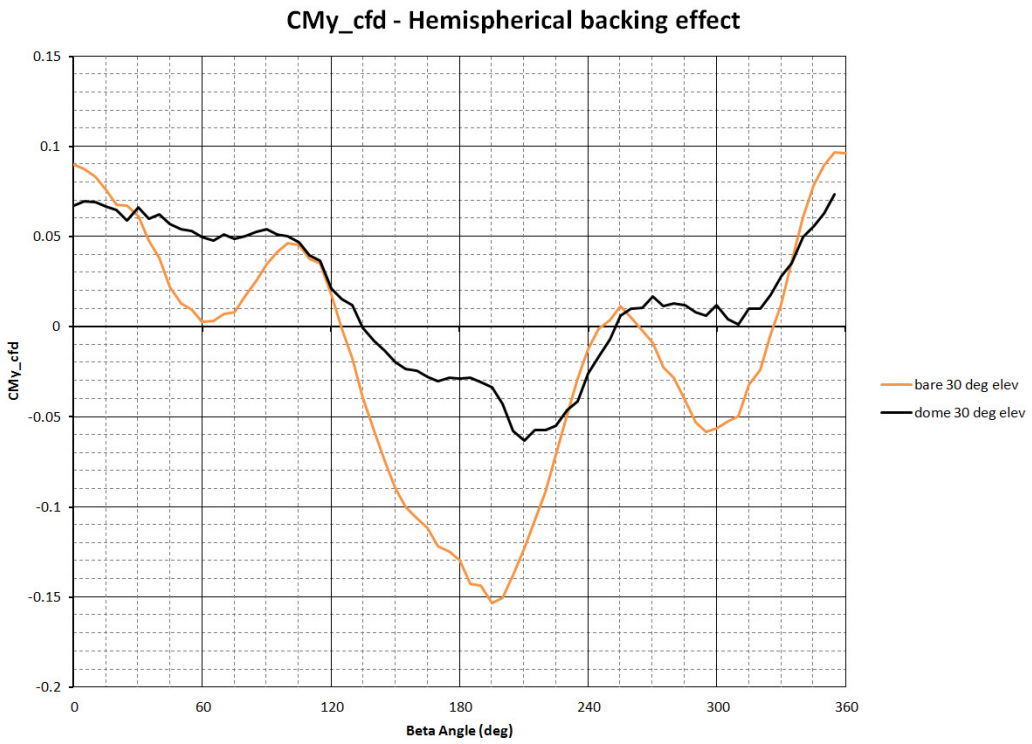
Hemispherical Backed Heliostat Experiments

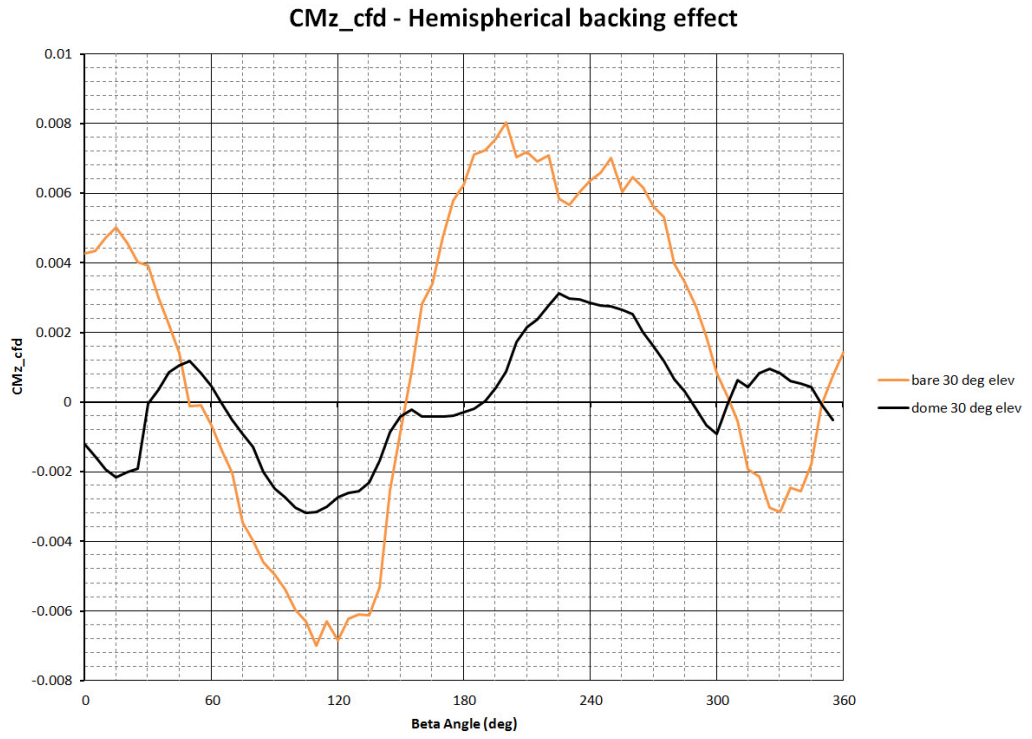
- **Heliostat Model Used:** 200mm x 200mm x 5mm reflector, HCL = 130mm
- **Hemispherical backing used:** 100mm peak height
- **Test conditions were as follows:**
    - Wind Speed = 18.2 m/s (60 ft/s) (41 MPH)
    - Air Temperature = 23 C (74º F)
    - Air Density = 1.20 kg/m^3 (14.85 psia, as reported from tunnel conditions)
    - Elevation angles (α) tested: 30degrees
    - Wind incidence angles (β) tested: 0 - 360 deg in 5 degree increments




