Gemeente Texel .txl

Behoort bij besluit van
Burgemeester en Wethouders van Texel,
zaaknummer: 3782945
kenmerk document: bijlage 8/10
namens de burgemeester en wethouders van Texel,

de heer R.J. Nieuwenhuijzen
teamleider Vergunningen, Toezicht & Handhaving a.i.

Bijlage E

DIANA FEM model

Royal HaskoningDHV
Enhancing Society Together

Lighthouse Texel - Radar frame

Pallavi Palla

2023-09-26

Table of Contents

General 1
Project information 1
Units 1
Geometry 2
Shapes 2
Geometry support sets 2
Bottom Supports 2
Materials & Cross-sections 2
Material: S235 2
Geometry: CHS139x12-Profile 3
Supports 3
Loading 3
Geometry load 'P-Dead Load-Z' 3
Geometry load 'P-Self weight-Z' 4
Geometry load 'V-Wind Load-X' 4
Geometry load 'V-Wind Load-XY' 5
Mesh 7
Analysis 7
Analysis: Linear Elastic 7
Definition 7
Results 9

General

Project information

Diana project name	C:\921093- Royal HaskoningDHVIslands-109-wad-ri\20230926140741-vFinal- New Radar-PPA/New Radar.dpf
Analysis aspects	['Structural']
Model dimension	['Three dimensional']
Default mesher type	HEXQUAD
Default mesher order	LINEAR
Diana version	Diana 10.5, Latest update: 2021-08-23 15:34:26
System	Windows NT 6.2 Build 9200

Units

The following units are applied

Quantity	Unit	Symbol
Length	meter	m
Mass	ton	T
Force	kilonewton	kN
Time	second	s
Temperature	kelvin	K
Angle	degree	°

Geometry

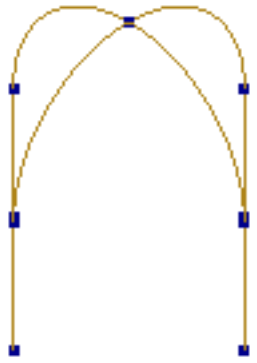




Figure 1: Structure

The model consists of the following shapes, reinforcements, piles and interfaces:

Shapes

Name	Set	Element Class	Material	Geometry	Seeding method	Element size [m]	Division
RadarFrame-Column-1	Shapes	CLS1B3	S235	CHS139x12-Profile	ElementSize	0.05	0
RadarFrame-Column-2	Shapes	CLS1B3	S235	CHS139x12-Profile	ElementSize	0.05	0
RadarFrame-Column-3	Shapes	CLS1B3	S235	CHS139x12-Profile	ElementSize	0.05	0
RadarFrame-Column-4	Shapes	CLS1B3	S235	CHS139x12-Profile	ElementSize	0.05	0
RadarFrame-Arc-1	Shapes	CLS1B3	S235	CHS139x12-Profile	ElementSize	0.05	0
RadarFrame-Arc-2	Shapes	CLS1B3	S235	CHS139x12-Profile	ElementSize	0.05	0
RadarFrame-Arc-3	Shapes	CLS1B3	S235	CHS139x12-Profile	ElementSize	0.05	0
RadarFrame-Arc-4	Shapes	CLS1B3	S235	CHS139x12-Profile	ElementSize	0.05	0

Geometry support sets

Bottom Supports

Name	Target	Translation	Rotation
Fixed Point-Support	POINT	X,Y,Z	X,Y,Z

Materials & Cross-sections

Material: S235

Name	Value
Material class	Steel
Material model	Linear elastic isotropic
Color	steelblue
Young’s modulus	2.1e+08 kN/m2
Poisson’s ratio	0.3
Mass density	7.85 T/m3

Geometry: CHS139x12-Profile

Name	Value
Geometry class	Lines
Geometry model	3D Class-I beam elements
Cross-section definition type	Predefined profiles
Shape	Circular pipe
Dimensions of a circular pipe	0.139 0.012 m

Supports

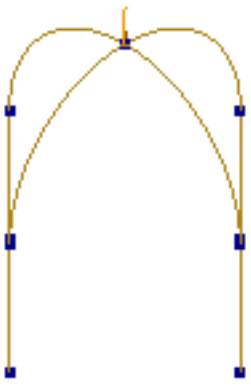
Name	Value
Support name	Fixed Point-Support
Points	vertex of “RadarFrame-Column-1” (2.3, 0, 40),vertex of “RadarFrame-Column-2” (1.40834e-16, 2.3, 40),vertex of “RadarFrame-Column-3” (-2.3, 2.81669e-16, 40),vertex of “RadarFrame-Column-4” (-4.22503e-16, -2.3, 40)
Coordinate system	1 2
Fixed translations	1 1 1
Fixed rotations	1 1 1

Loading

Load Combination	P-Dead Load-Z	V-Wind Load-X	V-Wind Load-XY	P-Self weight-Z
Dead Load Governing	1.2	0	0	1.2
Wind Load X Governing (DL Favourable)	0.9	1.3	0	0
Wind Load X Governing (DL Unfavourable)	1.1	1.3	0	0
Wind Load XY Governing (DL Favourable)	0.9	0	1.3	0
Wind Load XY Governing (DL Unfavourable)	1.1	0	1.3	0
Self Weight Only	1	0	0	1

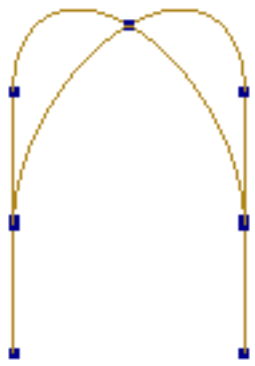
Geometry load ‘P-Dead Load-Z’

Name	Target	Type	Direction	DOF	Value	Unit
Self-weight	model	WEIGHT				
F-z-G-RadarInstallation	POINT	FORCE	Z		-5.5	kN



Geometry load ‘P-Self weight-Z’

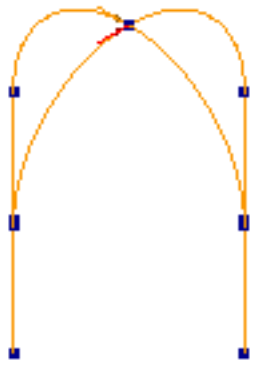
Name	Target	Type	Direction	DOF	Value	Unit
Self weight	model	WEIGHT				





Geometry load ‘V-Wind Load-X’

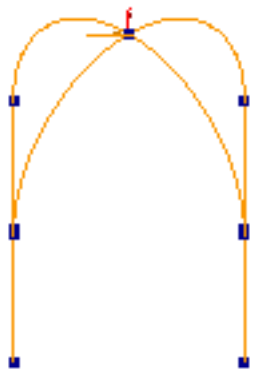
Name	Target	Type	Direction	DOF	Value	Unit
F-x-W-RadarInstallation	POINT	FORCE	X		19	kN
M-y-W-RadarInstallation	POINT	MOMENT	Y		26	kNm
q-x-W-RadarFrame	LINE	FORCE	X		0.35	kN/m
q-x-W-RadarFrame-Parallel	LINE	FORCE	X		0.22	kN/m





Geometry load ‘V-Wind Load-XY’

Name	Target	Type	Direction	DOF	Value	Unit
F-xy-W-RadarInstallation	POINT	FORCE	XY		19	kN
M-yx-W-RadarInstallation	POINT	MOMENT	YX		26	kNm
q-xy-W-RadarFrame	LINE	FORCE	XY		0.35	kN/m
q-xy-W-RadarFrame-Resultant45	LINE	FORCE	XY		0.28	kN/m





Name	Value
Load name	F-x-W-RadarInstallation
Load type	Force
Loaded point(s)	vertex of “RadarFrame-Arc-1” (1.40834e-16, 0, 44.5)
Force value	18.8 kN
Force load direction	1

Name	Value
Load name	F-xy-W-RadarInstallation
Load type	Force
Loaded point(s)	vertex of “RadarFrame-Arc-1” (1.40834e-16, 0, 44.5)
Force value	18.8 kN
Force load direction	4

Name	Value
Load name	F-z-G-RadarInstallation
Load type	Force
Loaded point(s)	vertex of “RadarFrame-Arc-1” (1.40834e-16, 0, 44.5)
Force value	-5.5 kN
Force load direction	3

Name	Value
Load name	M-y-W-RadarInstallation
Load type	Moment
Loaded point(s)	vertex of “RadarFrame-Arc-1” (1.40834e-16, 0, 44.5)
Moment value	25.71 kNm

Direction of moment (around)	2

Name	Value
Load name	M-yx-W-RadarInstallation
Load type	Moment
Loaded point(s)	vertex of “RadarFrame-Arc-1” (1.40834e-16, 0, 44.5)
Moment value	25.71 kNm
Direction of moment (around)	5

Name	Value
Load name	Self weight
Load type	Dead weight

Name	Value
Load name	Self-weight
Load type	Dead weight

Name	Value
Load name	q-x-W-RadarFrame
Load type	Distributed force
Loaded line	edge of “RadarFrame-Column-1” (2.3, 0, 41.1),edge of “RadarFrame-Column-2” (1.40834e-16, 2.3, 41.1),edge of “RadarFrame-Column-3” (-2.3, 2.81669e-16, 41.1),edge of “RadarFrame-Column-4” (-4.22503e-16, -2.3, 41.1),edge of “RadarFrame-Arc-2” (9.95849e-17, 1.62635, 43.8263),edge of “RadarFrame-Arc-4” (-2.98755e-16, -1.62635, 43.8263)
Distributed force value	0.346444 kN/m
Force load direction	1

Name	Value
Load name	q-x-W-RadarFrame-Parallel
Load type	Distributed force
Loaded line	edge of “RadarFrame-Arc-1” (1.62635, 0, 43.8263),edge of “RadarFrame-Arc-3” (-1.62635, 1.9917e-16, 43.8263)
Distributed force value	0.220553 kN/m
Force load direction	1

Name	Value
Load name	q-xy-W-RadarFrame
Load type	Distributed force
Loaded line	edge of “RadarFrame-Column-1” (2.3, 0, 41.1),edge of “RadarFrame-Column-2” (1.40834e-16, 2.3, 41.1),edge of “RadarFrame-Column-3” (-2.3, 2.81669e-16, 41.1),edge of “RadarFrame-Column-4” (-4.22503e-16, -2.3, 41.1)
Distributed force value	0.346444 kN/m
Force load direction	4

Name	Value
Load name	q-xy-W-RadarFrame-Resultant45
Load type	Distributed force
Loaded line	edge of “RadarFrame-Arc-1” (1.62635, 0, 43.8263),edge of “RadarFrame-Arc-2” (9.95849e-17, 1.62635, 43.8263),edge of “RadarFrame-Arc-3” (-1.62635, 1.9917e-16, 43.8263),edge of “RadarFrame-Arc-4” (-2.98755e-16, -1.62635, 43.8263)
Distributed force value	0.283498 kN/m
Force load direction	4

Mesh

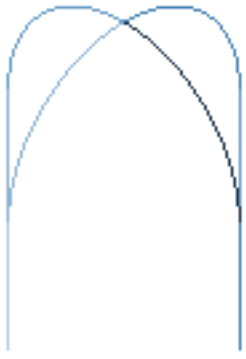




Figure 2: Structure

Analysis

Analysis: Linear Elastic

Definition

Structural linear static - default
Structural linear static
Evaluate model
Evaluate elements
Average nodal normals
Tolerance angle = 20
Evaluate composed elements
Assemble Elements
Degree of freedom tolerance = 1e-06
Setup element stiffness matrices
Setup load vectors
Solve the system of equations
Method = Parallel Direct Sparse
Convergence tolerance = 1e-08
Parallel Direct Sparse
Factorization
Output linear static analysis
Output linear static analysis
Device = DIANA native
Option = Binary
Seltyp = PRIMAR
Select
Blknam = OUTPUT
Modsel = Complete
Loads
User selection = ALL
Casety = LOADS
Primar

Structural linear static - additional
Structural linear static
Evaluate model
Evaluate elements
Average nodal normals
Tolerance angle = 20
Evaluate composed elements
Assemble Elements
Degree of freedom tolerance = 1e-06
Setup element stiffness matrices
Setup load vectors
Solve the system of equations
Method = Parallel Direct Sparse
Convergence tolerance = 1e-08
Parallel Direct Sparse
Factorization
Output linear static analysis
Output linear static analysis
Device = DIANA native
Option = Binary
Seltyp = USER
Select
Blknam = OUTPUT
Modsel = Complete
Loads
User selection = ALL
Casety = LOADS
User
Strains
Strains
Form = GREEN
Oper = VONMIS
Type = TOTAL
Total
Strains
Form = GREEN
Oper = PRINCI
Type = TOTAL
Total
Stresses
Stresses
Form = CAUCHY
Oper = VONMIS
Type = TOTAL
Total
Stresses
Form = CAUCHY
Oper = LOCAL
Type = TOTAL
Total
Forces
Forces
Form = ROTATI
Oper = GLOBAL
Type = REACTI
Reaction
Forces
Form = TRANSL
Oper = LOCAL
Type = REACTI

Reaction Forces
Form = TRANSL
Oper = GLOBAL
Type = REACTI
Reaction Forces
Form = TRANSL
Oper = LOCAL
Type = EXTERN
External

Results

GENERAL

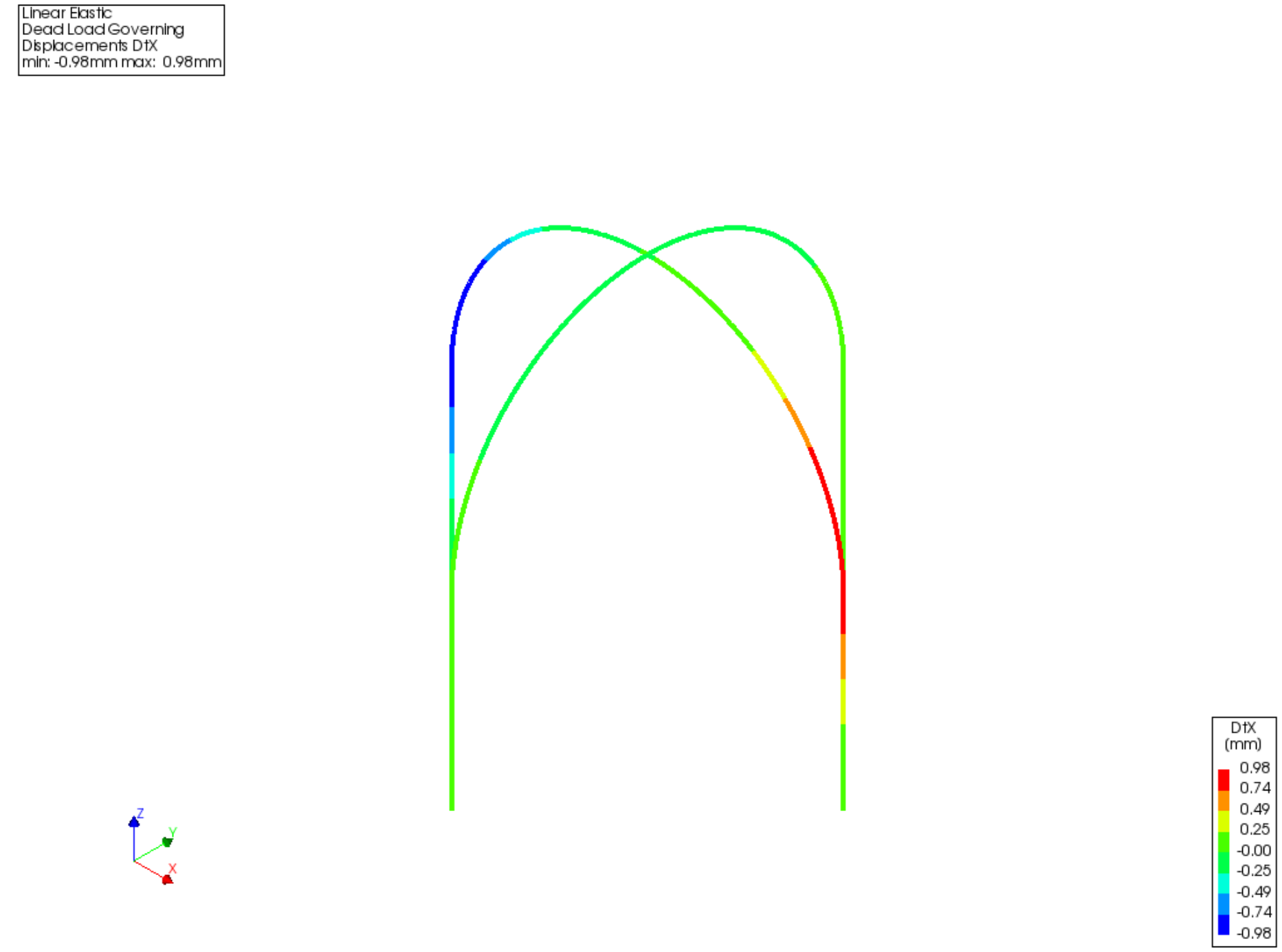


Figure 1: General - Displacement DtX - Dead Load Governing

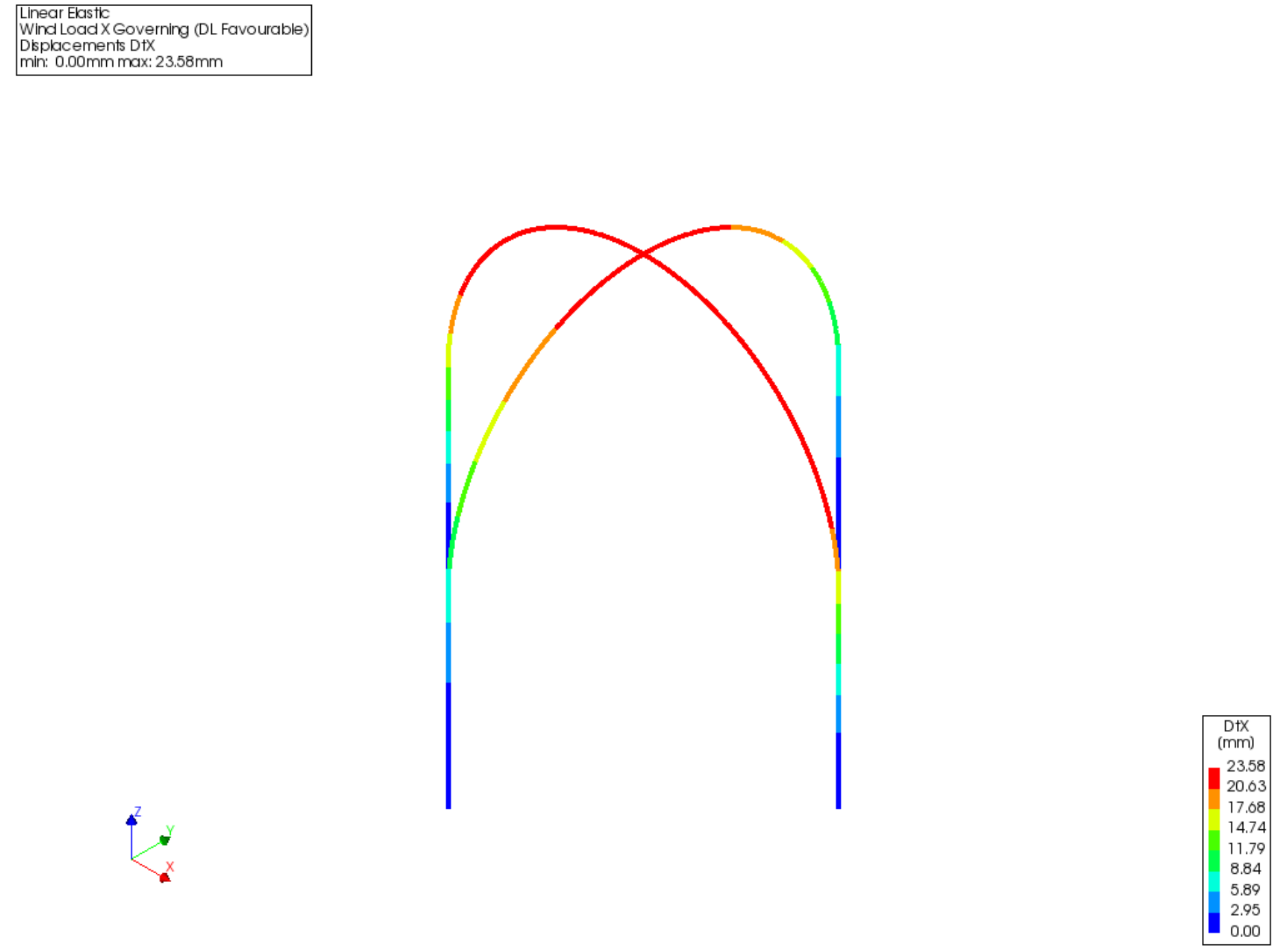


Figure 2: General - Displacement DtX - Wind Load X Governing (DL Favourable)

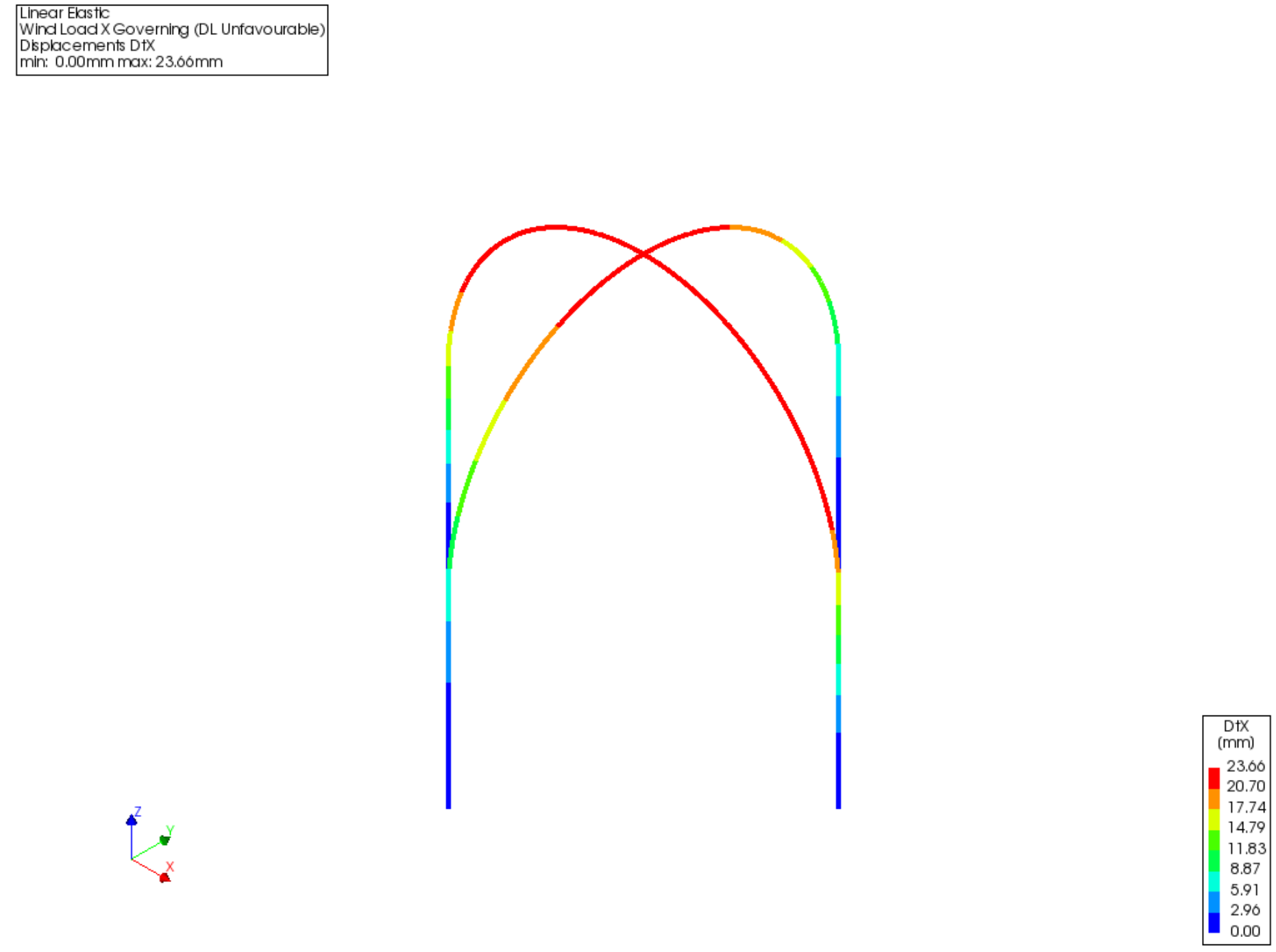


Figure 3: General - Displacement DtX - Wind Load X Governing (DL Unfavourable)