CFy_cfd - Hemispherical backing effect
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
-0.4
CFy_cfd
0
60
120
180
240
300
360
Beta Angle (deg)
bare 30 deg elev
dome 30 deg elev

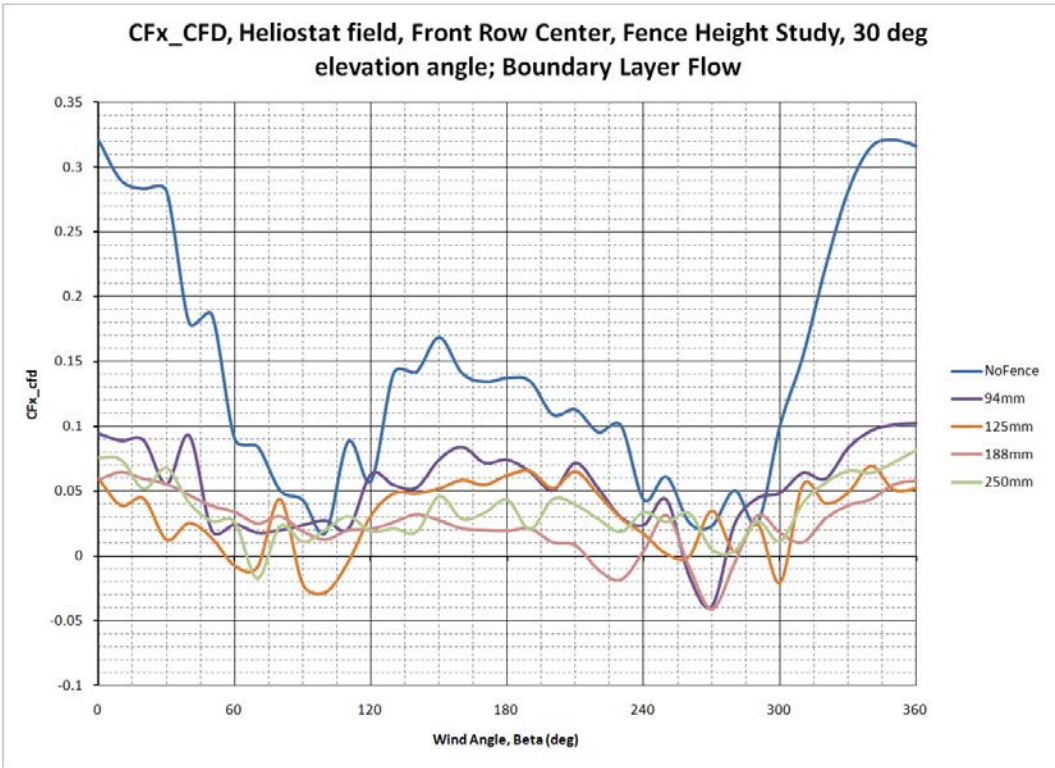

CFz_cfd - Hemispherical backing effect
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
CFz_cfd
0
60
120
180
240
300
360
Beta Angle (deg)
bare 30 deg elev
dome 30 deg elev

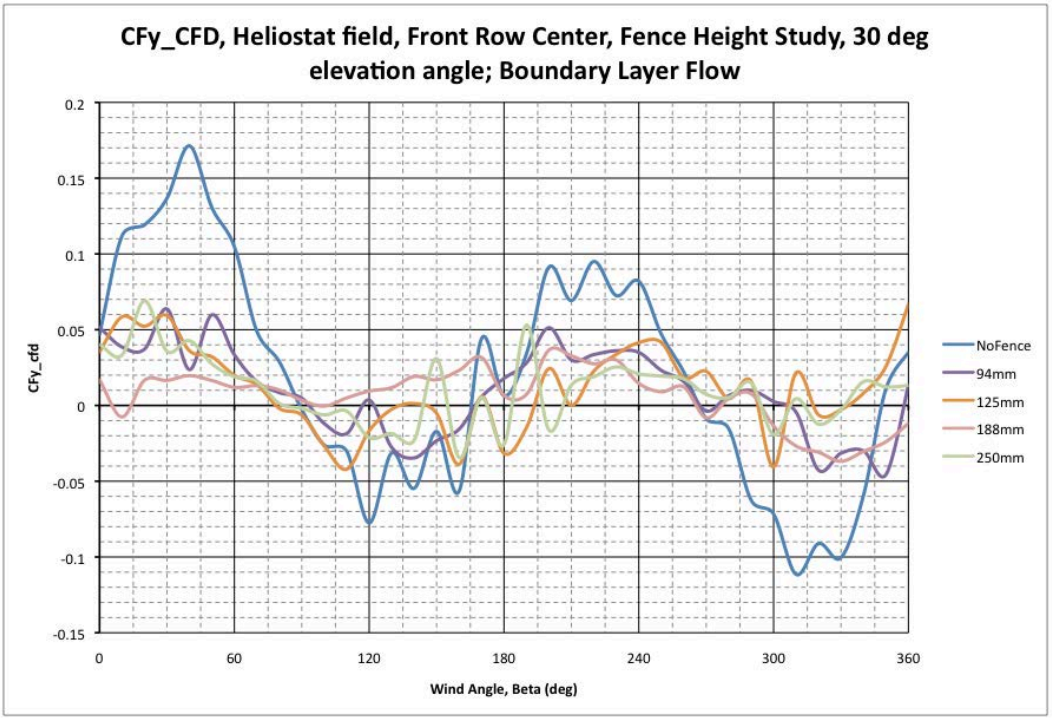

CMy_cfd - Hemispherical backing effect
0.15
0.1
0.05
0
-0.05
-0.1
-0.15
-0.2
CMy_cfd
0
60
120
180
240
300
360
Beta Angle (deg)
bare 30 deg elev
dome 30 deg elev

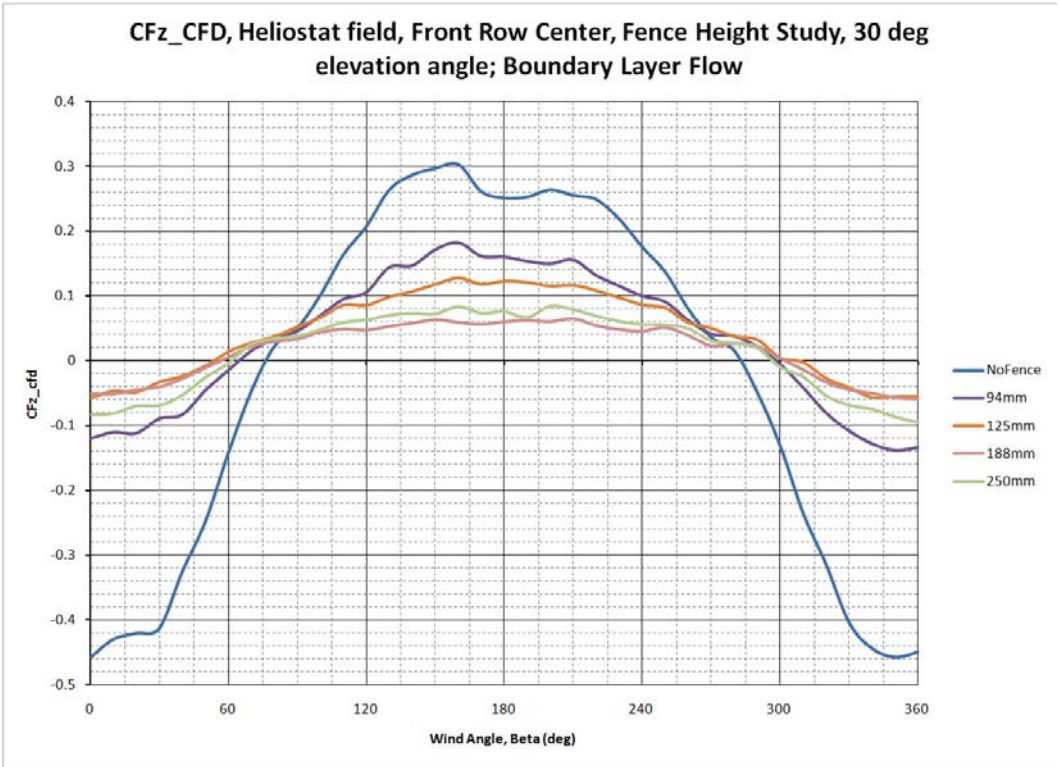

CMz_cfd - Hemispherical backing effect
0.01
0.008
0.006
0.004
0.002
0
-0.002
-0.004
-0.006
-0.008
CMz_cfd
0
60
120
180
240
300
360
Beta Angle (deg)
bare 30 deg elev
dome 30 deg elev