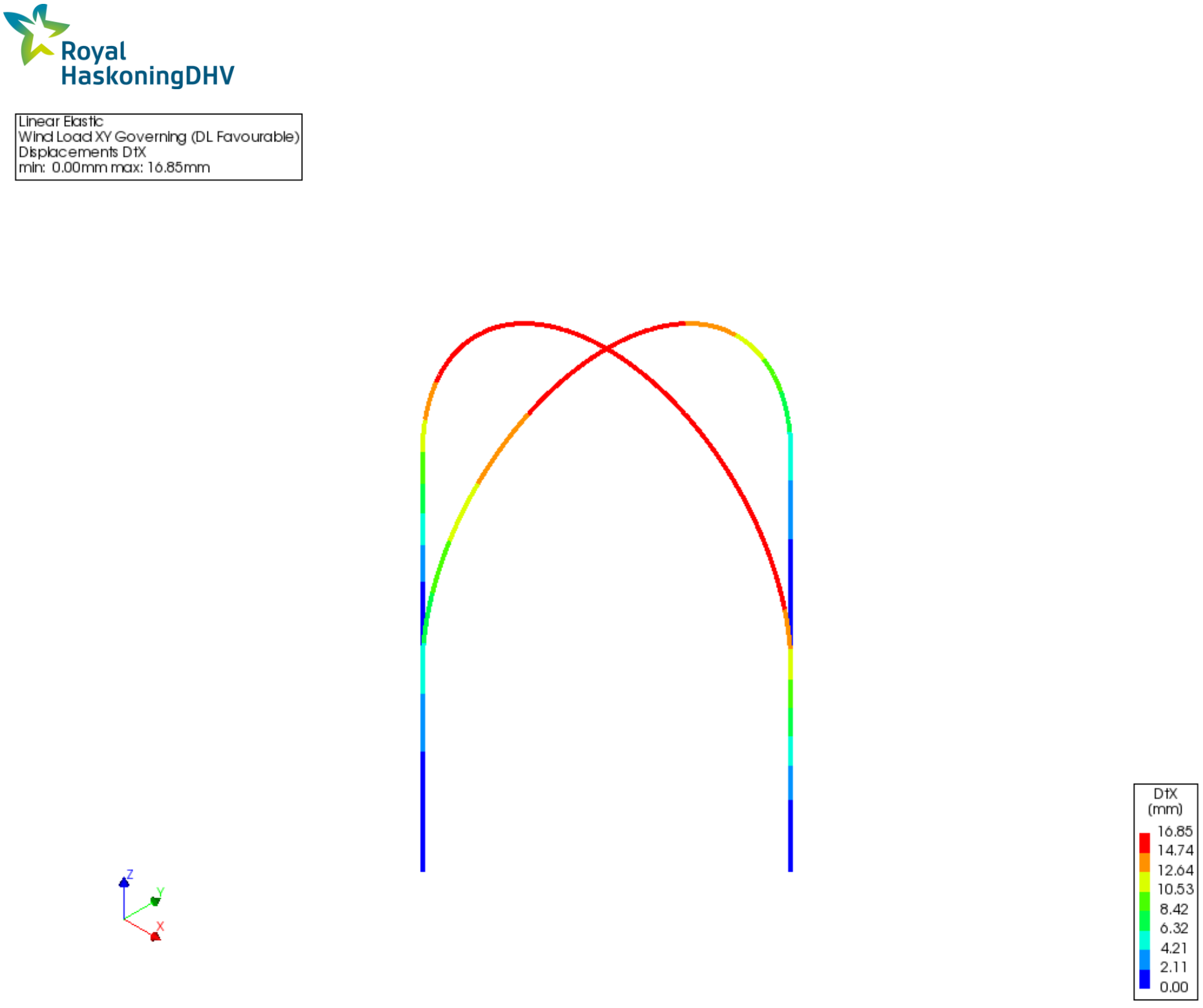


Figure 4: General - Displacement DtX - Wind Load XY Governing (DL Favourable)

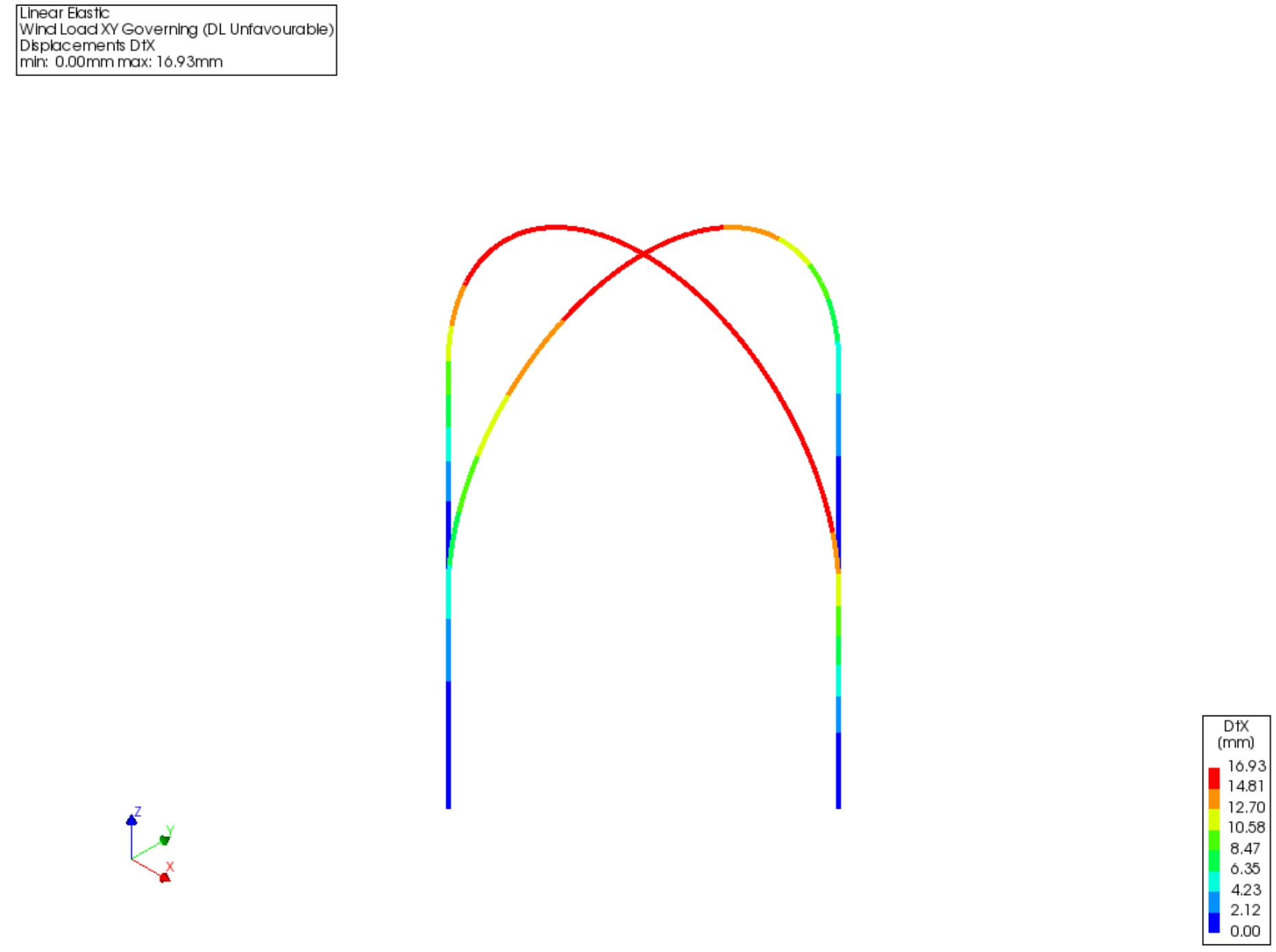


Figure 5: General - Displacement DtX - Wind Load XY Governing (DL Unfavourable)

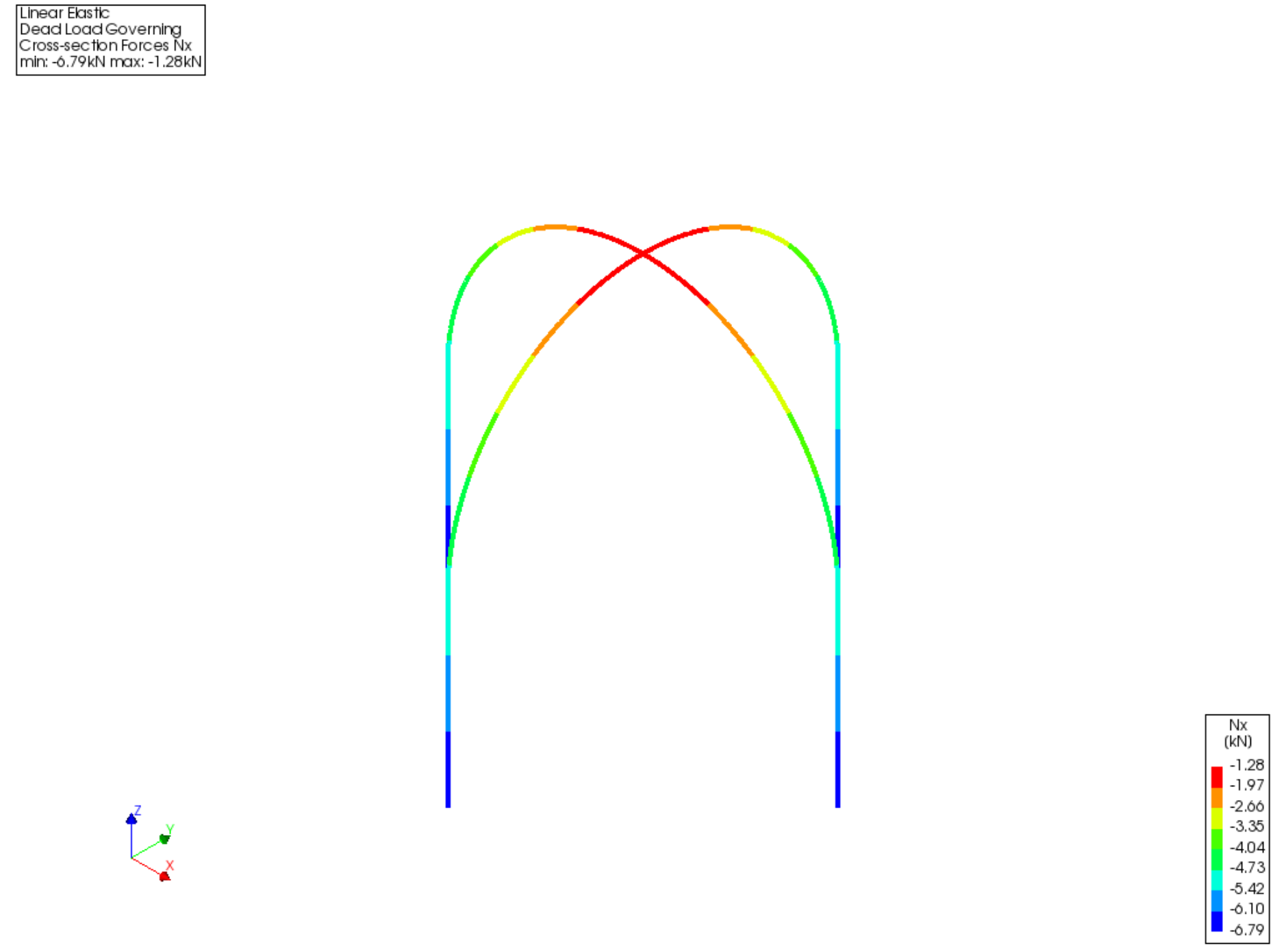


Figure 6: General - Cross-section normal force Nx - Dead Load Governing

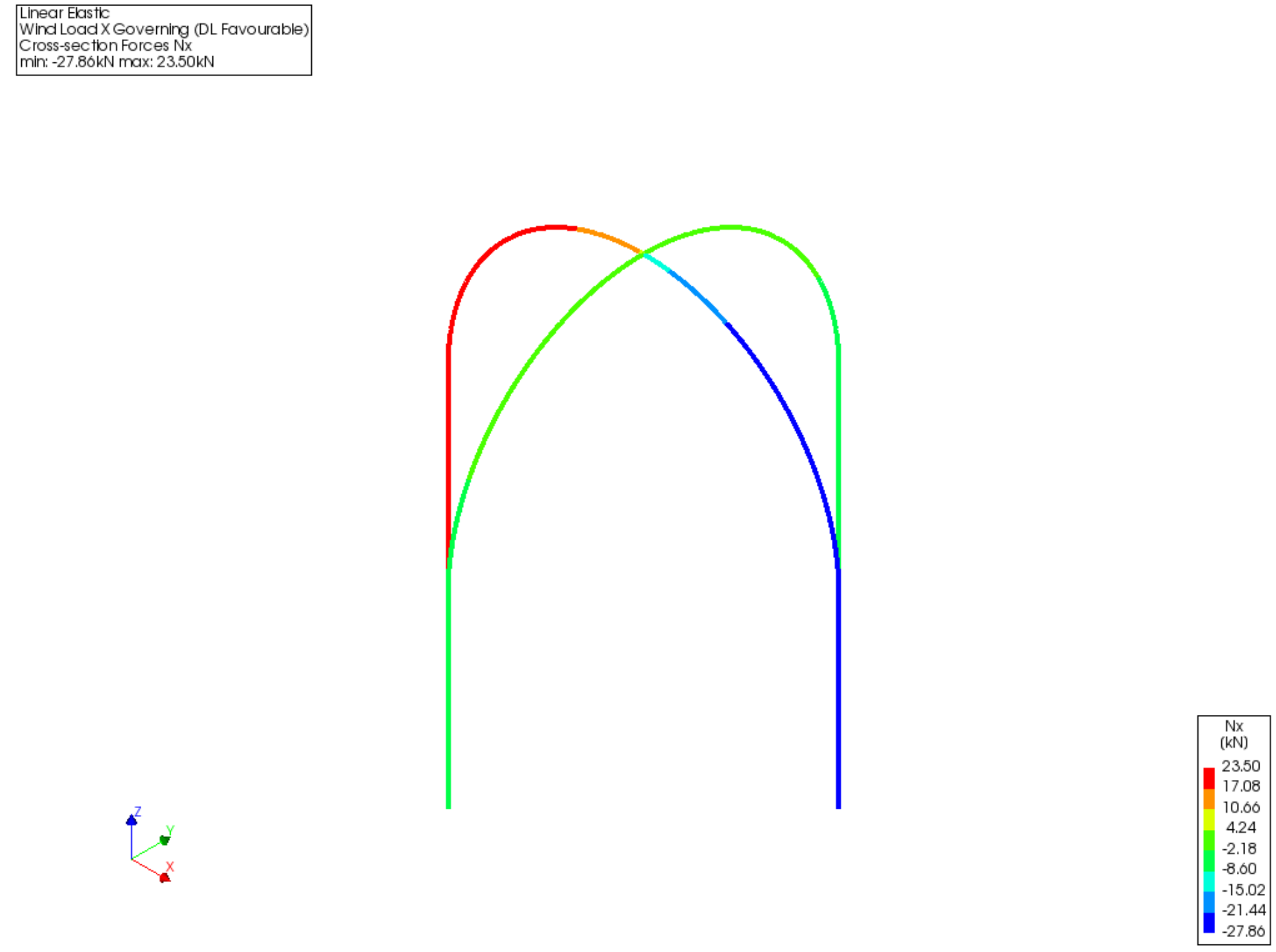


Figure 7: General - Cross-section normal force Nx - Wind Load X Governing (DL Favourable)

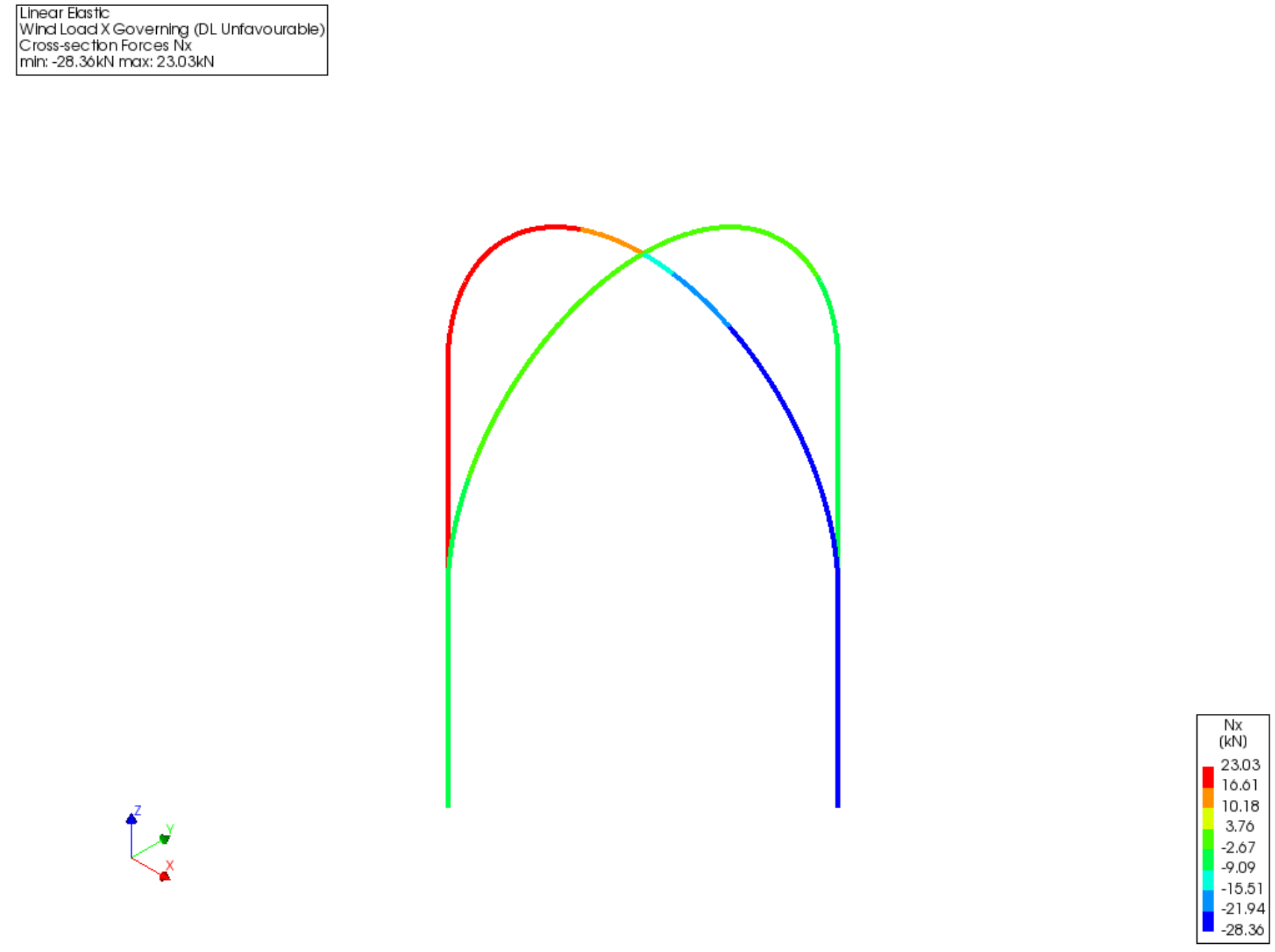


Figure 8: General - Cross-section normal force Nx - Wind Load X Governing (DL Unfavourable)

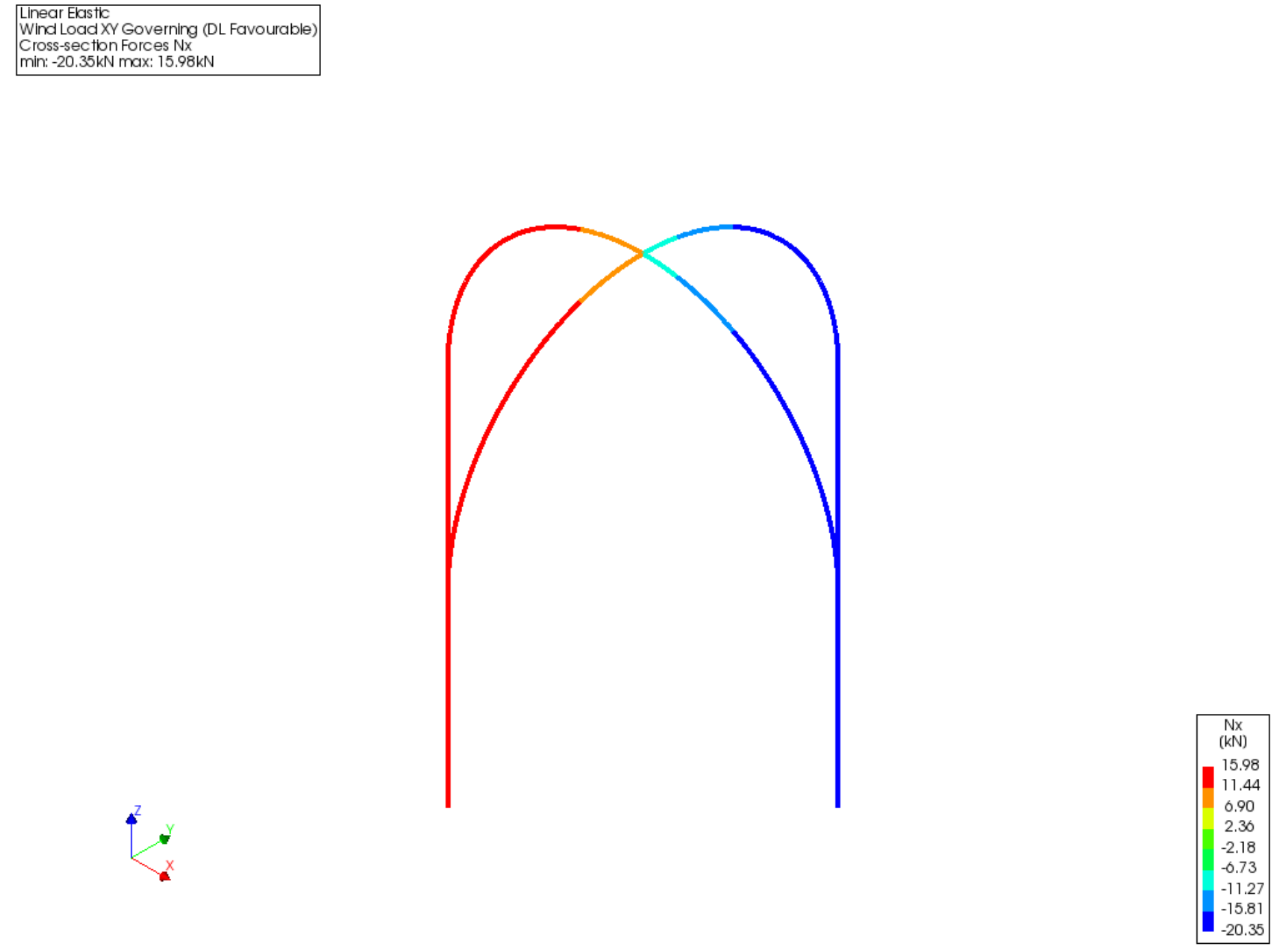


Figure 9: General - Cross-section normal force Nx - Wind Load XY Governing (DL Favourable)

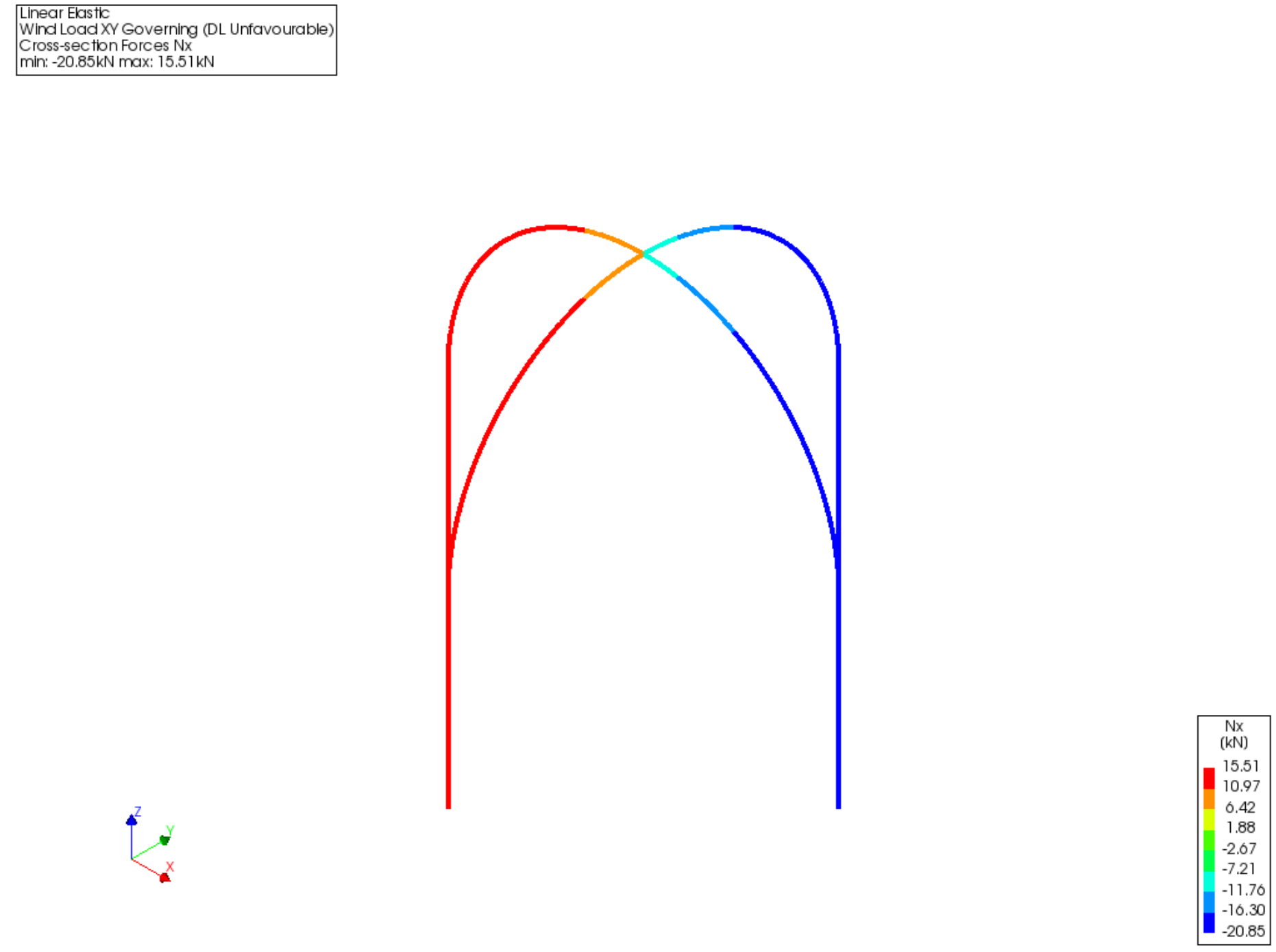


Figure 10: General - Cross-section normal force Nx - Wind Load XY Governing (DL Unfavourable)

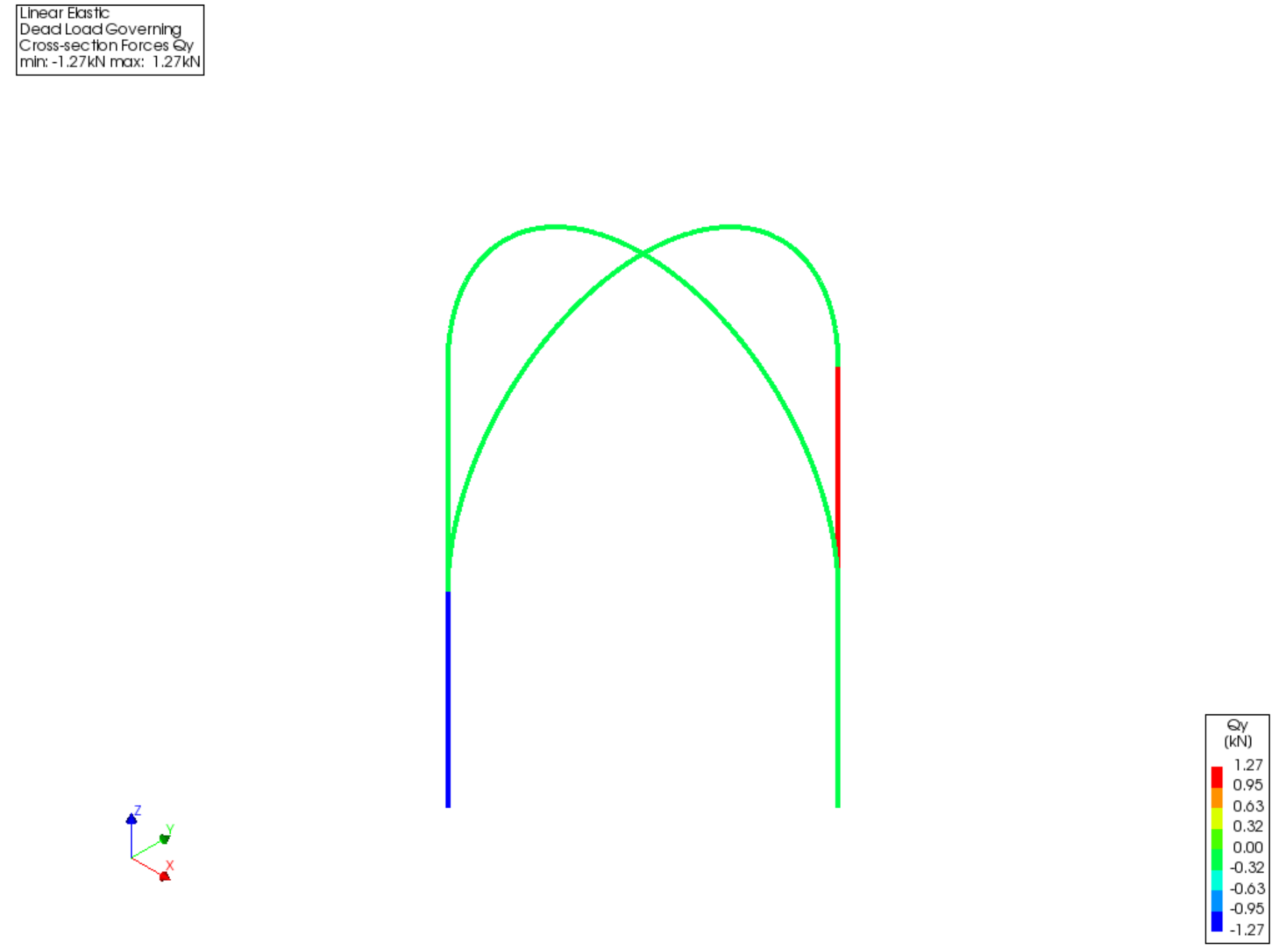


Figure 11: General - Cross-section shear force Qy - Dead Load Governing

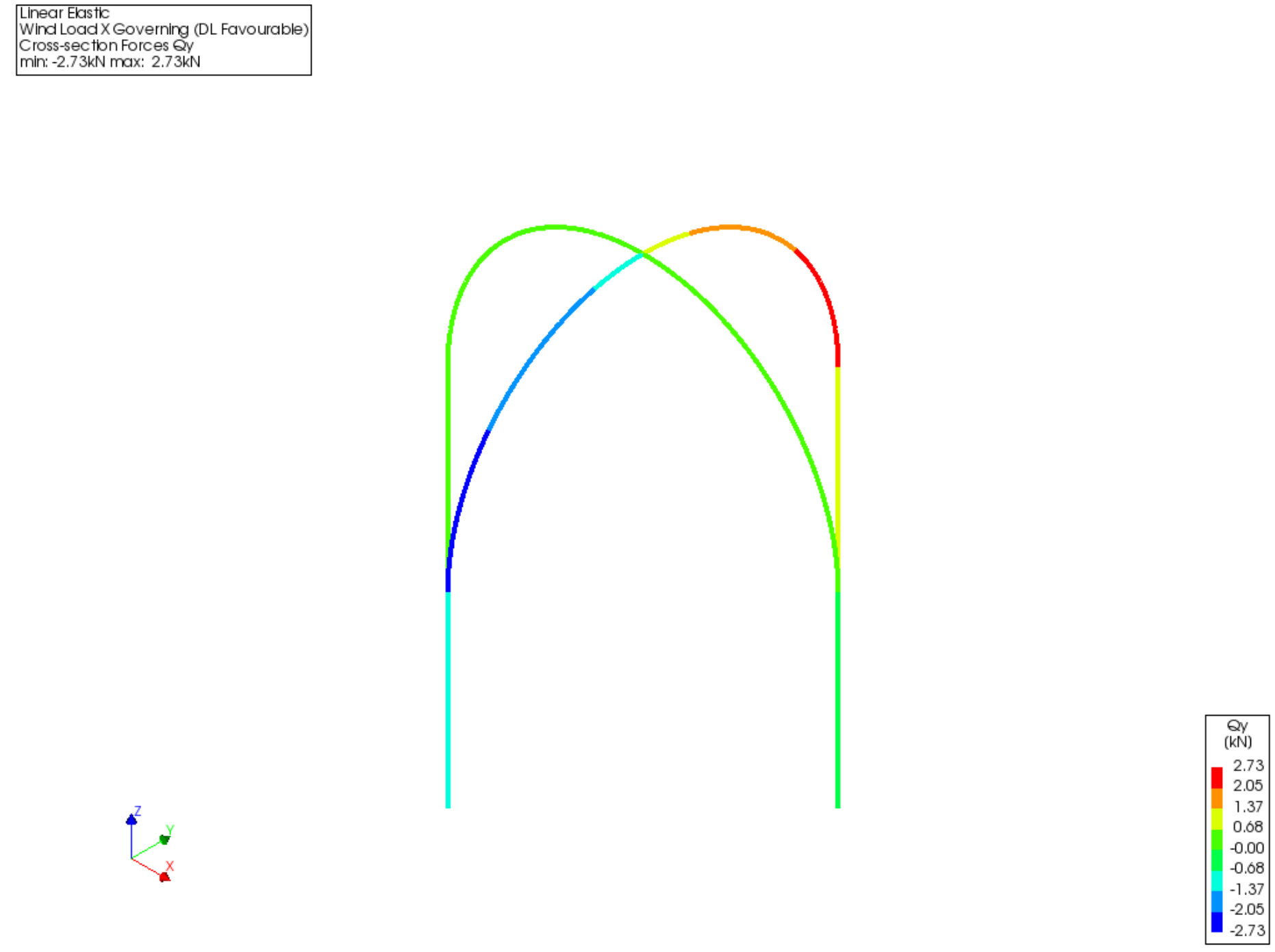


Figure 12: General - Cross-section shear force Qy - Wind Load X Governing (DL Favourable)

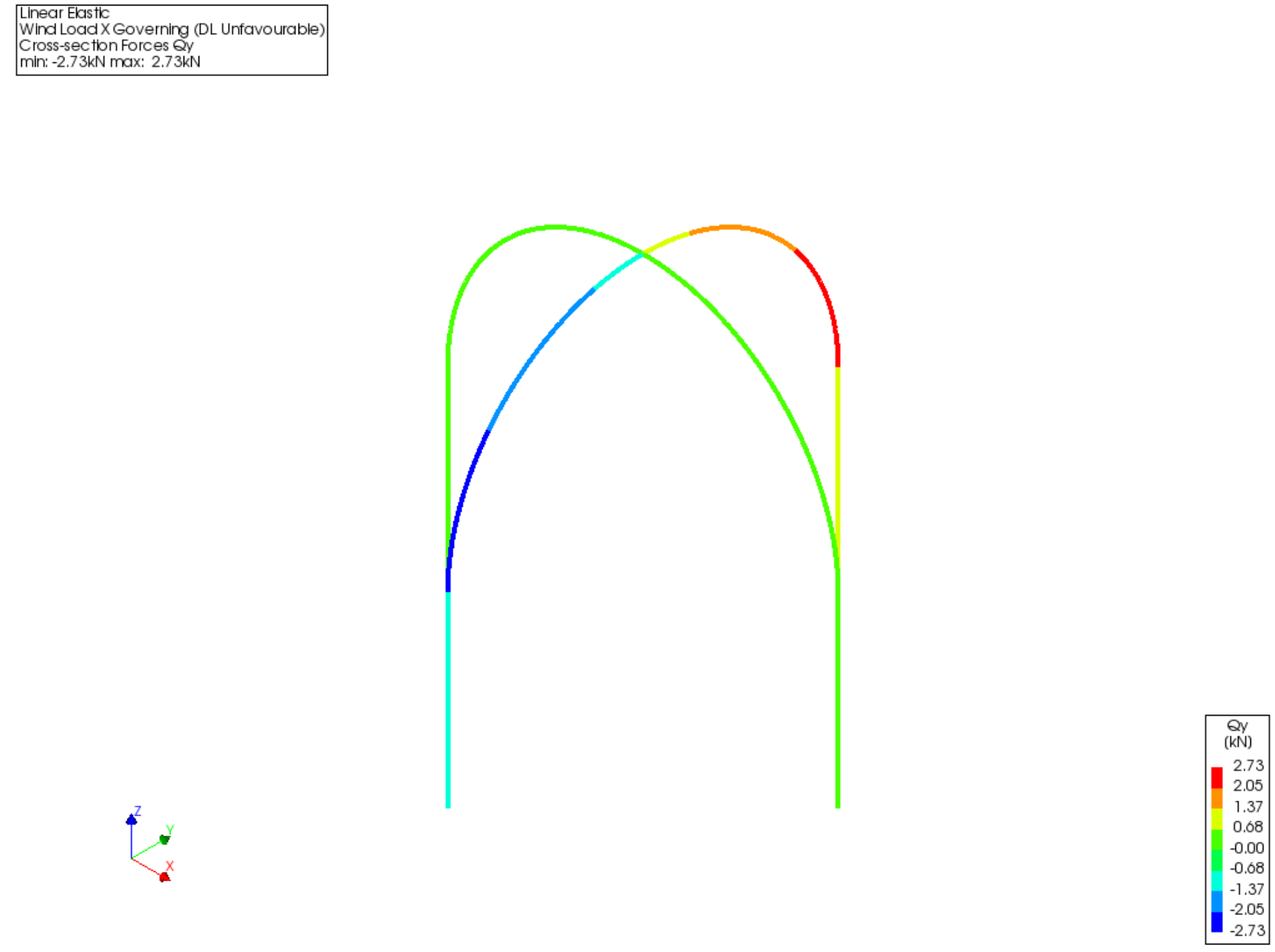


Figure 13: General - Cross-section shear force Qy - Wind Load X Governing (DL Unfavourable)

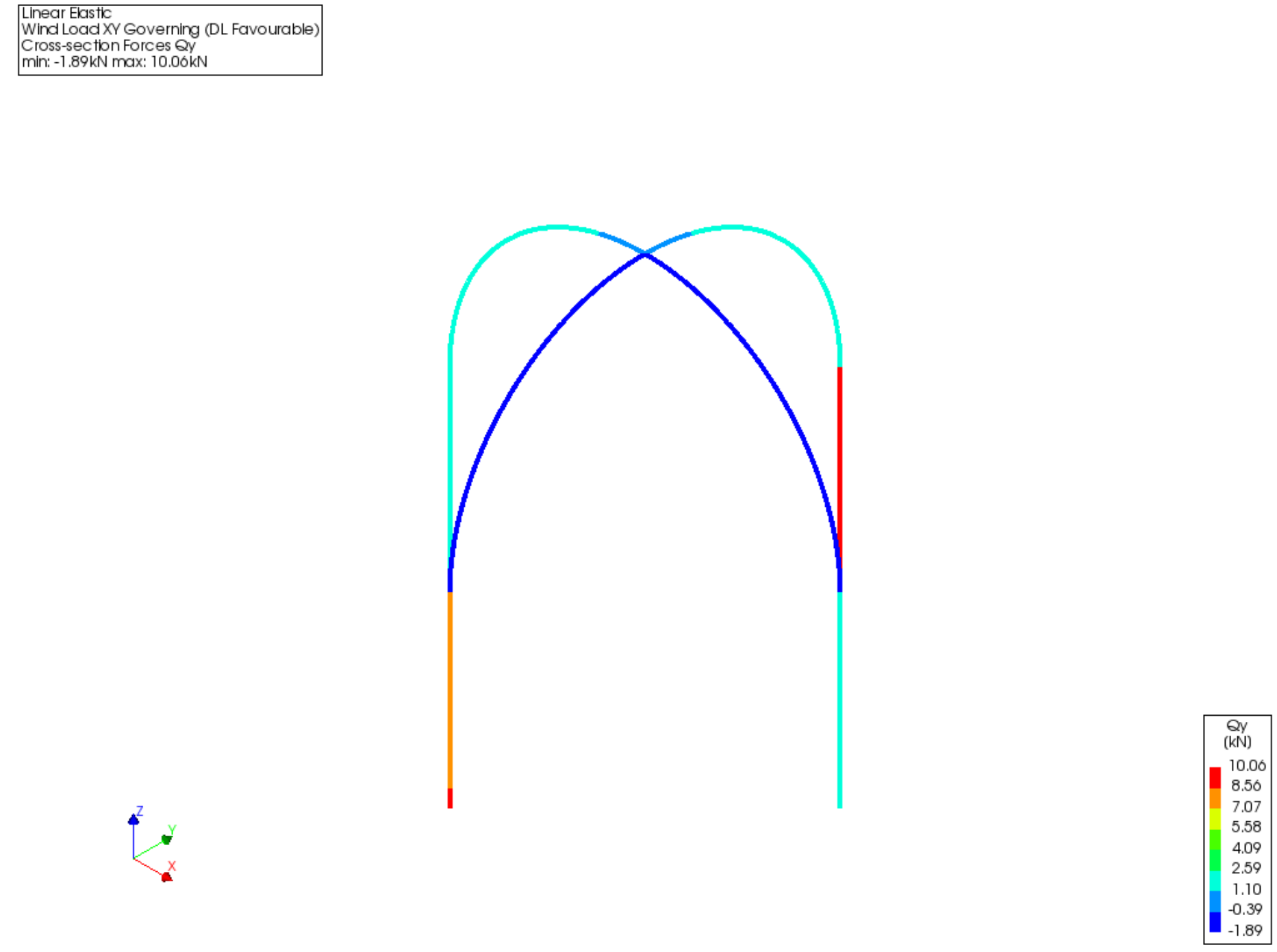


Figure 14: General - Cross-section shear force Qy - Wind Load XY Governing (DL Favourable)

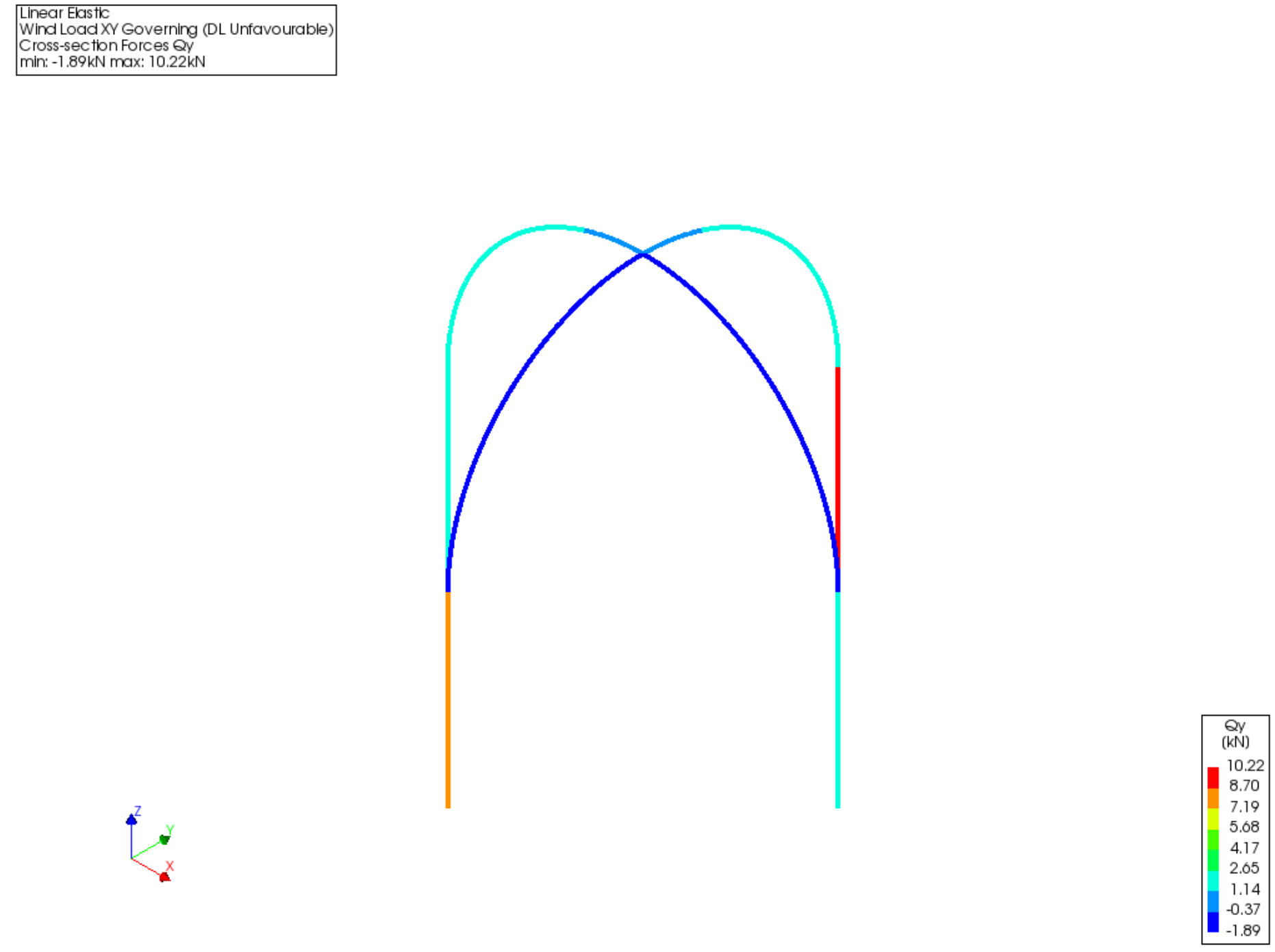


Figure 15: General - Cross-section shear force Qy - Wind Load XY Governing (DL Unfavourable)