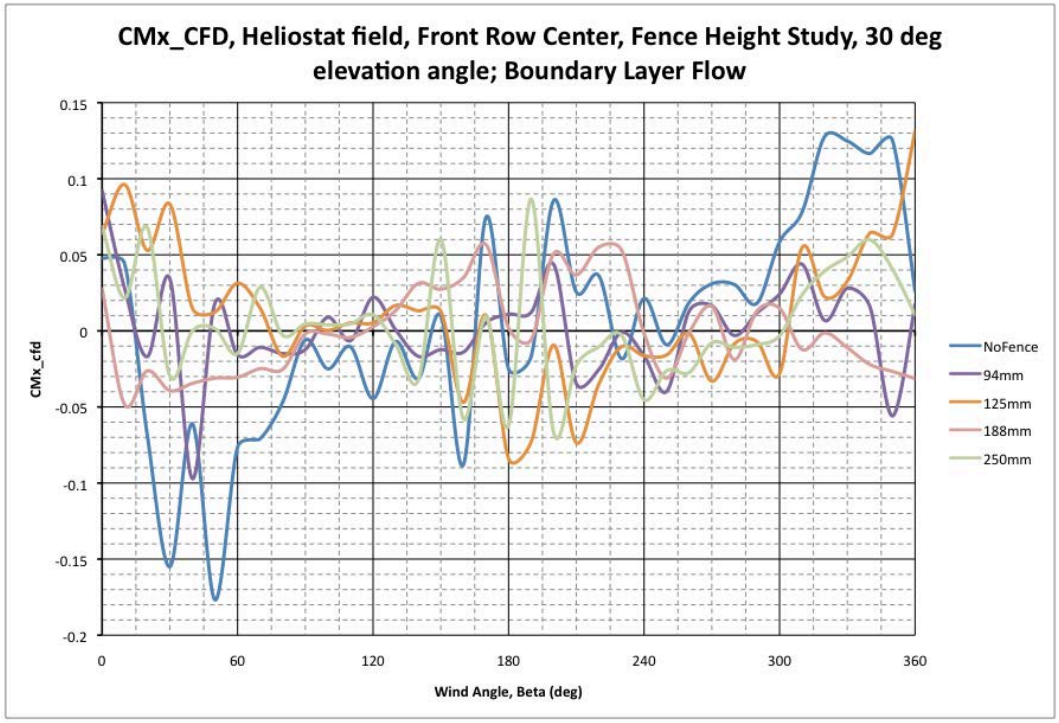
Fence Height Experiments

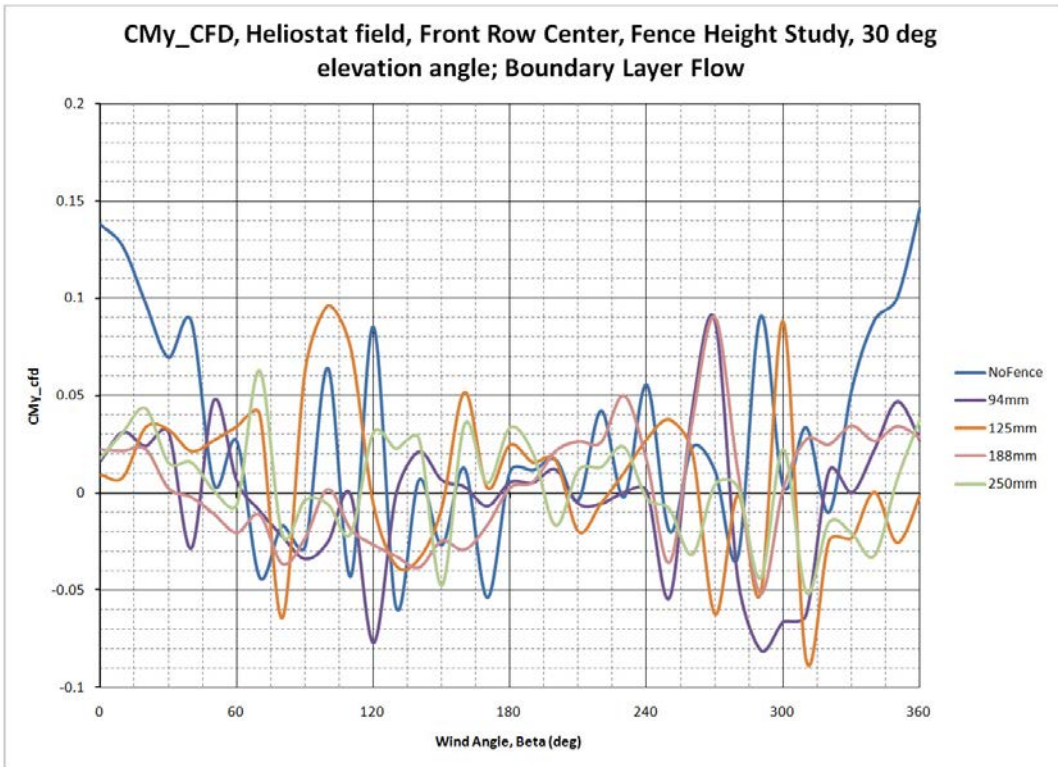
- **Heliostat Model Used:** 100mm x 100mm x 3mm reflector, HCL = 75mm
- **Fence Model Used:** 94mm, 125mm, 188mm, 250mm tall, 46% OA
- **Test conditions were as follows:**
    - Q = 0.95 kPa (20psf)
    - Wind Speed = 40 m/s (132 ft/s)
    - Air Temperature = 23 C (74° F)
    - Air Density = 1.20 kg/m^3 (14.85 psia, as reported from tunnel conditions)
    - Elevation angles (alpha) tested: 30, 0 degrees
    - Azimuth angles (beta) tested: 0 - 360 deg in 5 degree increments
    - Instrumented field positions: 1st row, 4th row