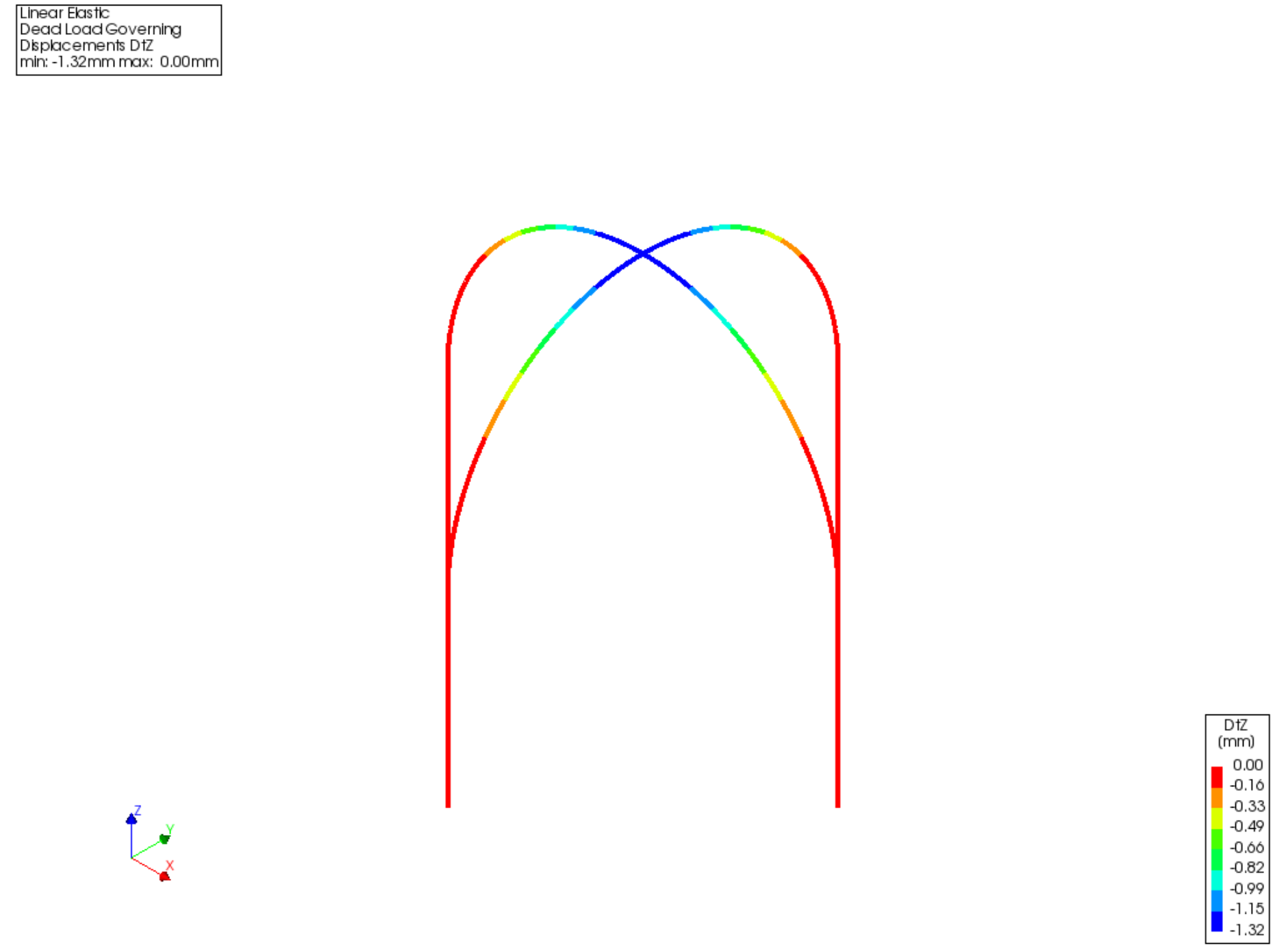


Figure 16: General - Displacement DtZ - Dead Load Governing

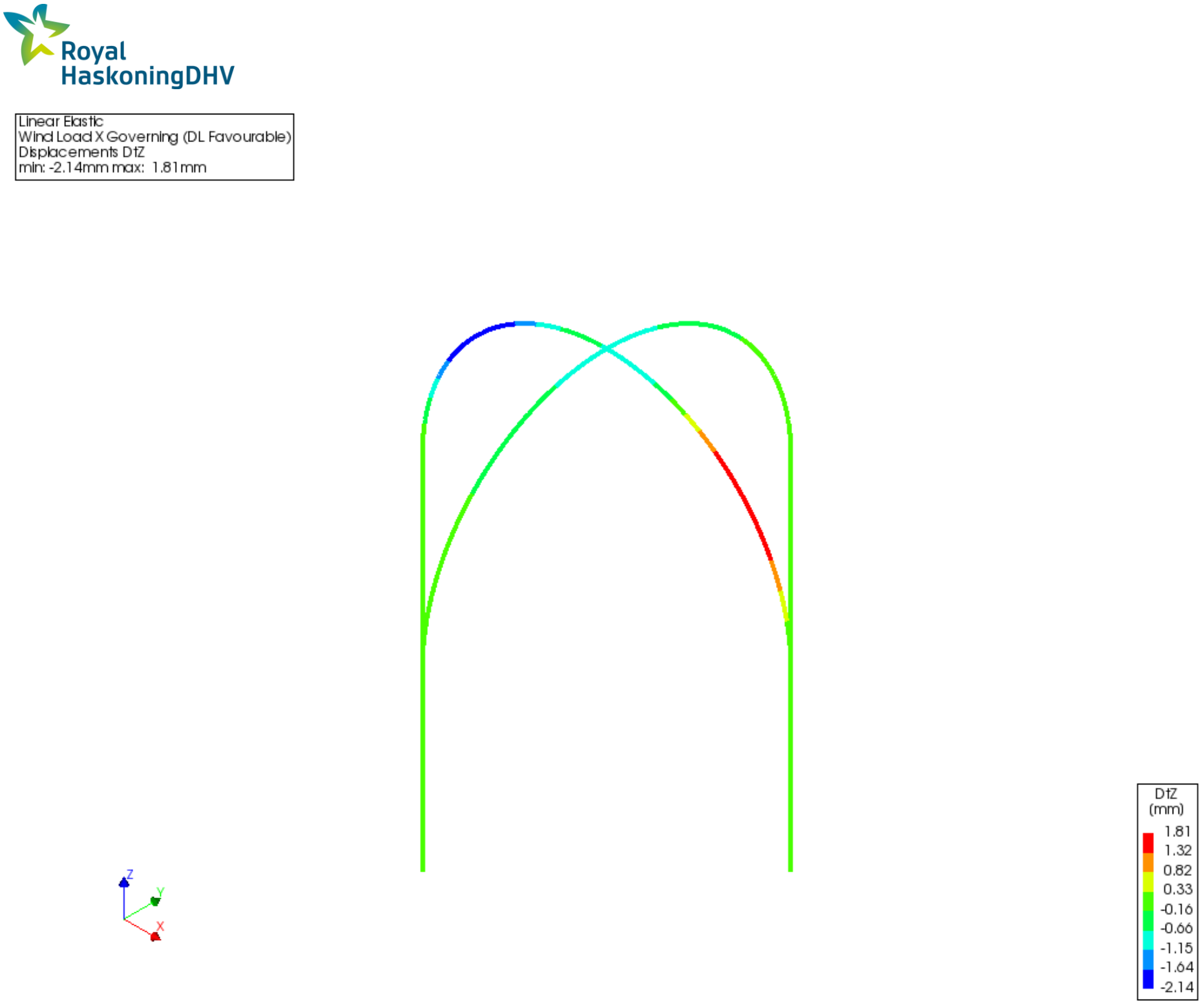


Figure 17: General - Displacement DtZ - Wind Load X Governing (DL Favourable)

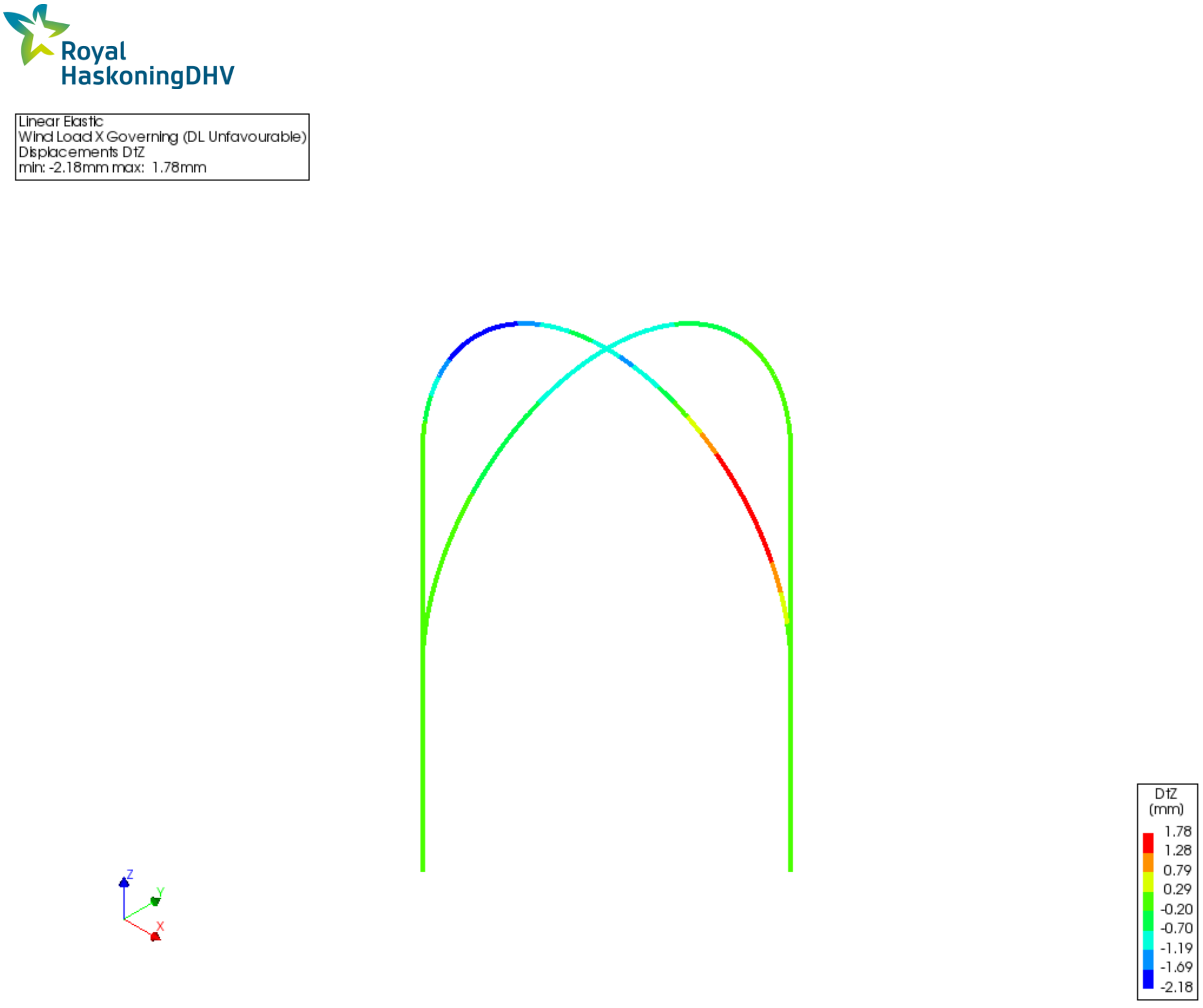


Figure 18: General - Displacement DtZ - Wind Load X Governing (DL Unfavourable)

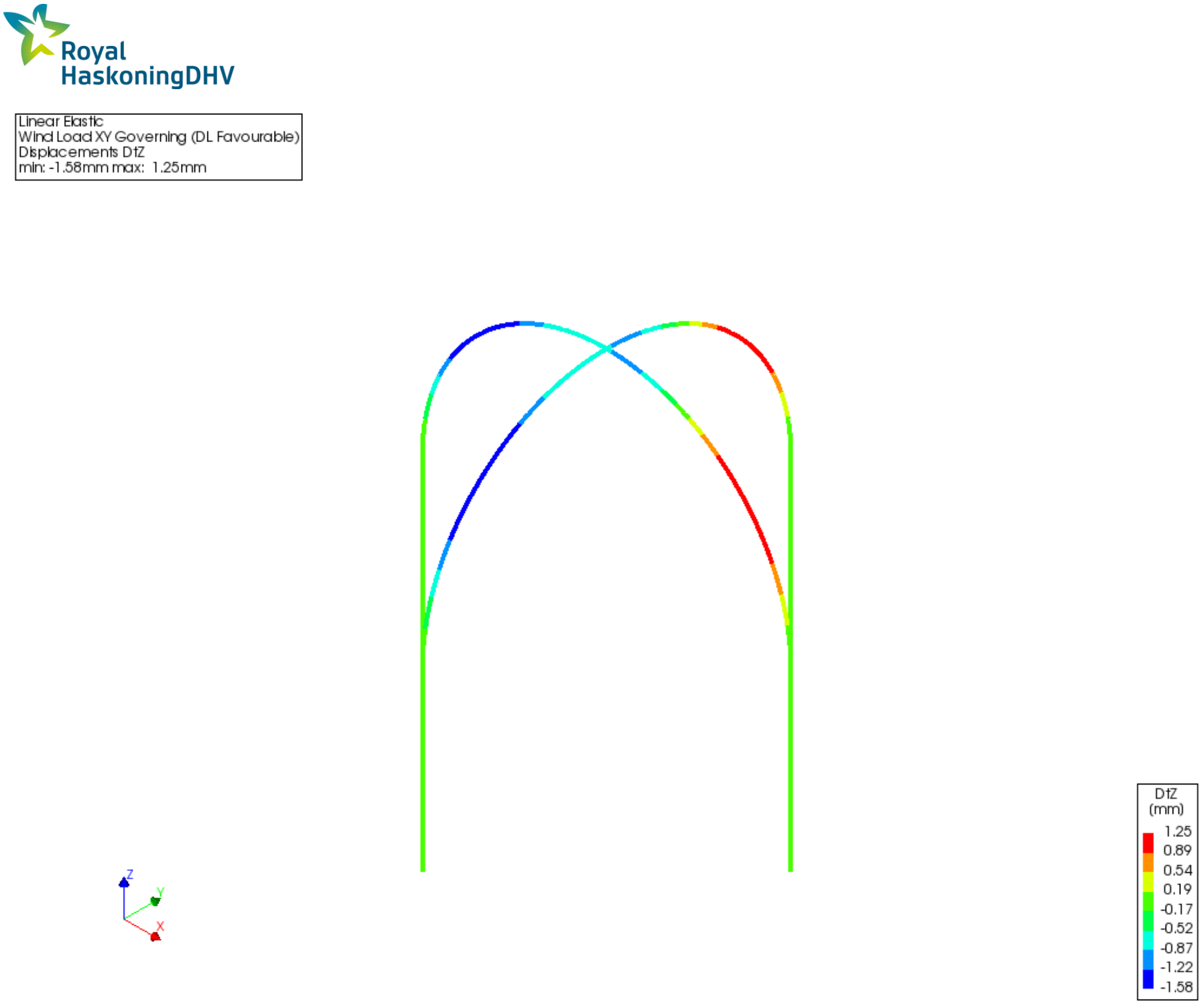


Figure 19: General - Displacement DtZ - Wind Load XY Governing (DL Favourable)

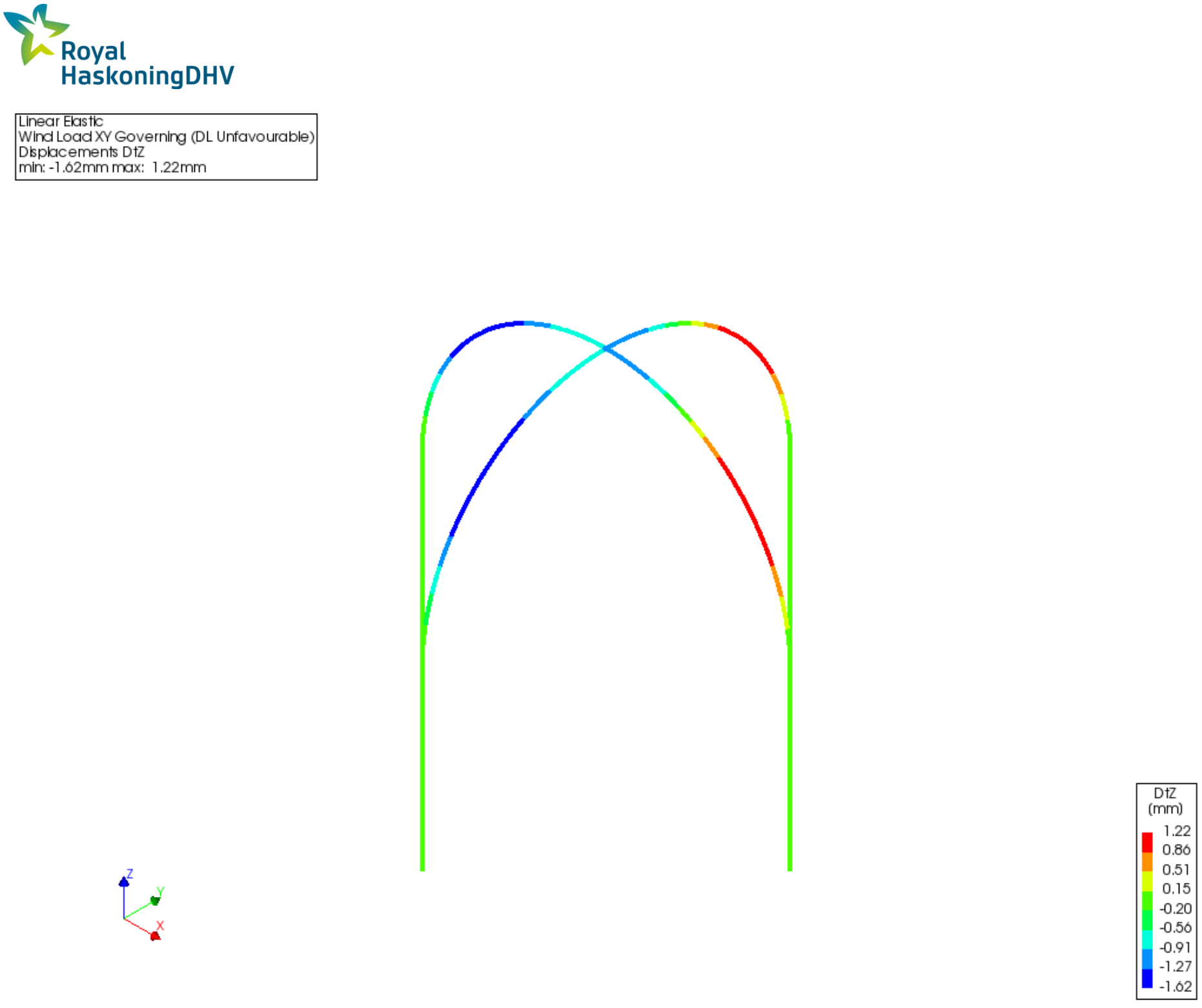


Figure 20: General - Displacement DtZ - Wind Load XY Governing (DL Unfavourable)

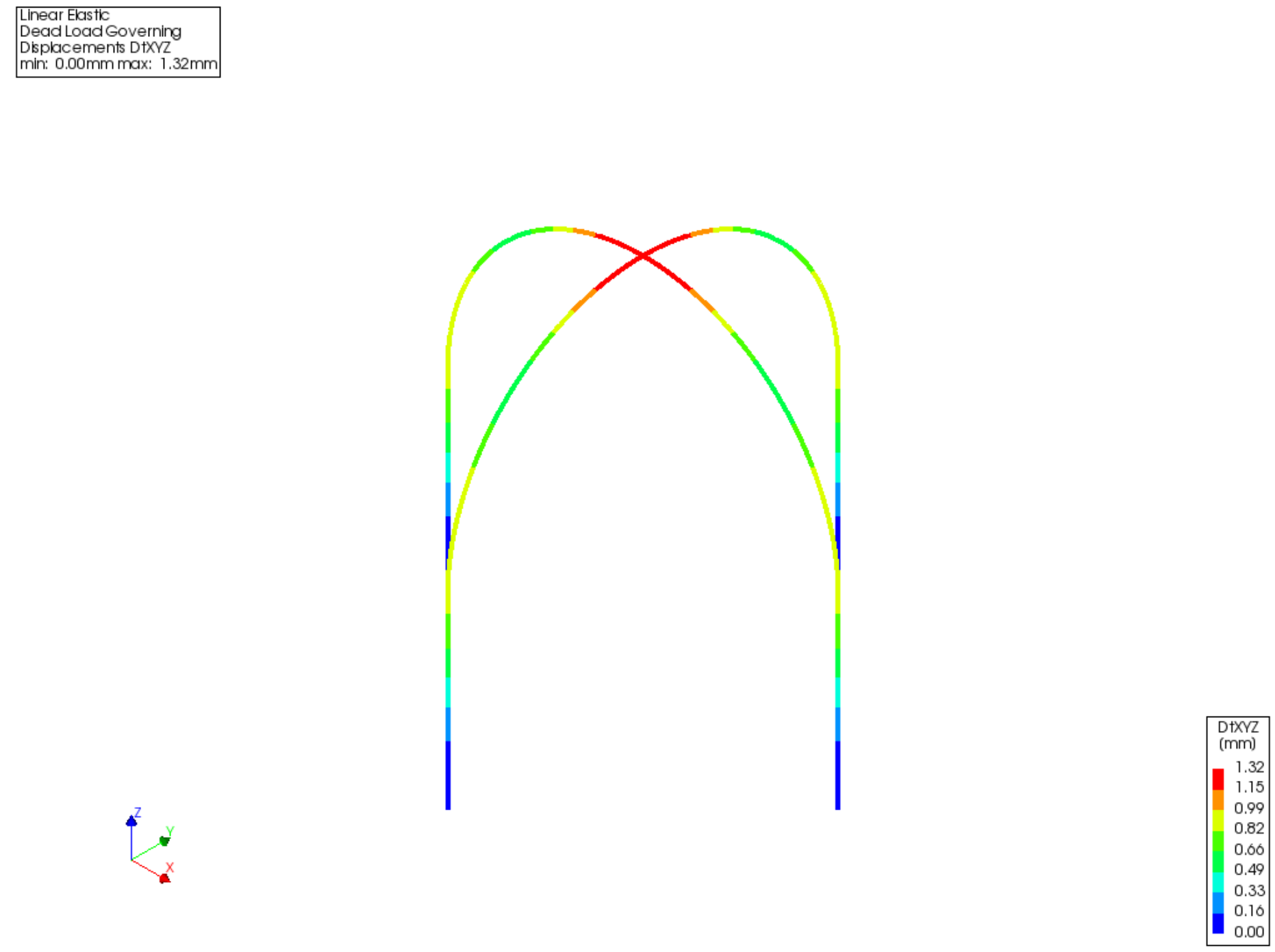


Figure 21: General - Displacement DtXYZ - Dead Load Governing

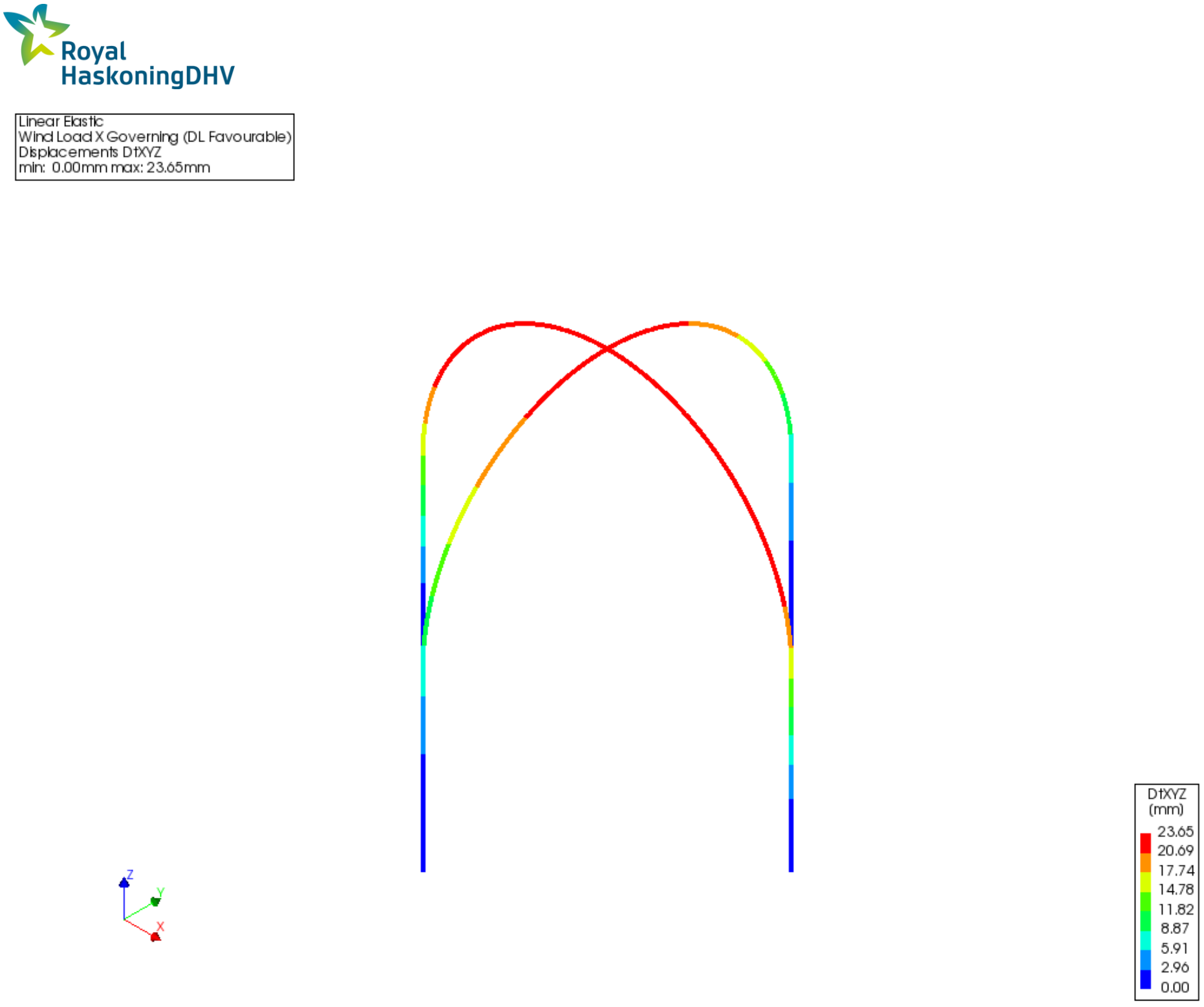


Figure 22: General - Displacement DtXYZ - Wind Load X Governing (DL Favourable)

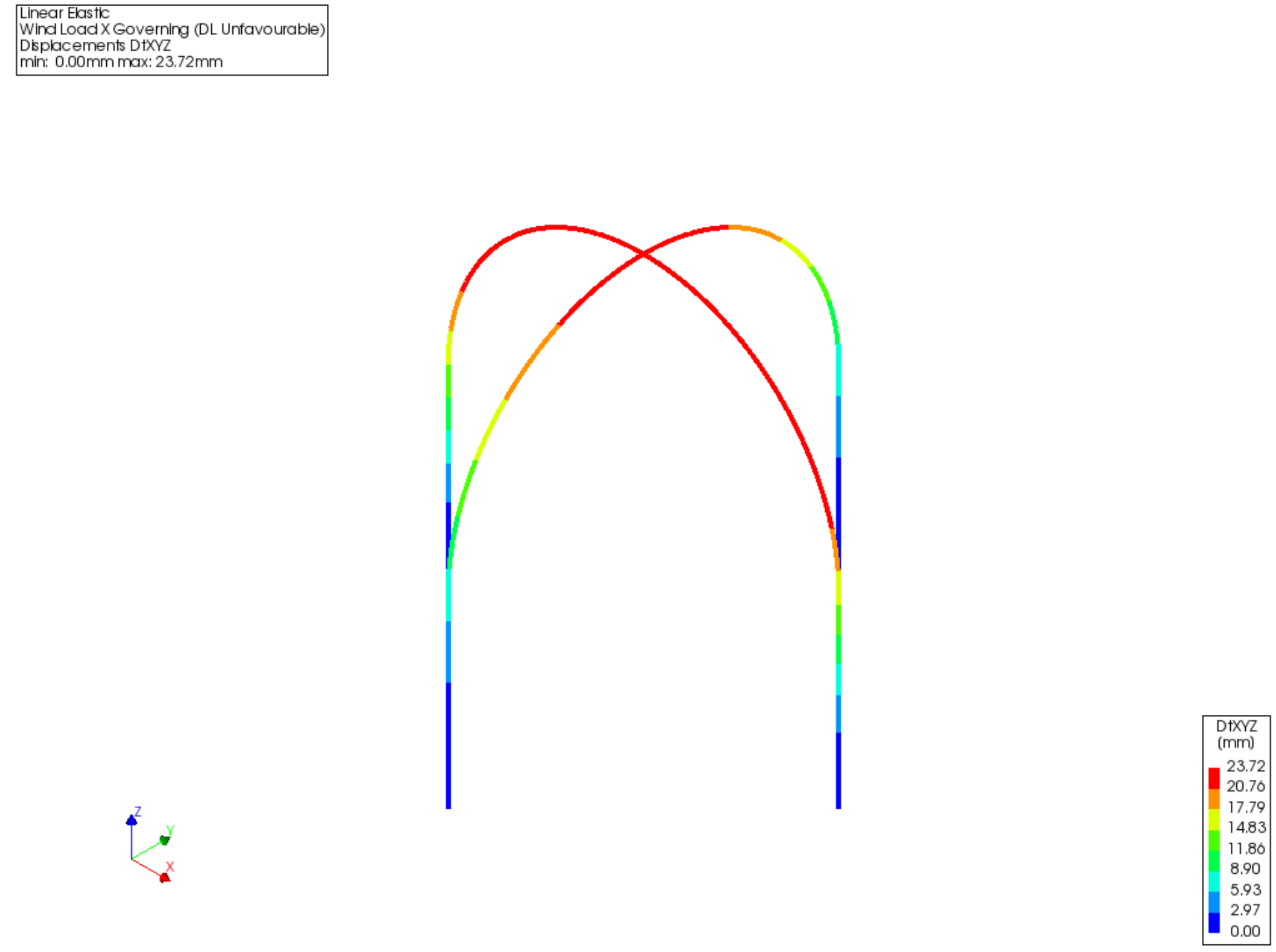


Figure 23: General - Displacement DtXYZ - Wind Load X Governing (DL Unfavourable)

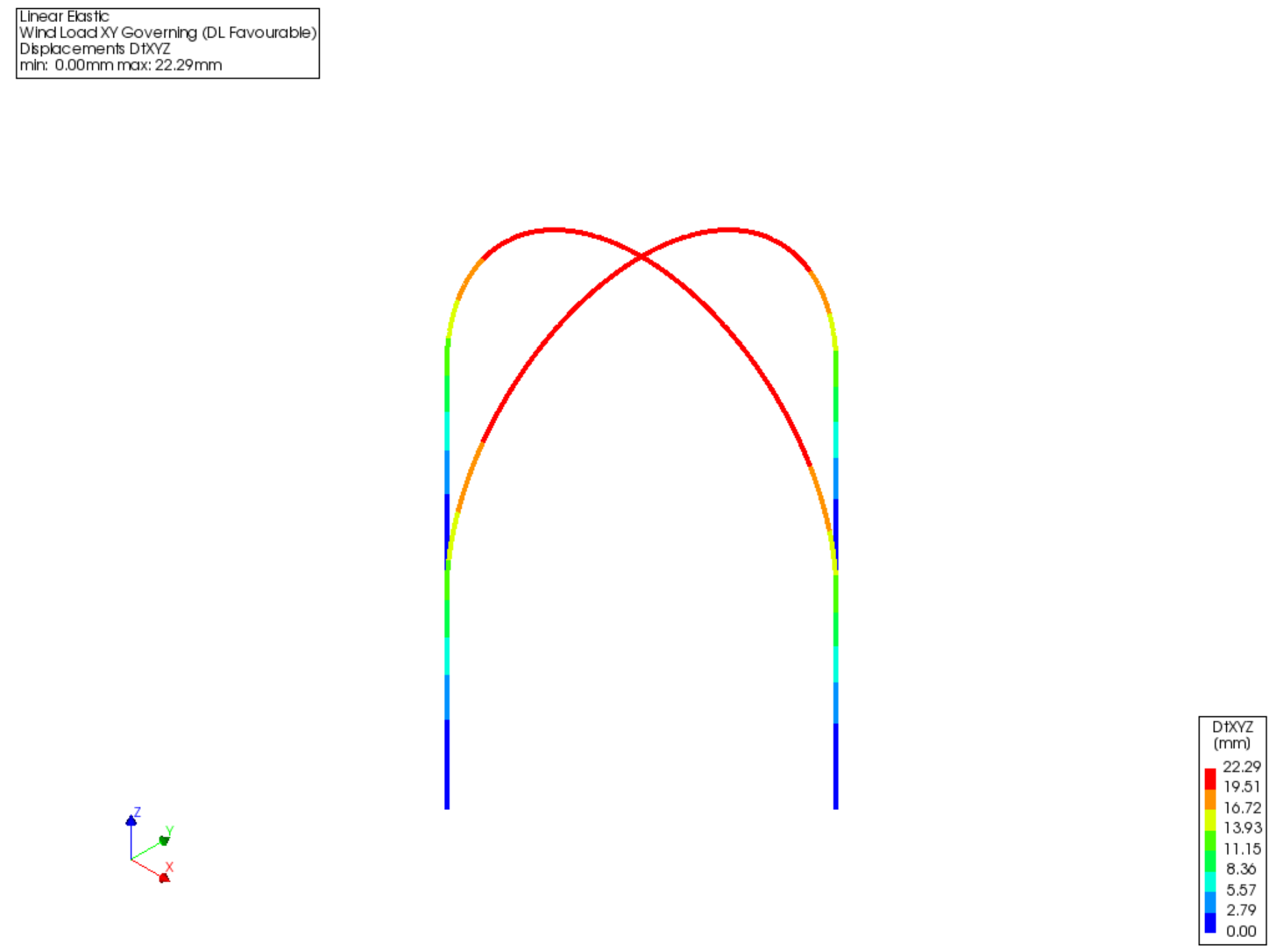


Figure 24: General - Displacement DtXYZ - Wind Load XY Governing (DL Favourable)

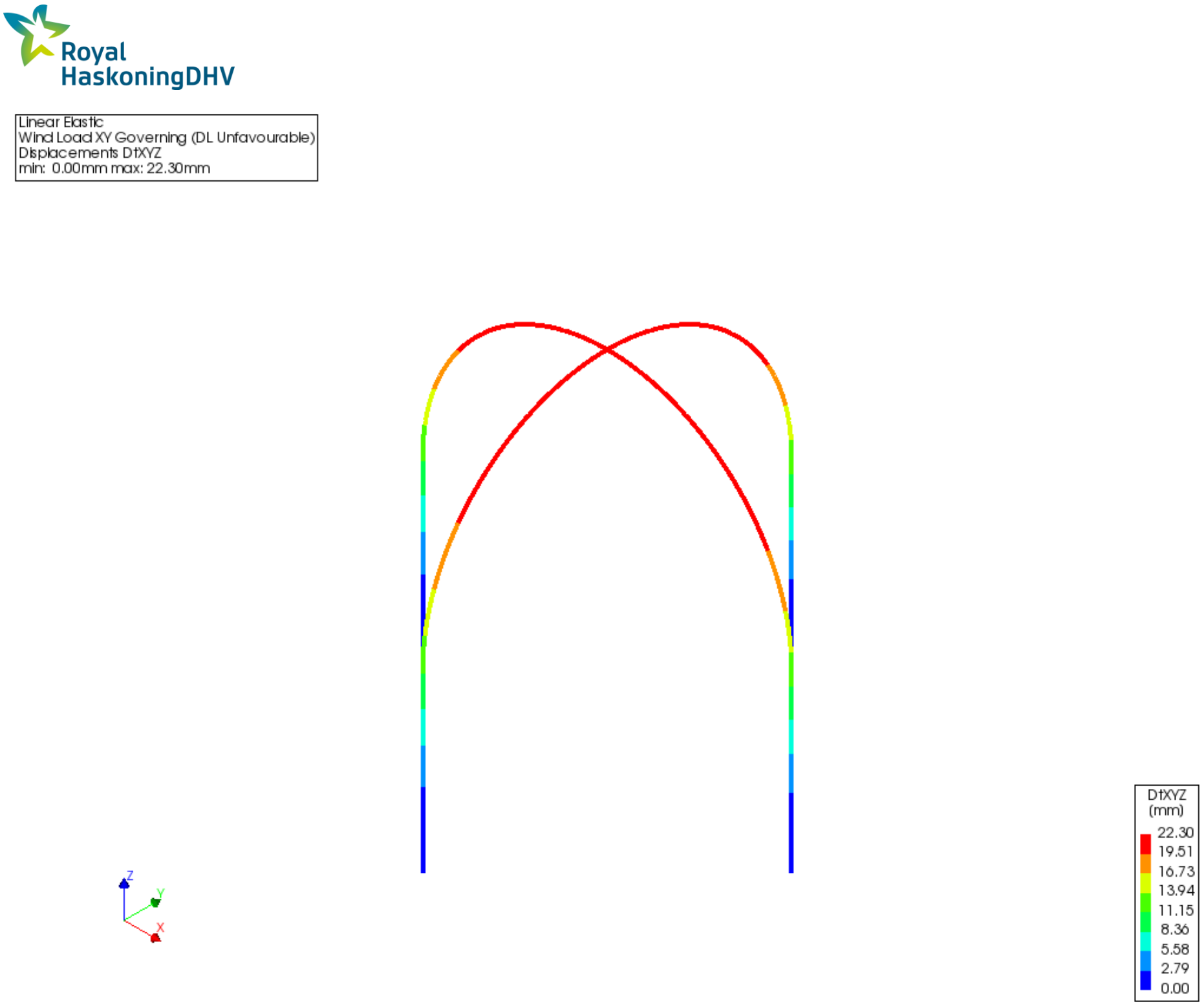


Figure 25: General - Displacement DtXYZ - Wind Load XY Governing (DL Unfavourable)

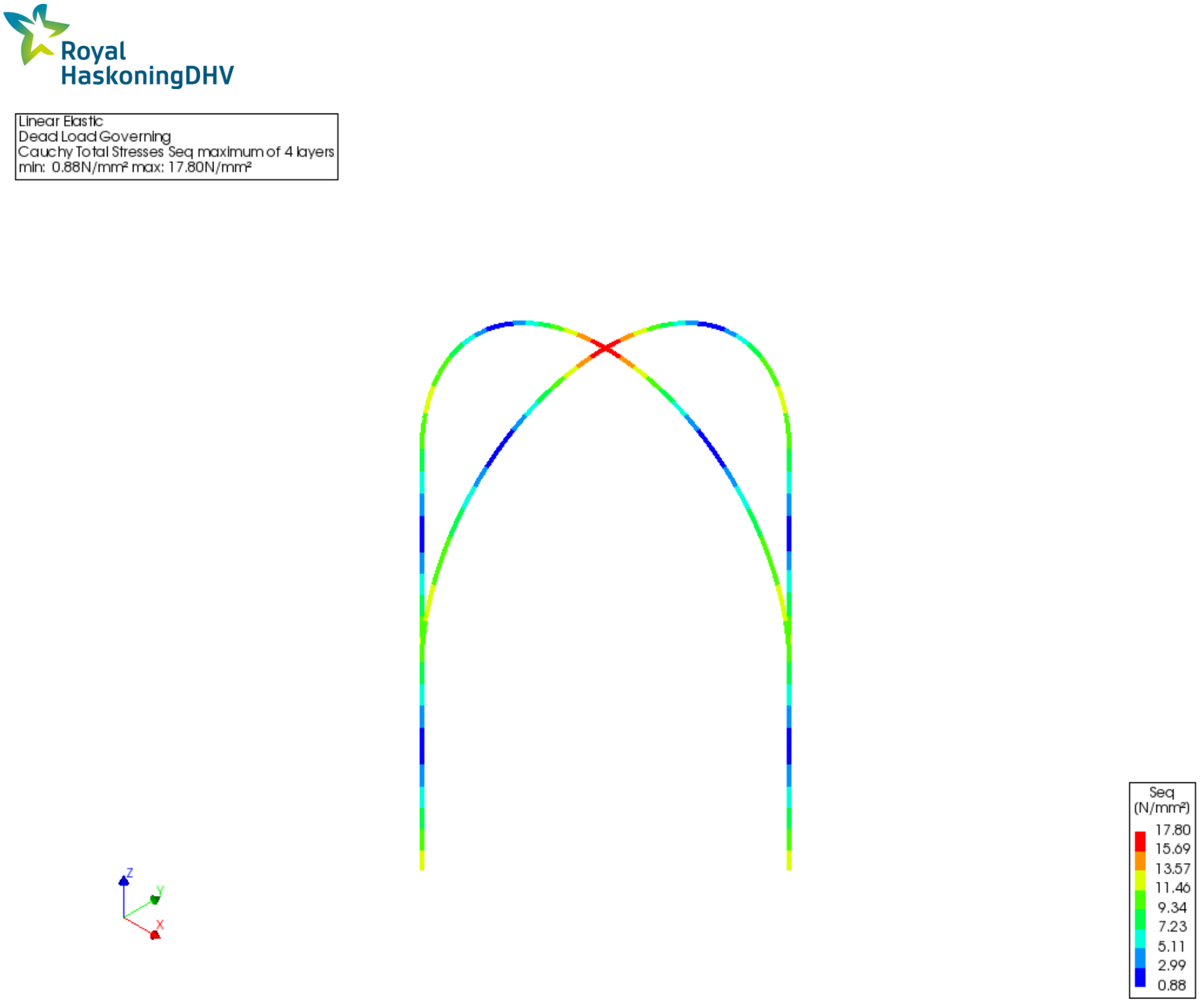


Figure 26: General - Von Mises stress Seq - Dead Load Governing

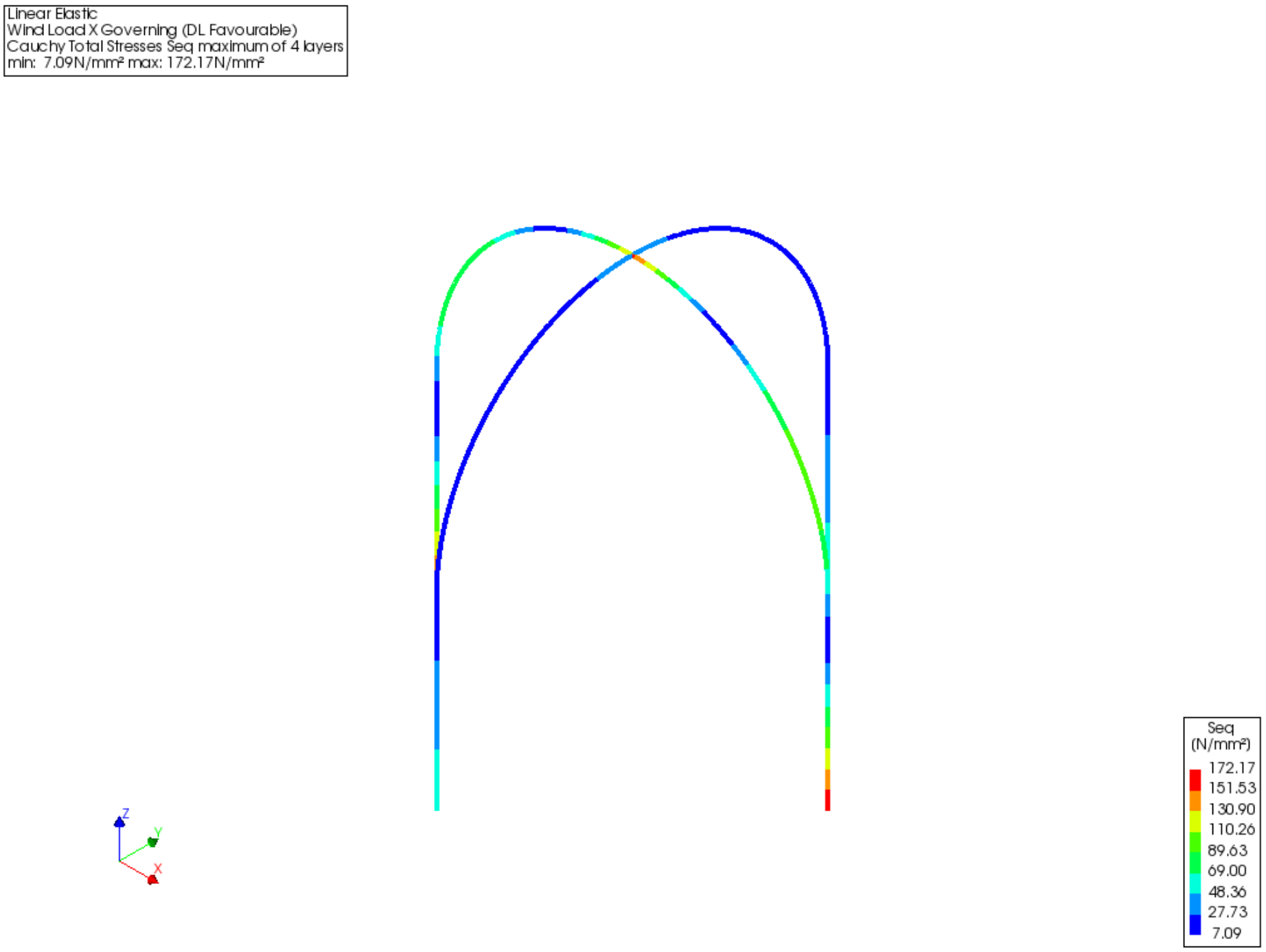


Figure 27: General - Von Mises stress Seq - Wind Load X Governing (DL Favourable)