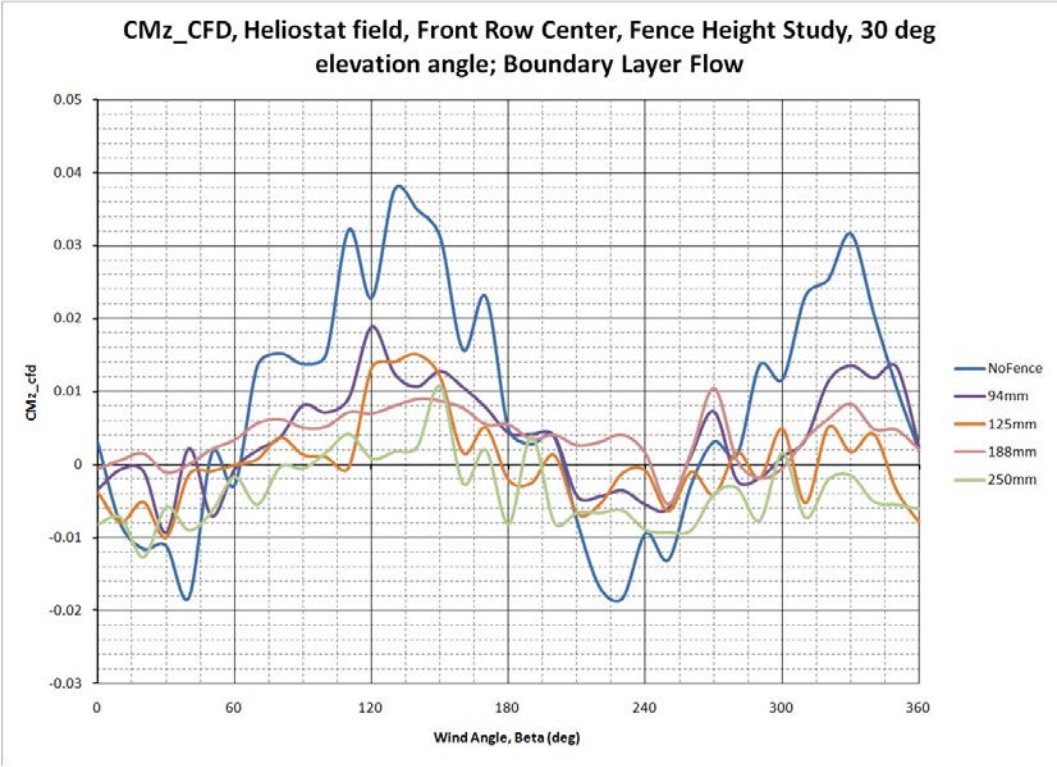



CFy_CFD, Heliostat field, Front Row Center, Fence Height Study, 30 deg elevation angle; Boundary Layer Flow
CFy_cfd
0.2
0.15
0.1
0.05
0
-0.05
-0.1
-0.15
0
60
120
180
240
300
360
Wind Angle, Beta (deg)
NoFence
94mm
125mm
188mm
250mm


CFz_CFD, Heliostat field, Front Row Center, Fence Height Study, 30 deg elevation angle; Boundary Layer Flow
CFz_cfd
0.4
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
-0.4
-0.5
0
60
120
180
240
300
360
Wind Angle, Beta (deg)
NoFence
94mm
125mm
188mm
250mm