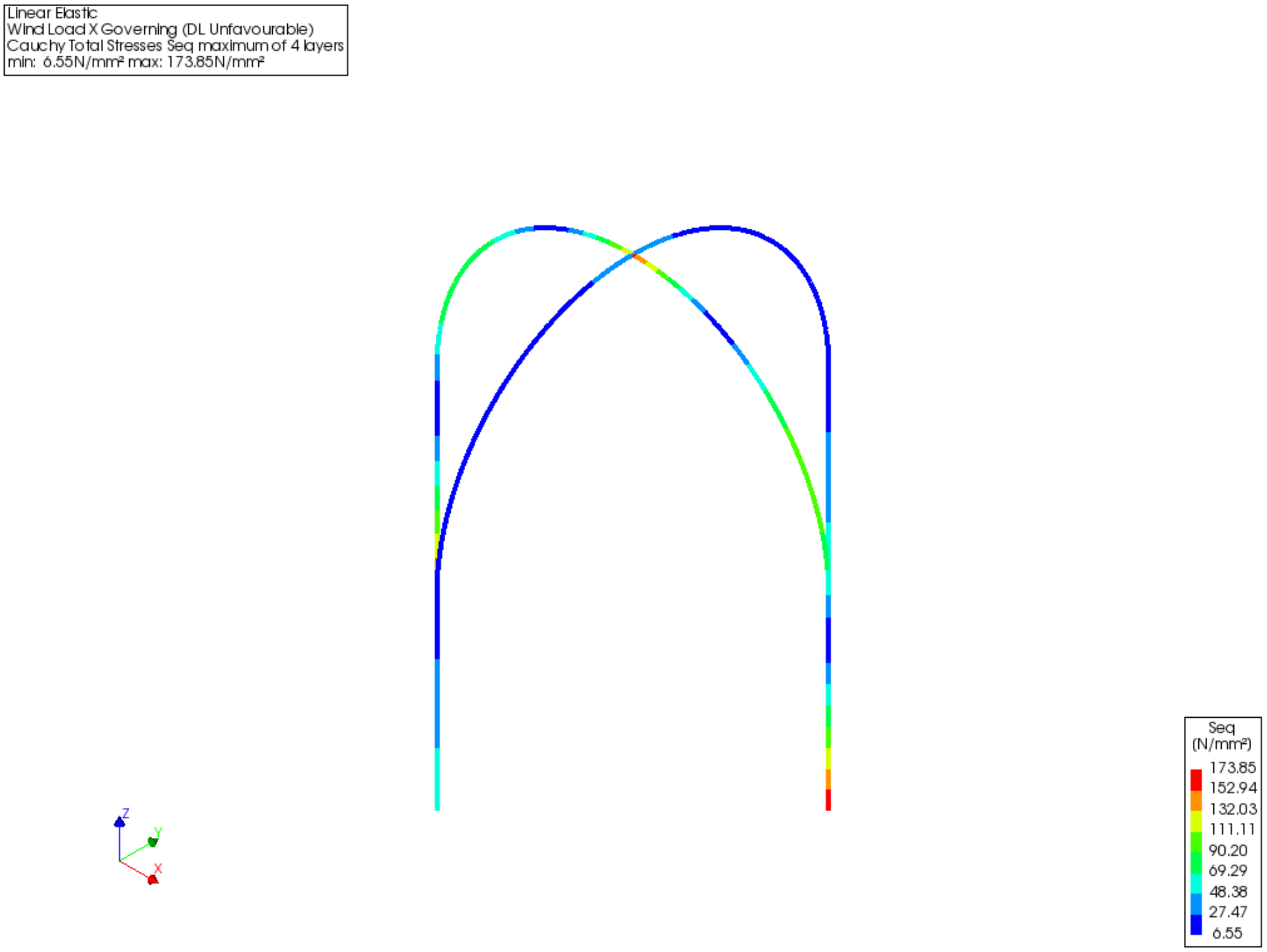


Figure 28: General - Von Mises stress Seq - Wind Load X Governing (DL Unfavourable)

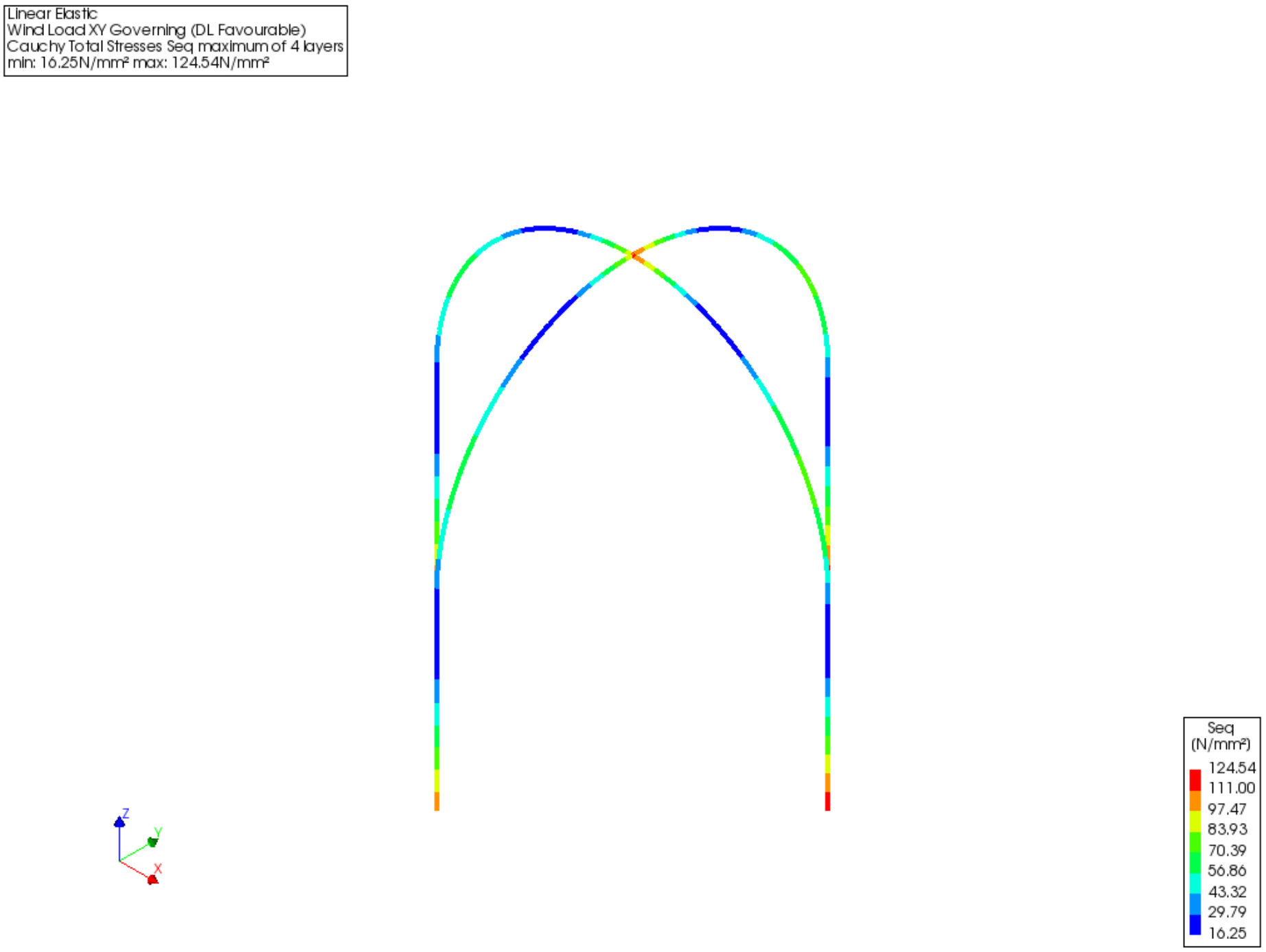


Figure 29: General - Von Mises stress Seq - Wind Load XY Governing (DL Favourable)

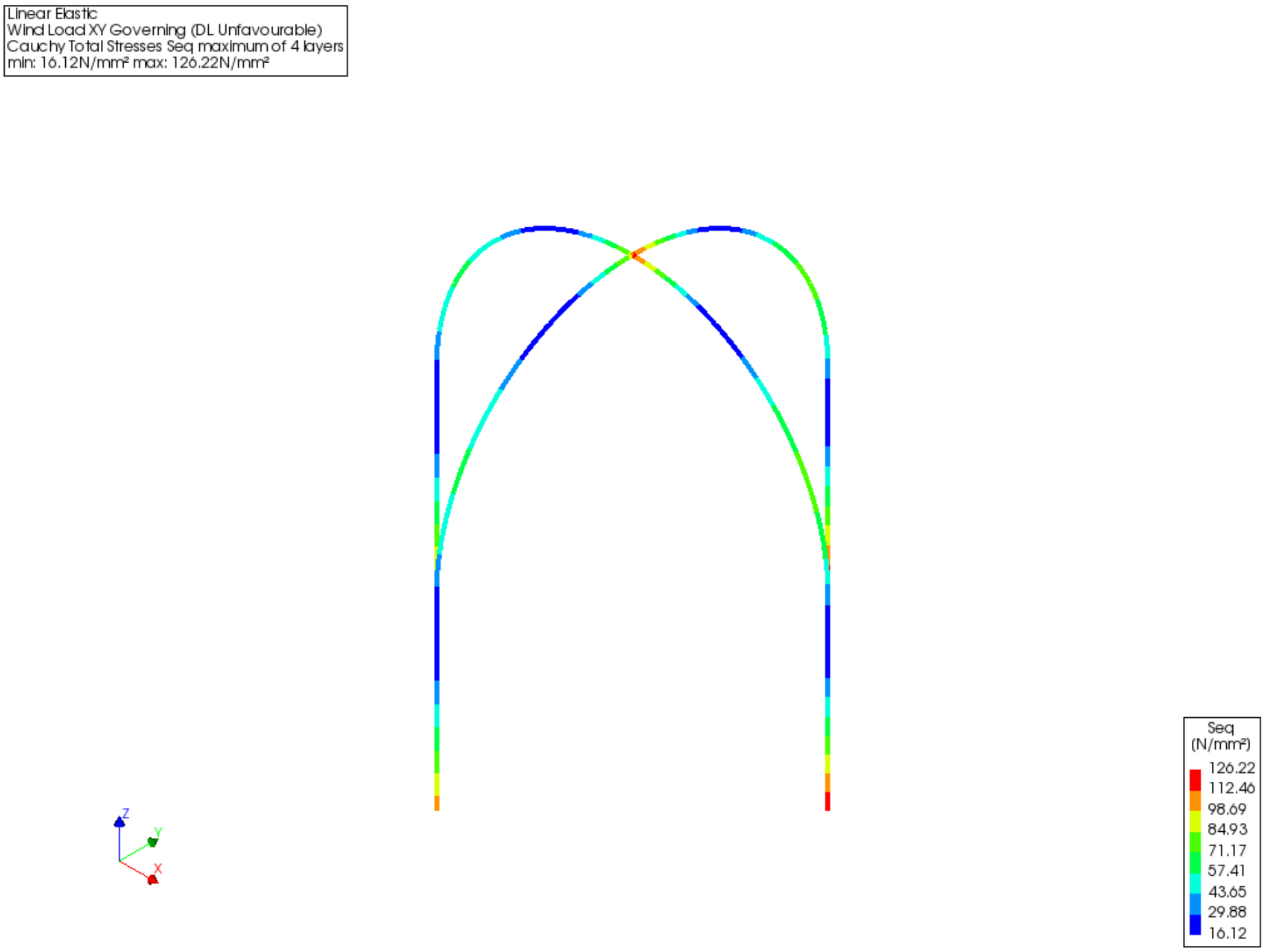


Figure 30: General - Von Mises stress Seq - Wind Load XY Governing (DL Unfavourable)

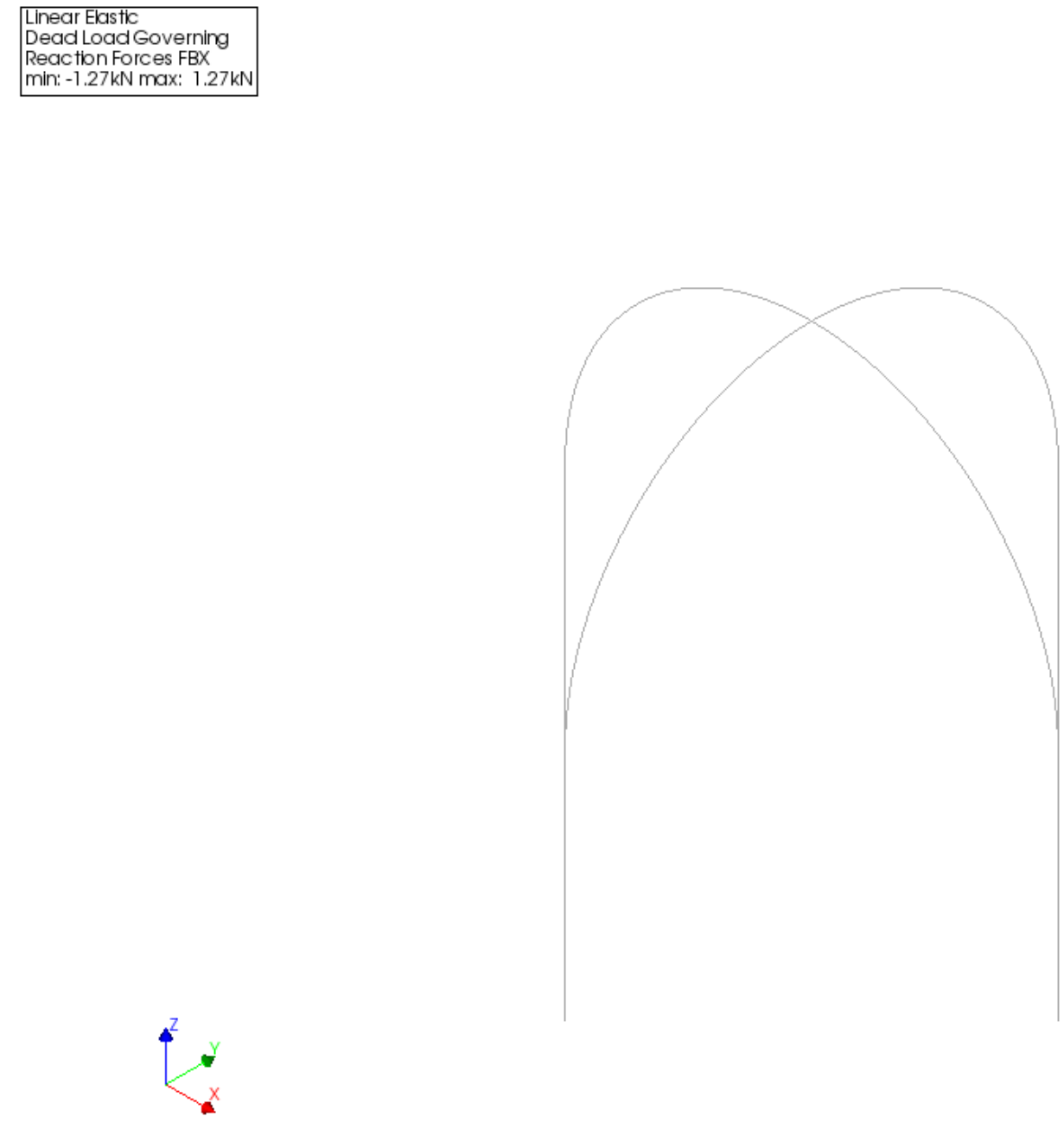


Figure 31: General - Reaction force FBX - Dead Load Governing

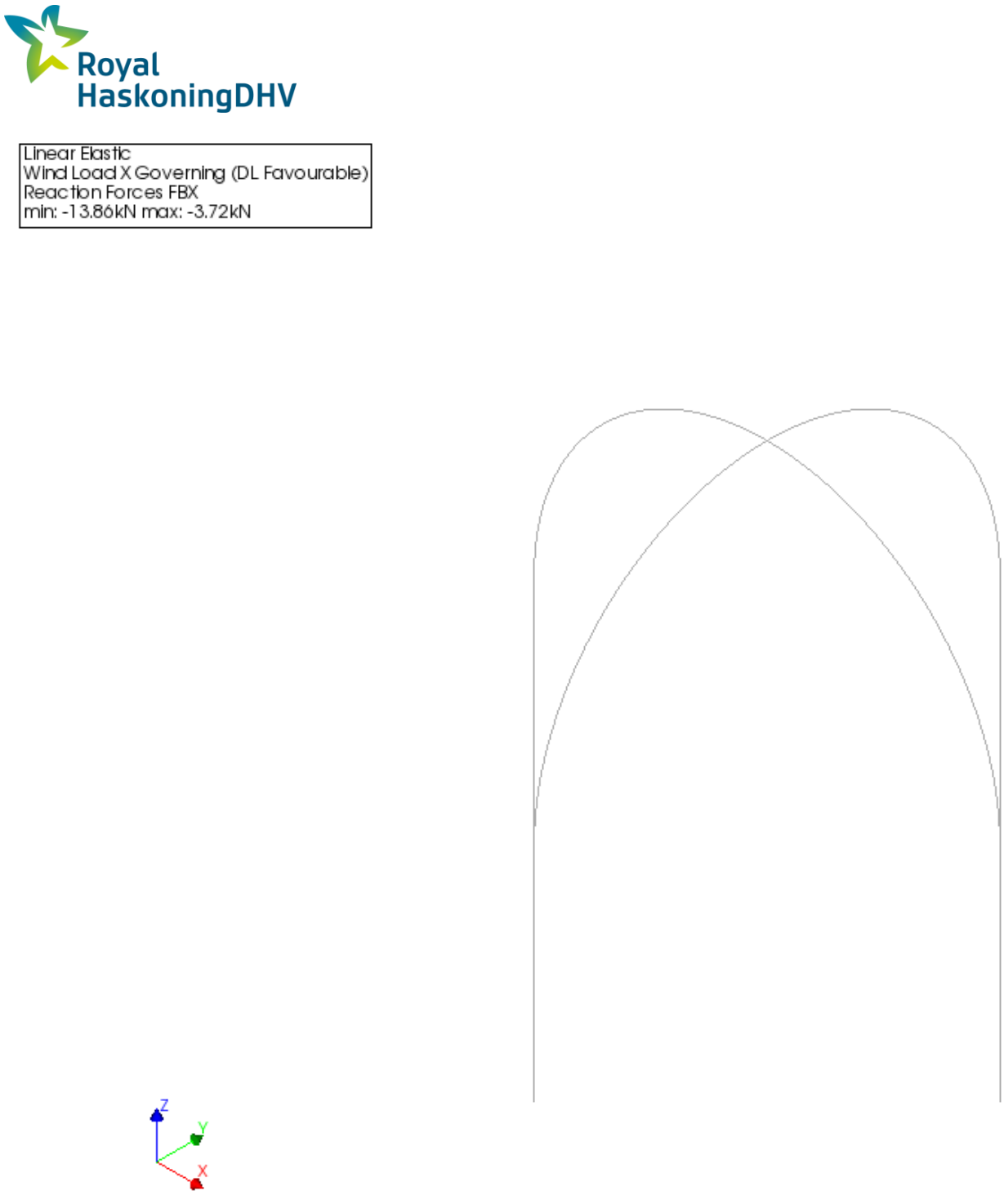


Figure 32: General - Reaction force FBX - Wind Load X Governing (DL Favourable)

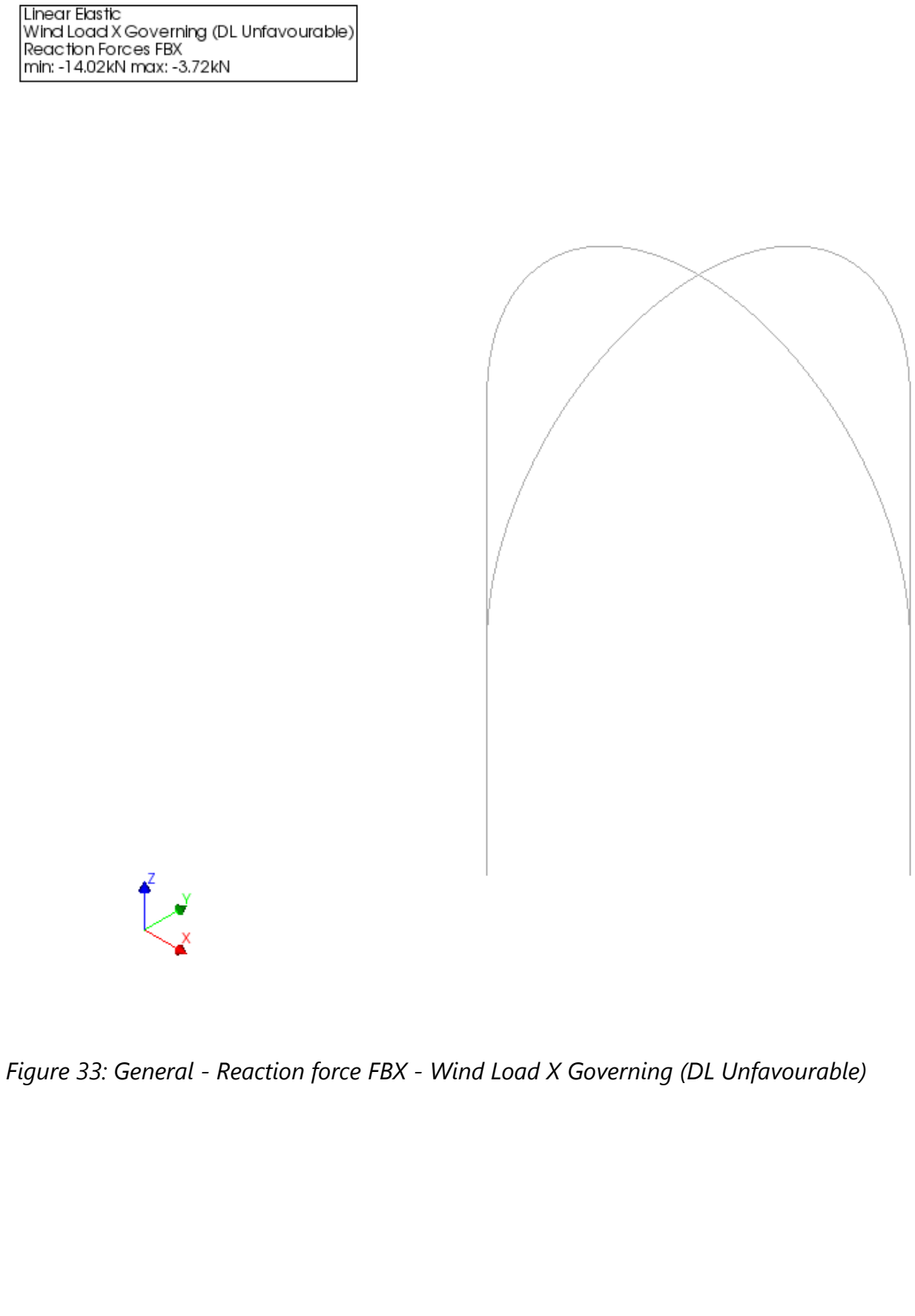


Figure 33: General - Reaction force FBX - Wind Load X Governing (DL Unfavourable)

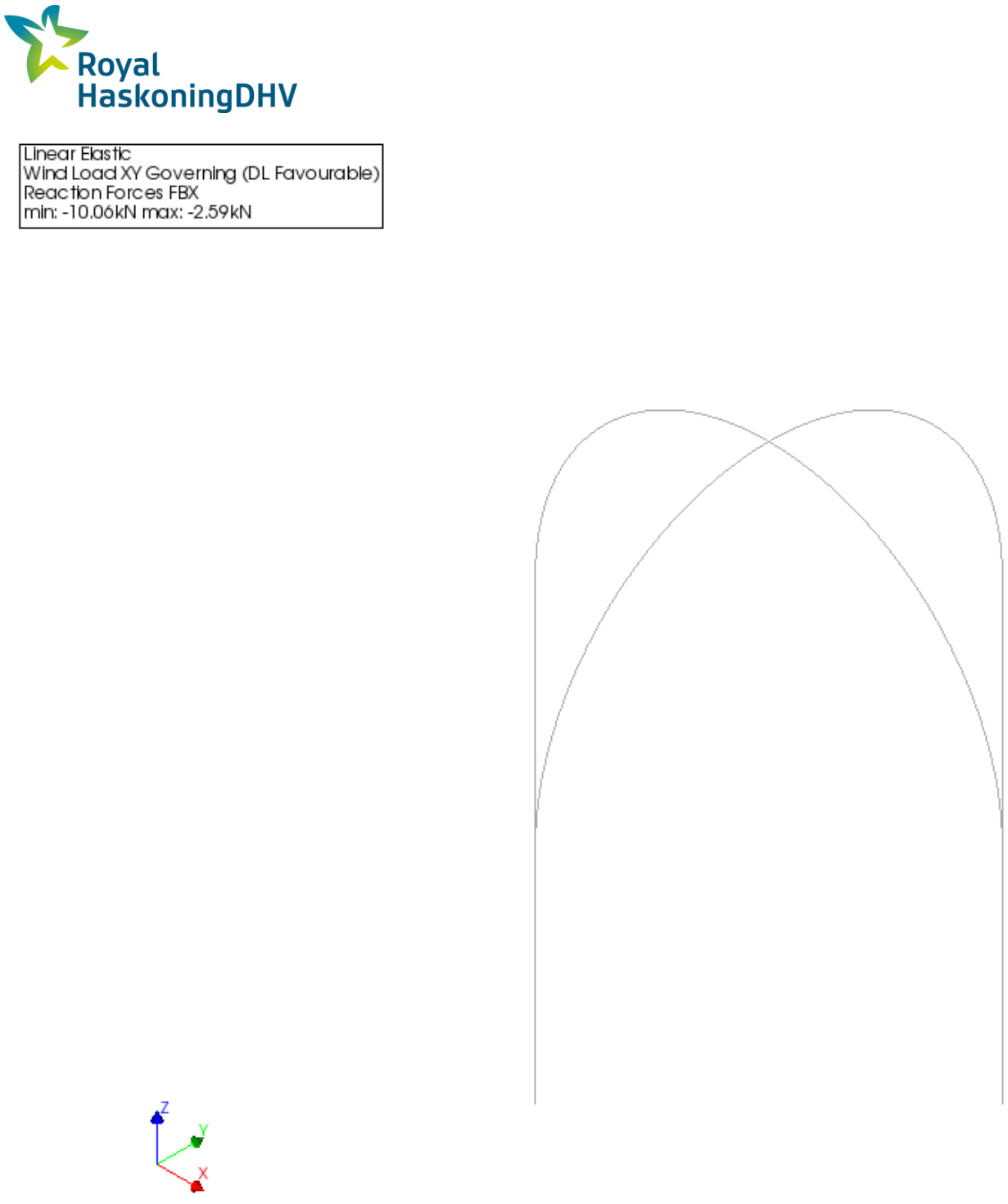


Figure 34: General - Reaction force FBX - Wind Load XY Governing (DL Favourable)

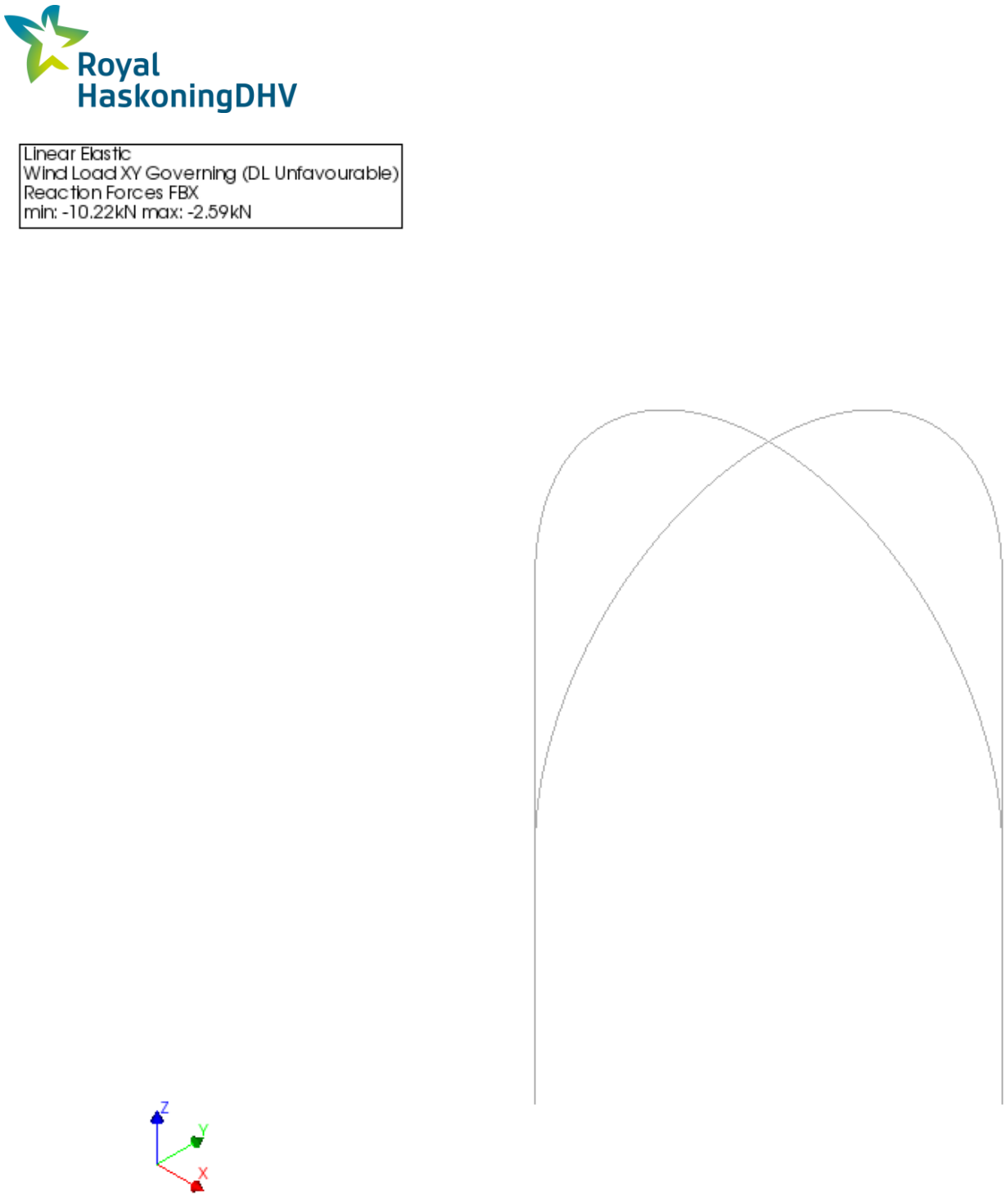


Figure 35: General - Reaction force FBX - Wind Load XY Governing (DL Unfavourable)

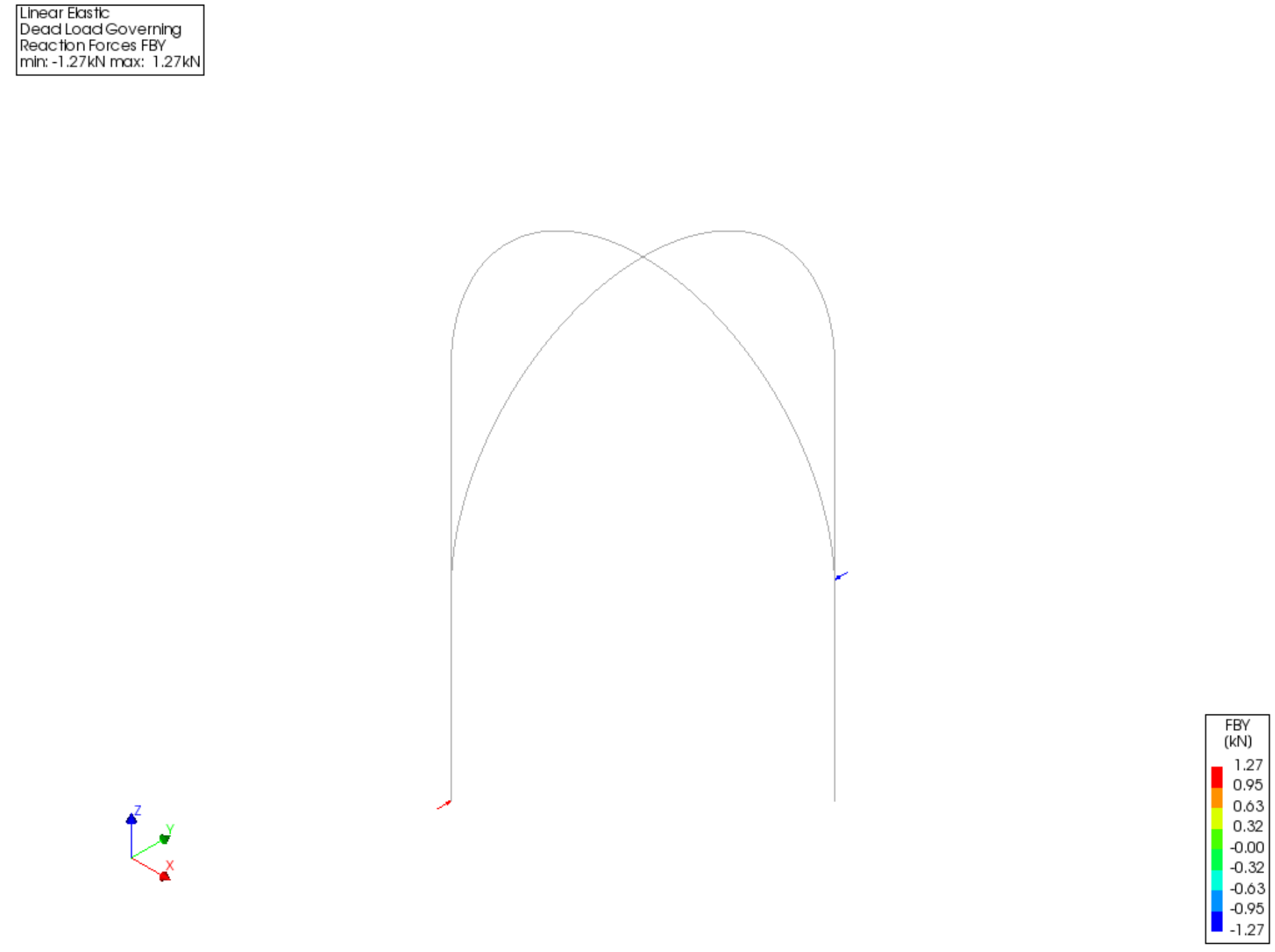


Figure 36: General - Reaction force FBY - Dead Load Governing

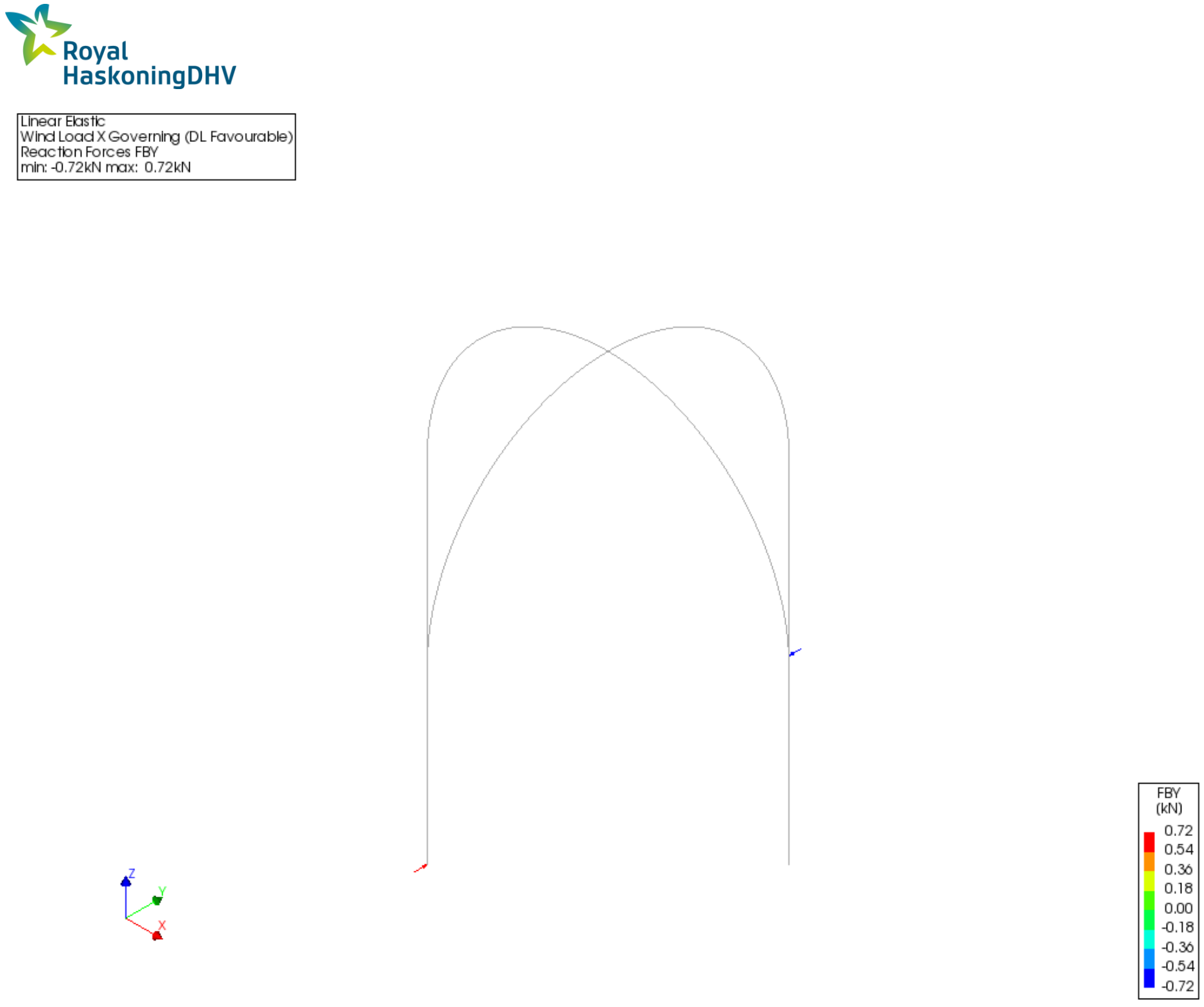


Figure 37: General - Reaction force FBY - Wind Load X Governing (DL Favourable)

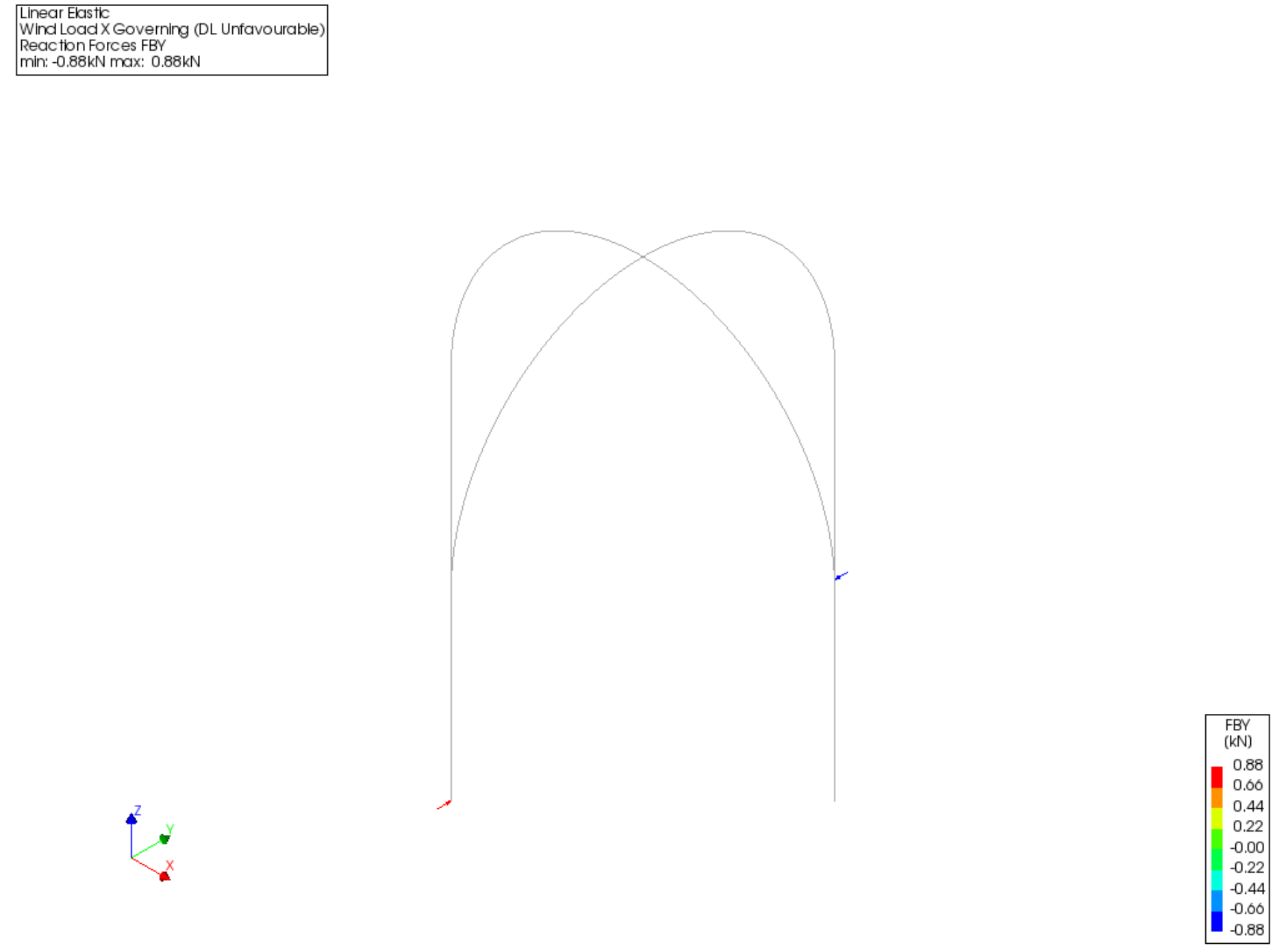


Figure 38: General - Reaction force FBY - Wind Load X Governing (DL Unfavourable)

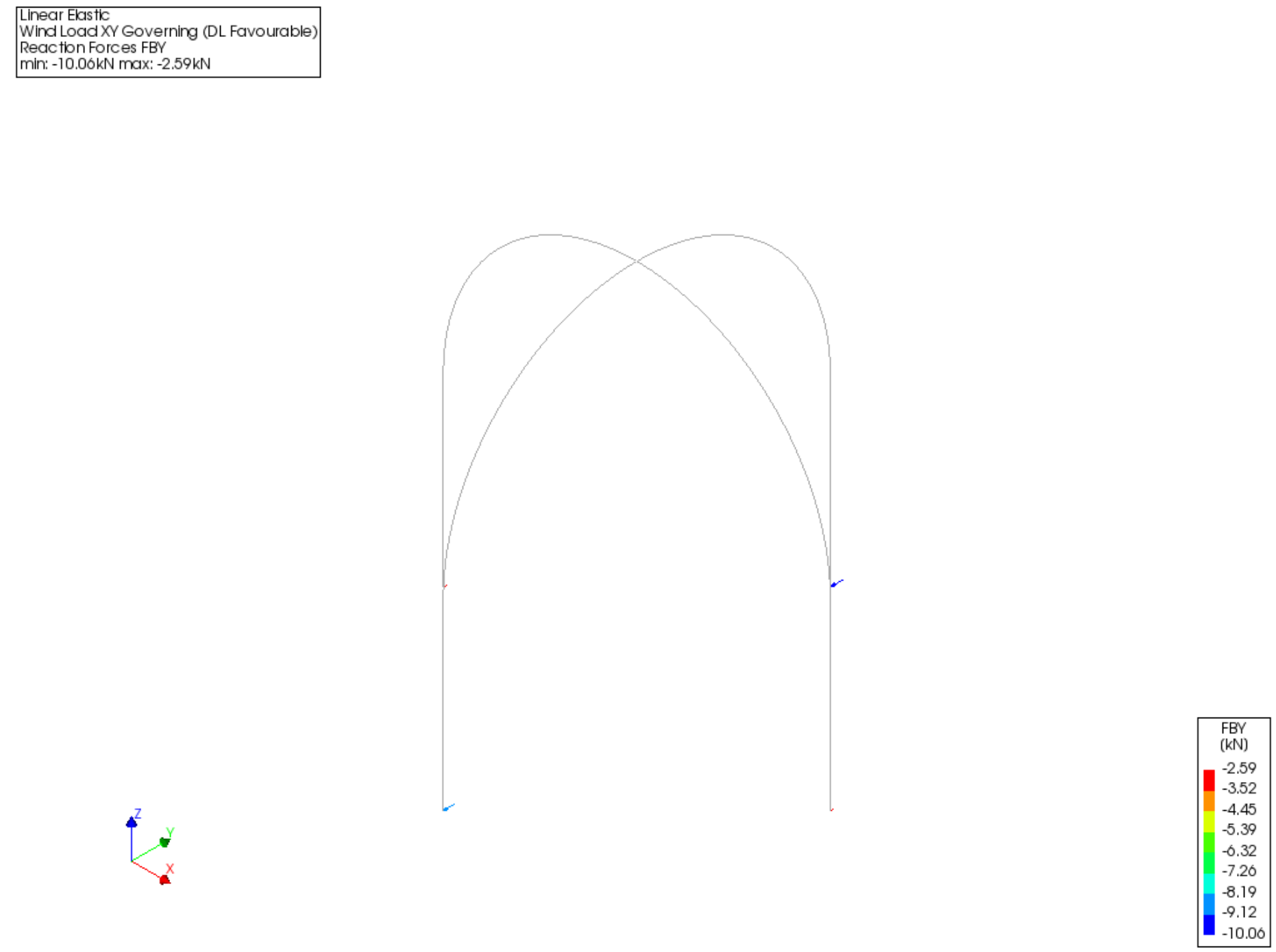


Figure 39: General - Reaction force FBY - Wind Load XY Governing (DL Favourable)

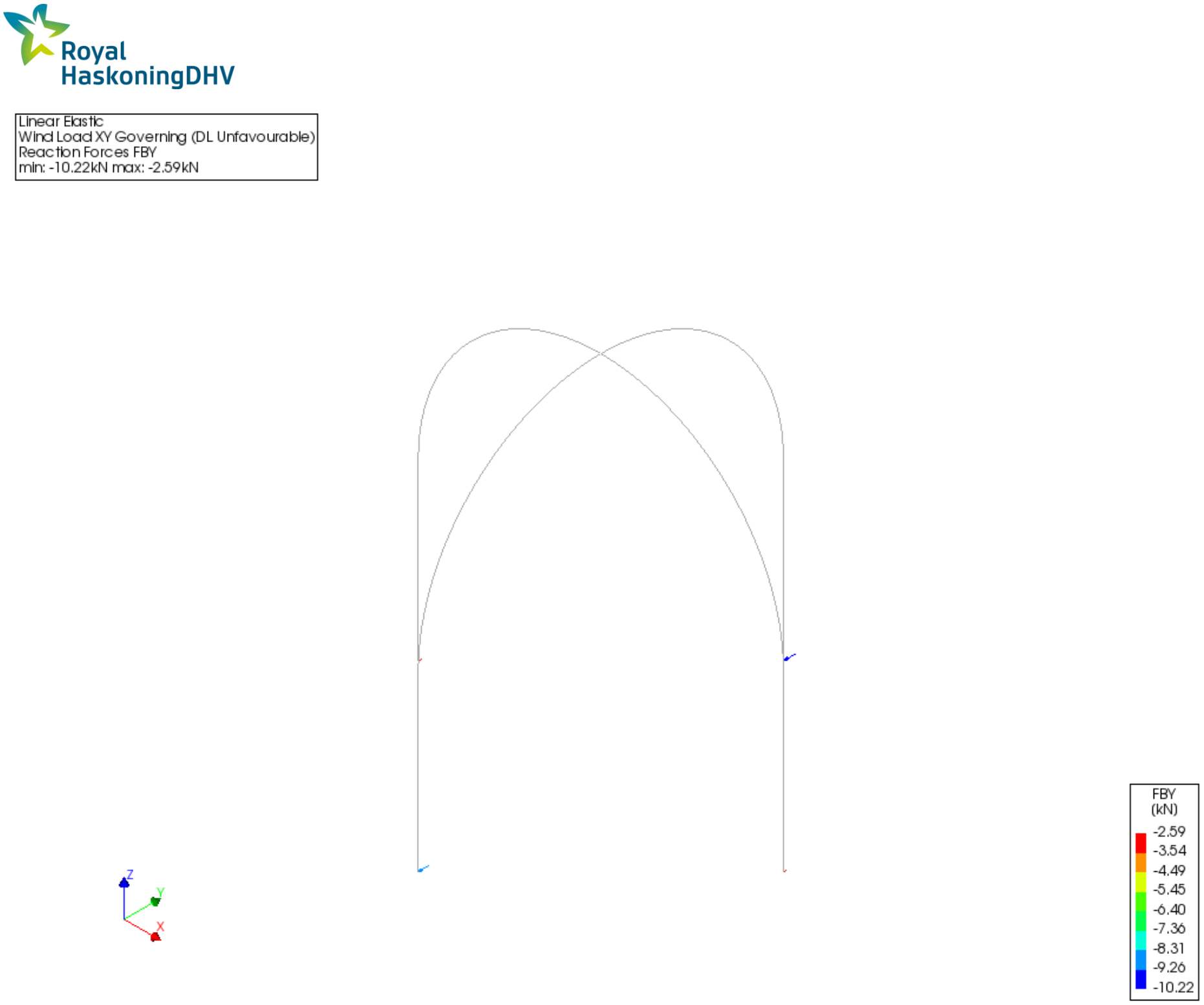


Figure 40: General - Reaction force FBY - Wind Load XY Governing (DL Unfavourable)