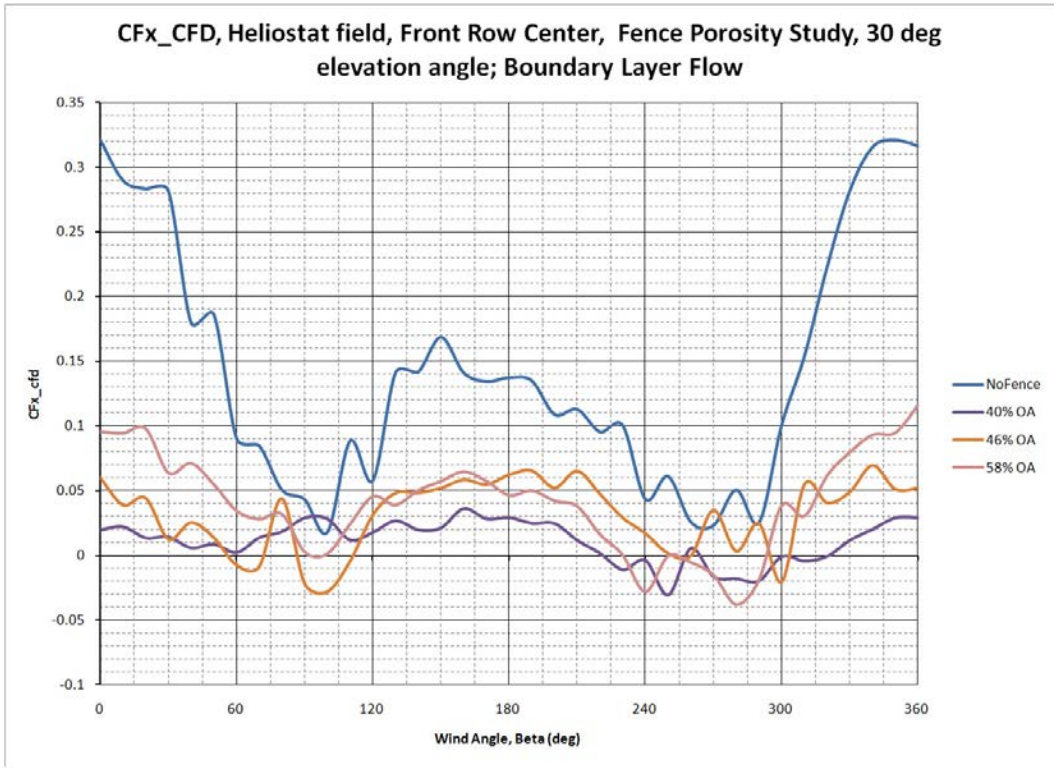

CMx_CFD, Heliostat field, Front Row Center, Fence Height Study, 30 deg elevation angle; Boundary Layer Flow
0.15
0.1
0.05
0
-0.05
-0.1
-0.15
-0.2
CMx_cfd
0
60
120
180
240
300
360
Wind Angle, Beta (deg)
NoFence
94mm
125mm
188mm
250mm

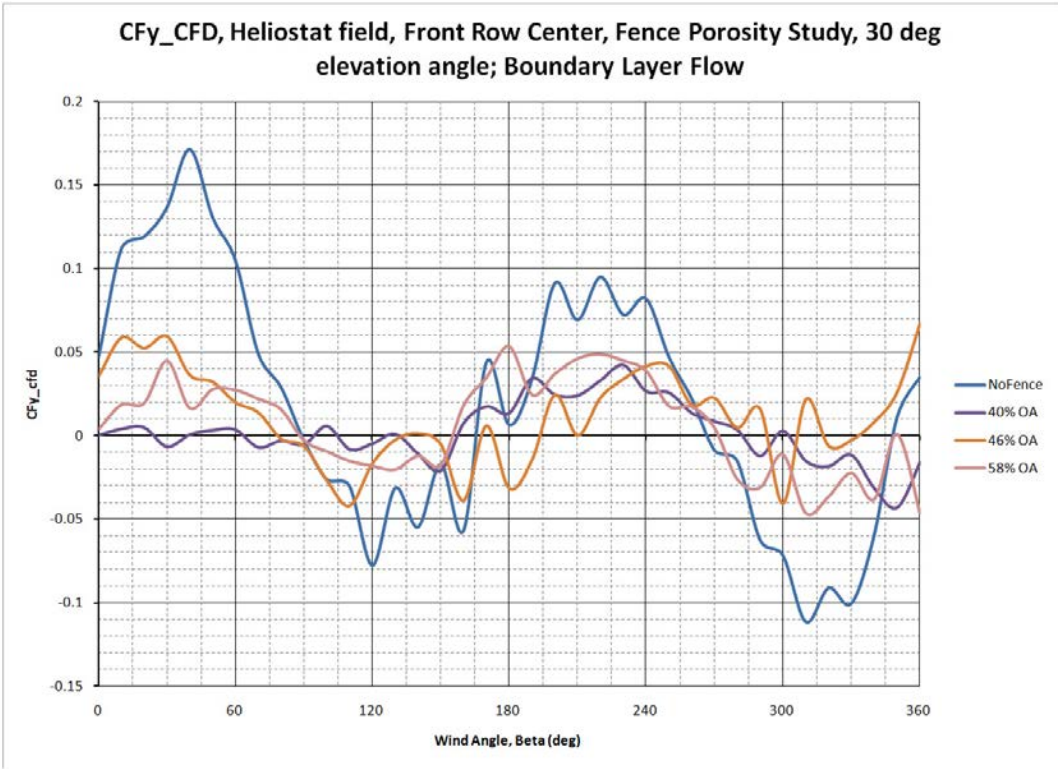

CMy_CFD, Heliostat field, Front Row Center, Fence Height Study, 30 deg elevation angle; Boundary Layer Flow
0.2
0.15
0.1
0.05
0
-0.05
-0.1
CMy_cfd
0
60
120
180
240
300
360
Wind Angle, Beta (deg)
NoFence
94mm
125mm
188mm
250mm

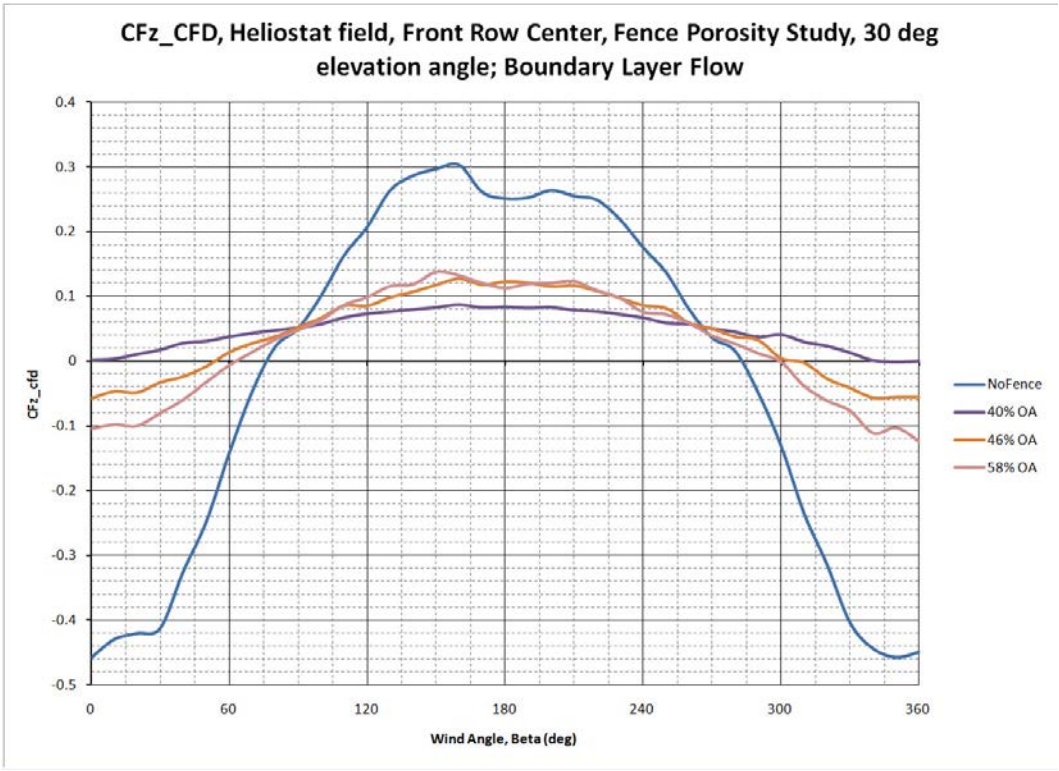


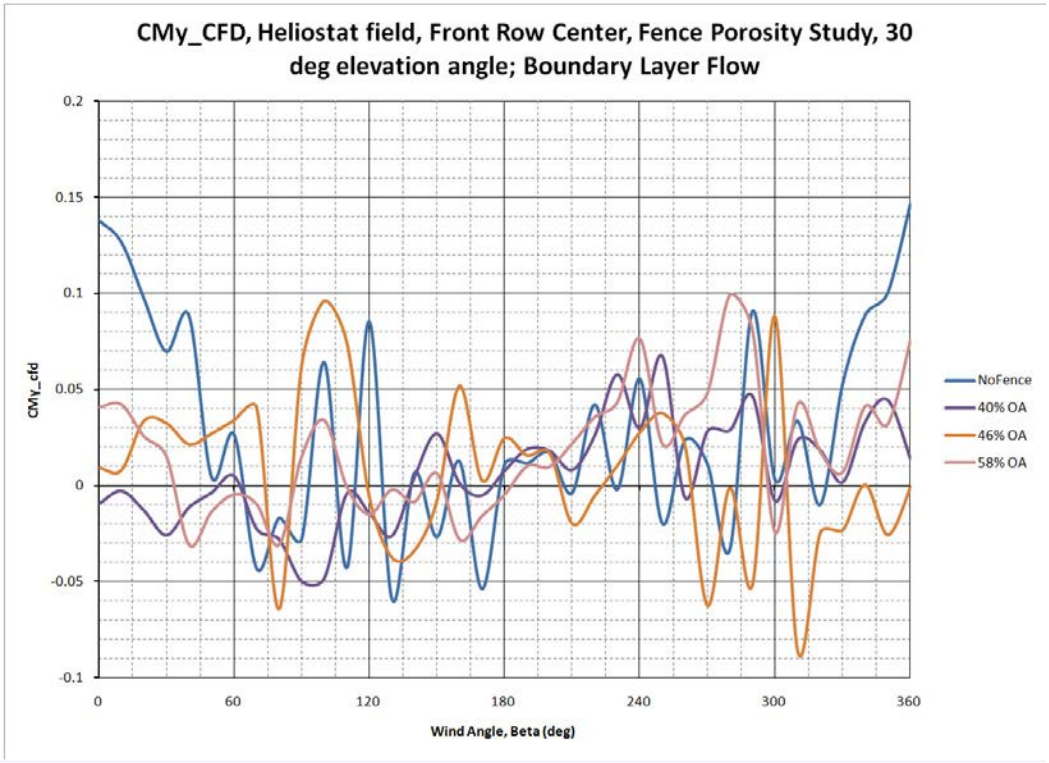
Fence Porosity Experiments

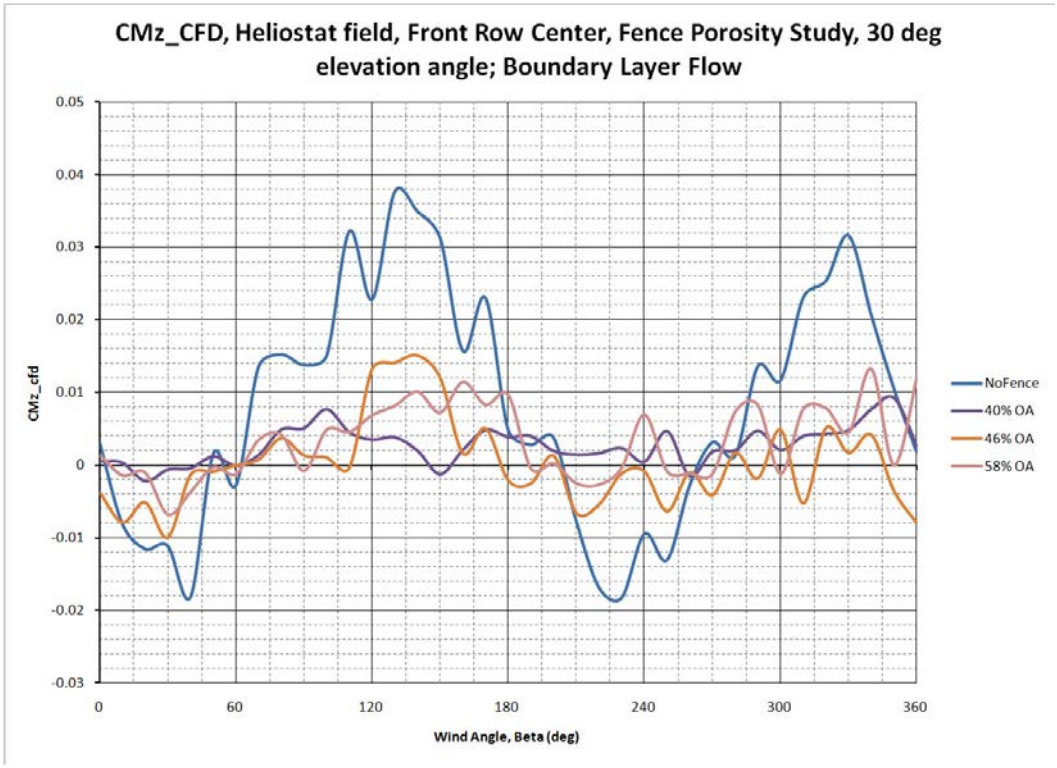
- **Heliostat Model Used:** 100mm x 100mm x 3mm reflector, HCL = 75mm
- **Fence Model Used:** 125mm tall, 40%OA, 46% OA, 58%OA
- **Test conditions were as follows:**
    - Q = 0.95 kPa (20psf)
    - Wind Speed = 40 m/s (132 ft/s)
    - Air Temperature = 23 C (74° F)
    - Air Density = 1.20 kg/m^3 (14.85 psia, as reported from tunnel conditions)
    - Elevation angles (alpha) tested: 30 degrees
    - Azimuth angles (beta) tested: 0 - 360 deg in 5 degree increments
    - Instrumented field positions: 1st row


CFx_CFD, Heliostat field, Front Row Center, Fence Porosity Study, 30 deg elevation angle; Boundary Layer Flow
CFx_cfd
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
-0.05
-0.1
0
60
120
180
240
300
360
Wind Angle, Beta (deg)
NoFence
40% OA
46% OA
58% OA


CFy_CFD, Heliostat field, Front Row Center, Fence Porosity Study, 30 deg elevation angle; Boundary Layer Flow
CFy_cfd
0.2
0.15
0.1
0.05
0
-0.05
-0.1
-0.15
0
60
120
180
240
300
360
Wind Angle, Beta (deg)
NoFence
40% OA
46% OA
58% OA


CFz_CFD, Heliostat field, Front Row Center, Fence Porosity Study, 30 deg elevation angle; Boundary Layer Flow
CFz_cfd
0.4
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
-0.4
-0.5
0
60
120
180
240
300
360
Wind Angle, Beta (deg)
NoFence
40% OA
46% OA
58% OA


CMy_CFD, Heliostat field, Front Row Center, Fence Porosity Study, 30 deg elevation angle; Boundary Layer Flow
CMy_cfd
0.2
0.15
0.1
0.05
0
-0.05
-0.1
0
60
120
180
240
300
360
Wind Angle, Beta (deg)
NoFence
40% OA
46% OA
58% OA


CMz_CFD, Heliostat field, Front Row Center, Fence Porosity Study, 30 deg elevation angle; Boundary Layer Flow
CMz_cfd
0.05
0.04
0.03
0.02
0.01
0
-0.01
-0.02
-0.03
0
60
120
180
240
300
360
Wind Angle, Beta (deg)
NoFence
40% OA
46% OA
58% OA