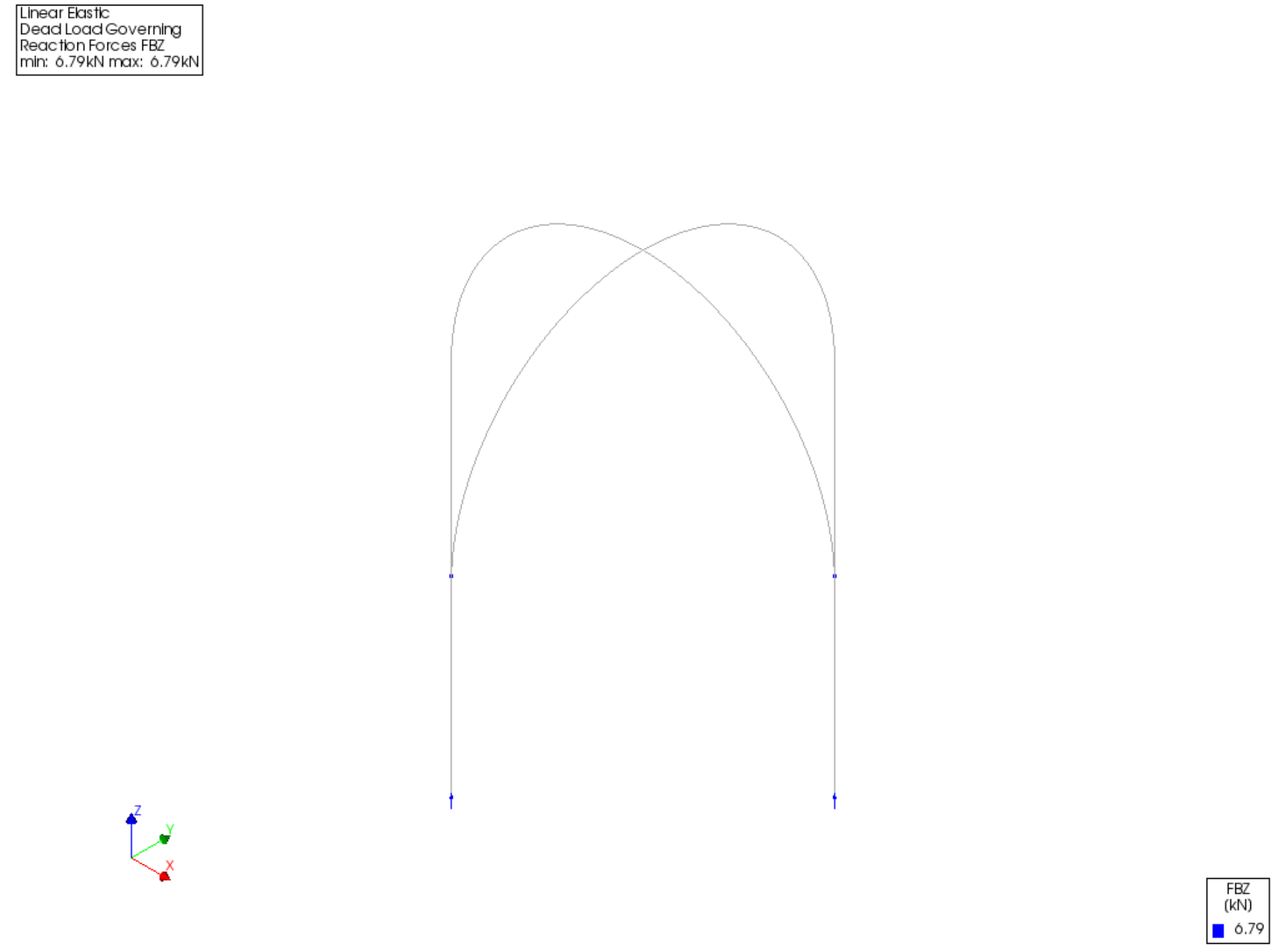


Figure 41: General - Reaction force FBZ - Dead Load Governing

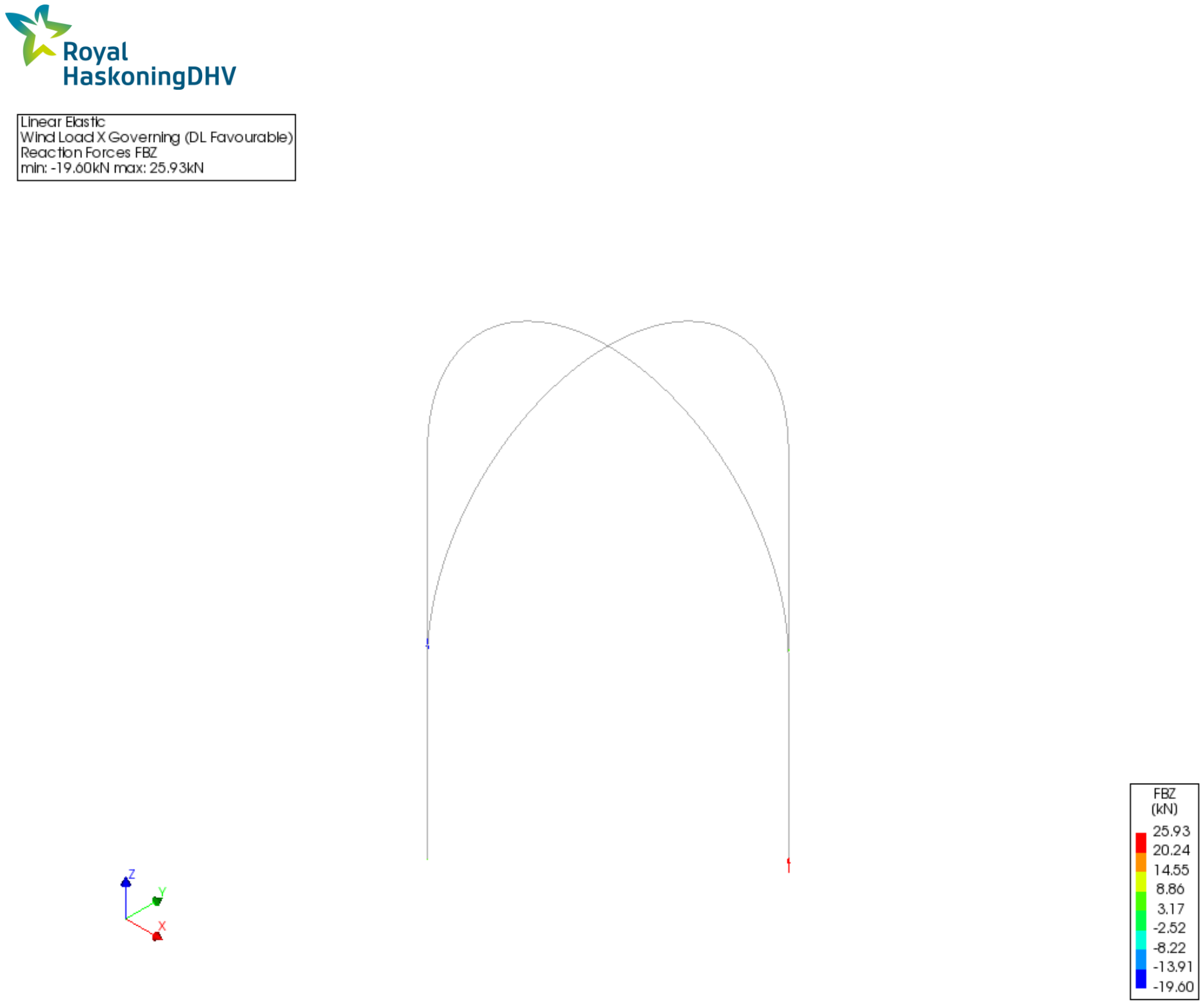


Figure 42: General - Reaction force FBZ - Wind Load X Governing (DL Favourable)

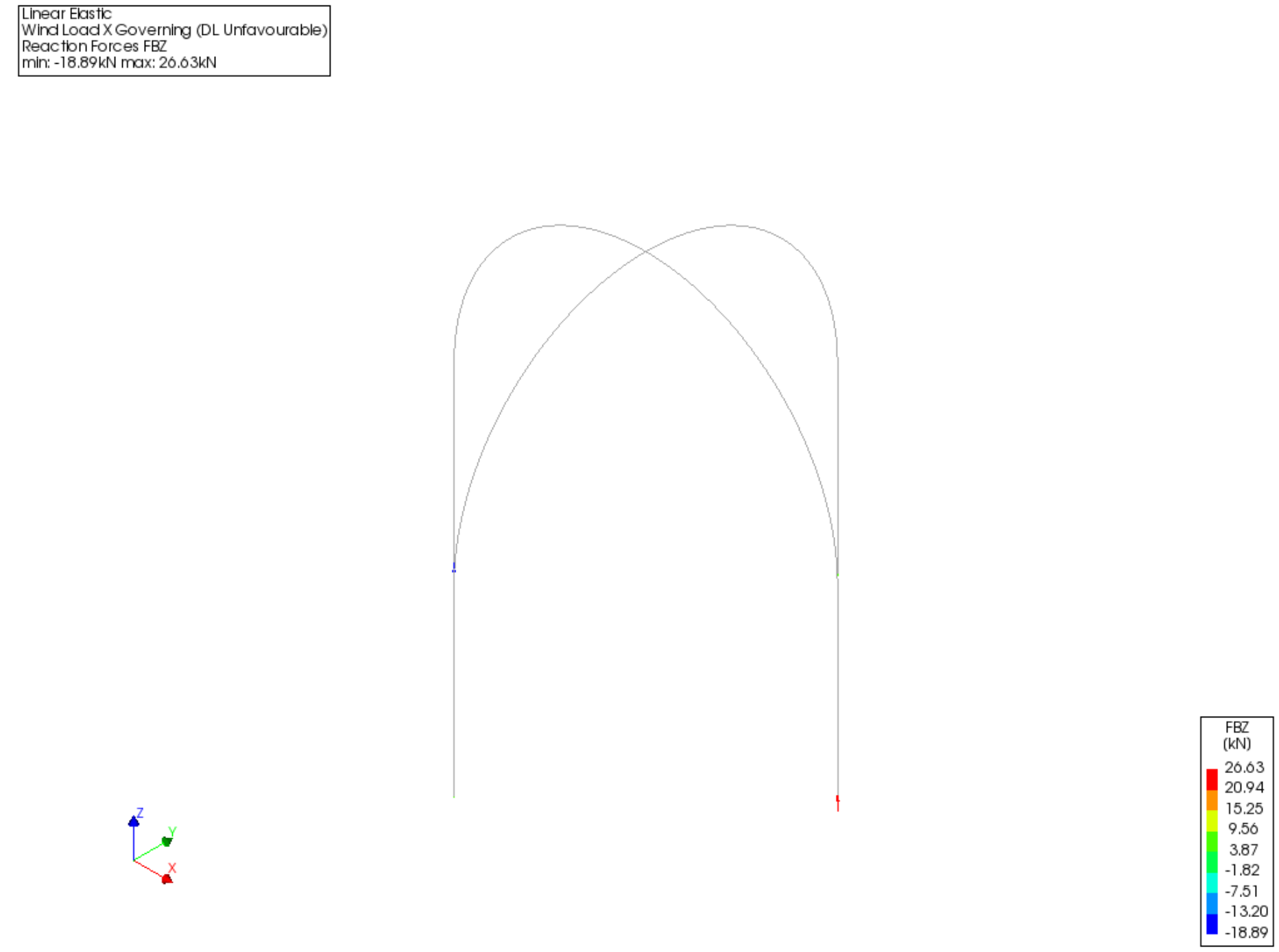


Figure 43: General - Reaction force FBZ - Wind Load X Governing (DL Unfavourable)

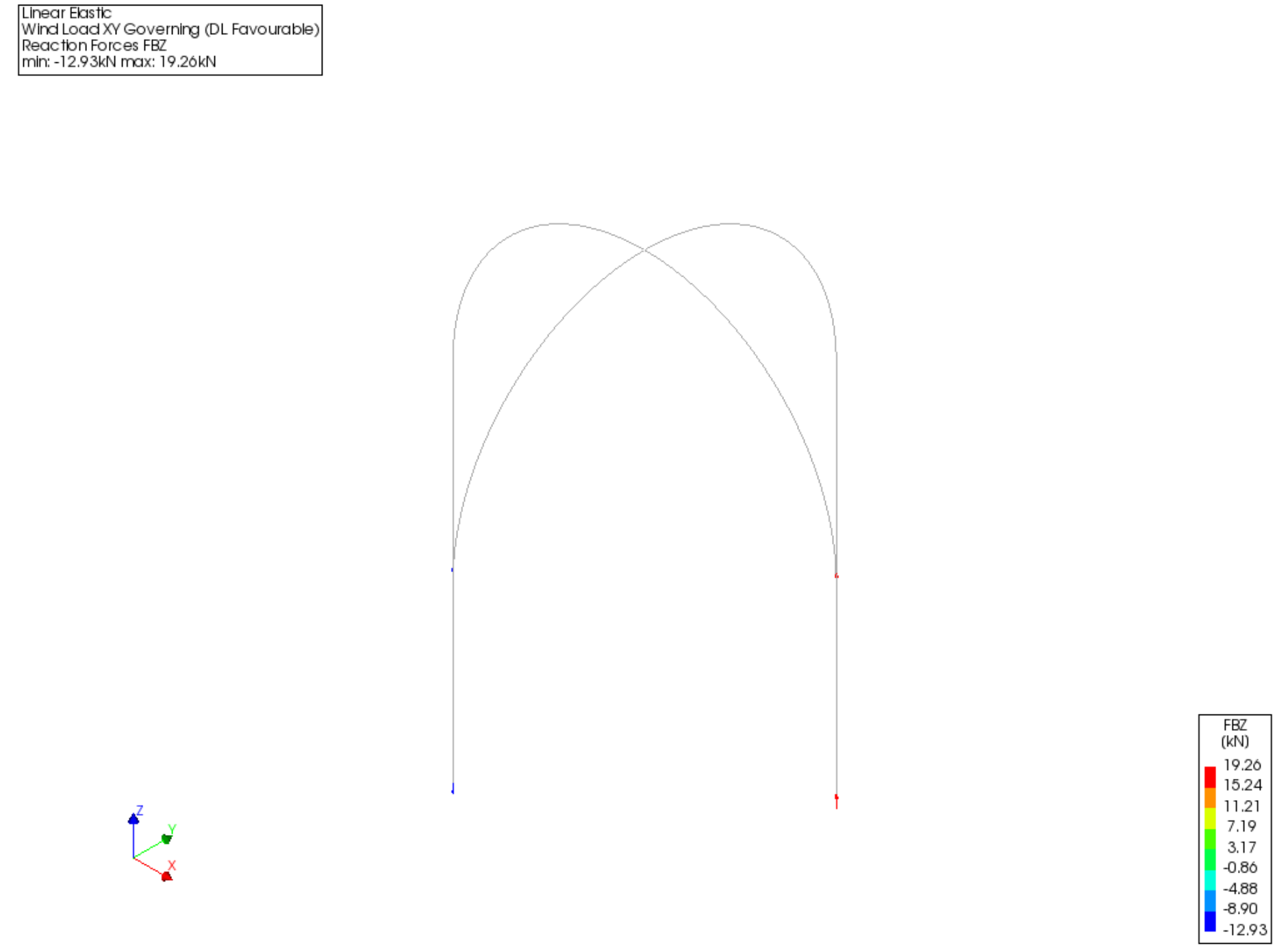


Figure 44: General - Reaction force FBZ - Wind Load XY Governing (DL Favourable)

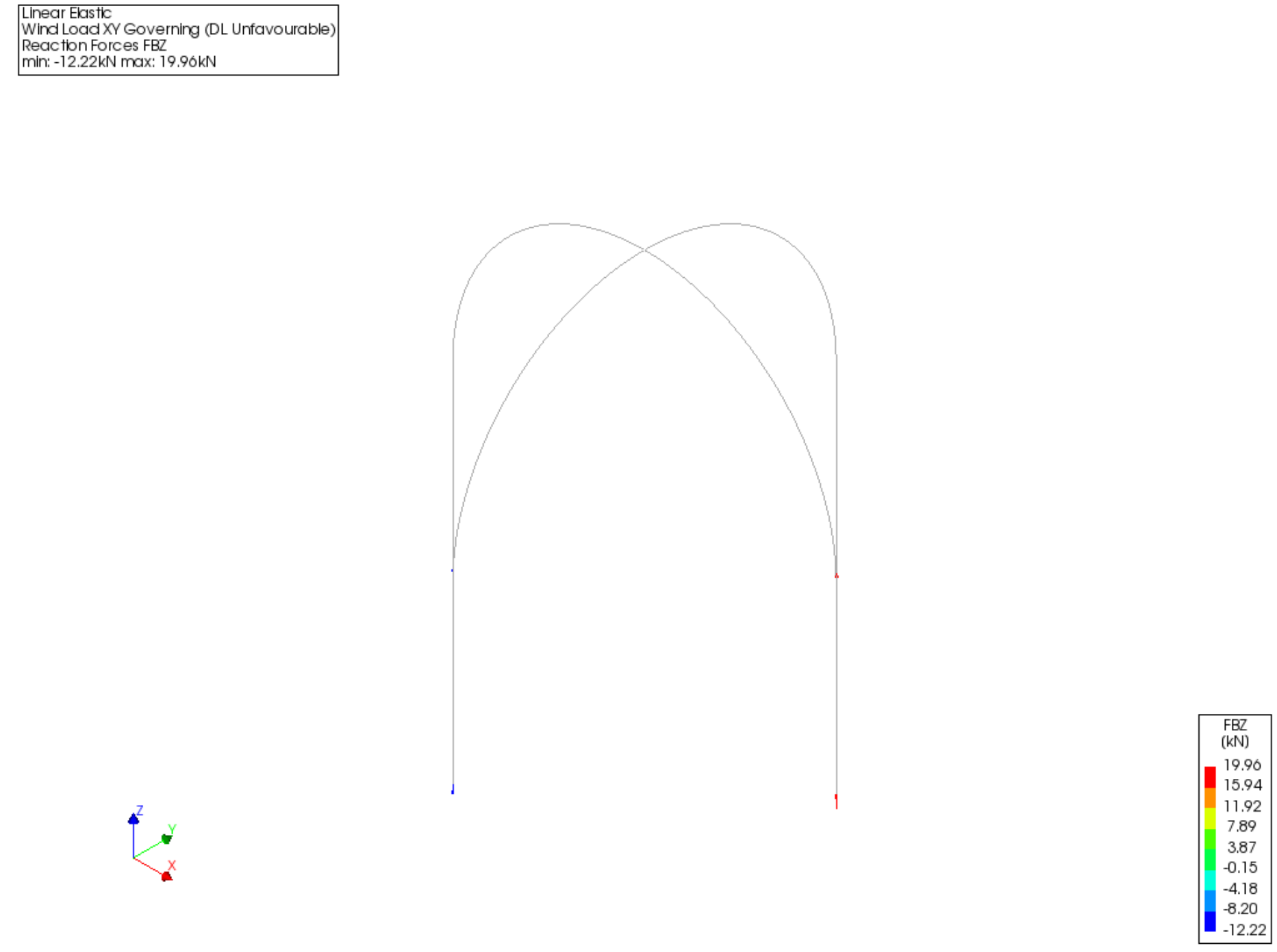


Figure 45: General - Reaction force FBZ - Wind Load XY Governing (DL Unfavourable)

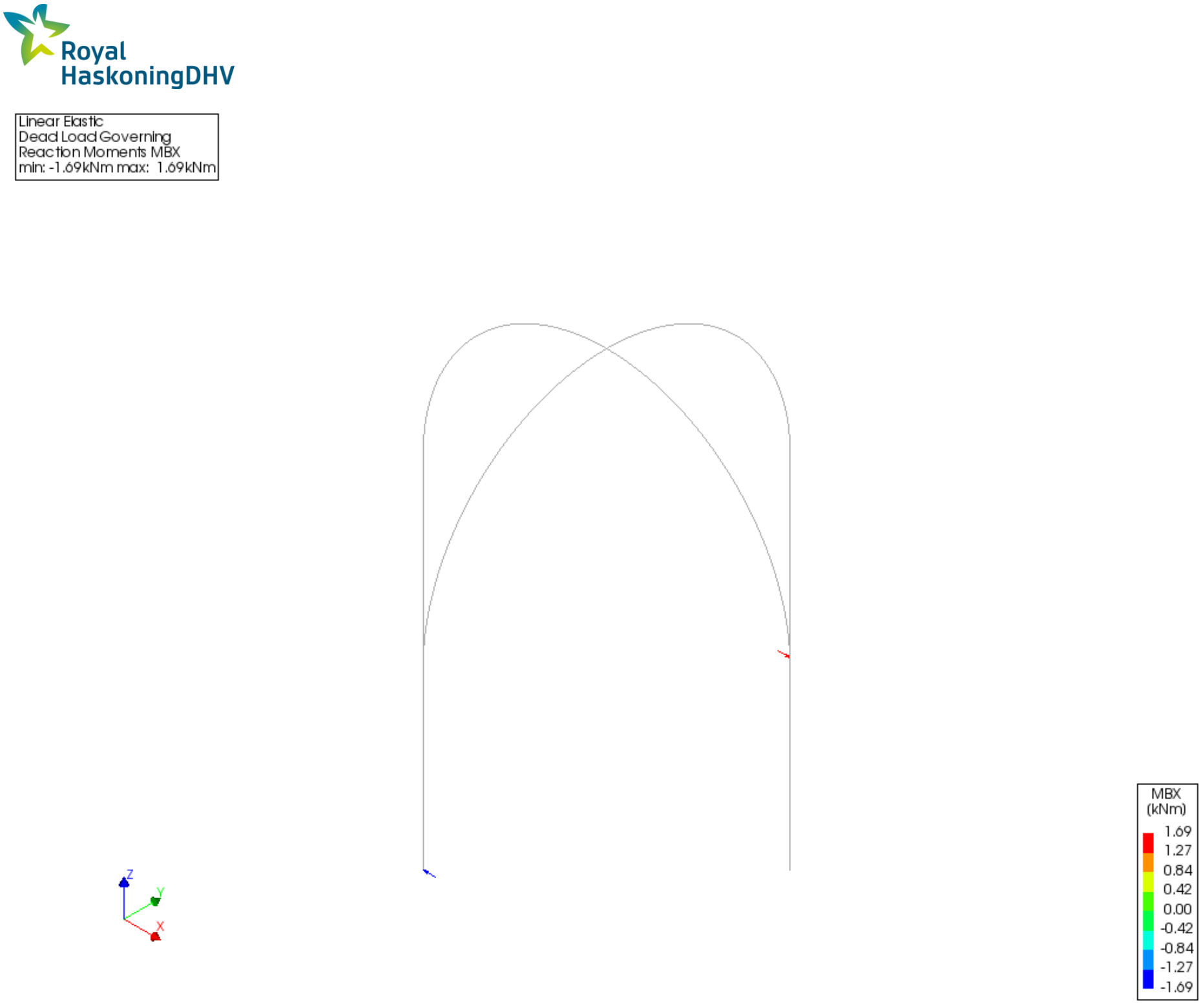


Figure 46: General - Reaction moment FBX - Dead Load Governing

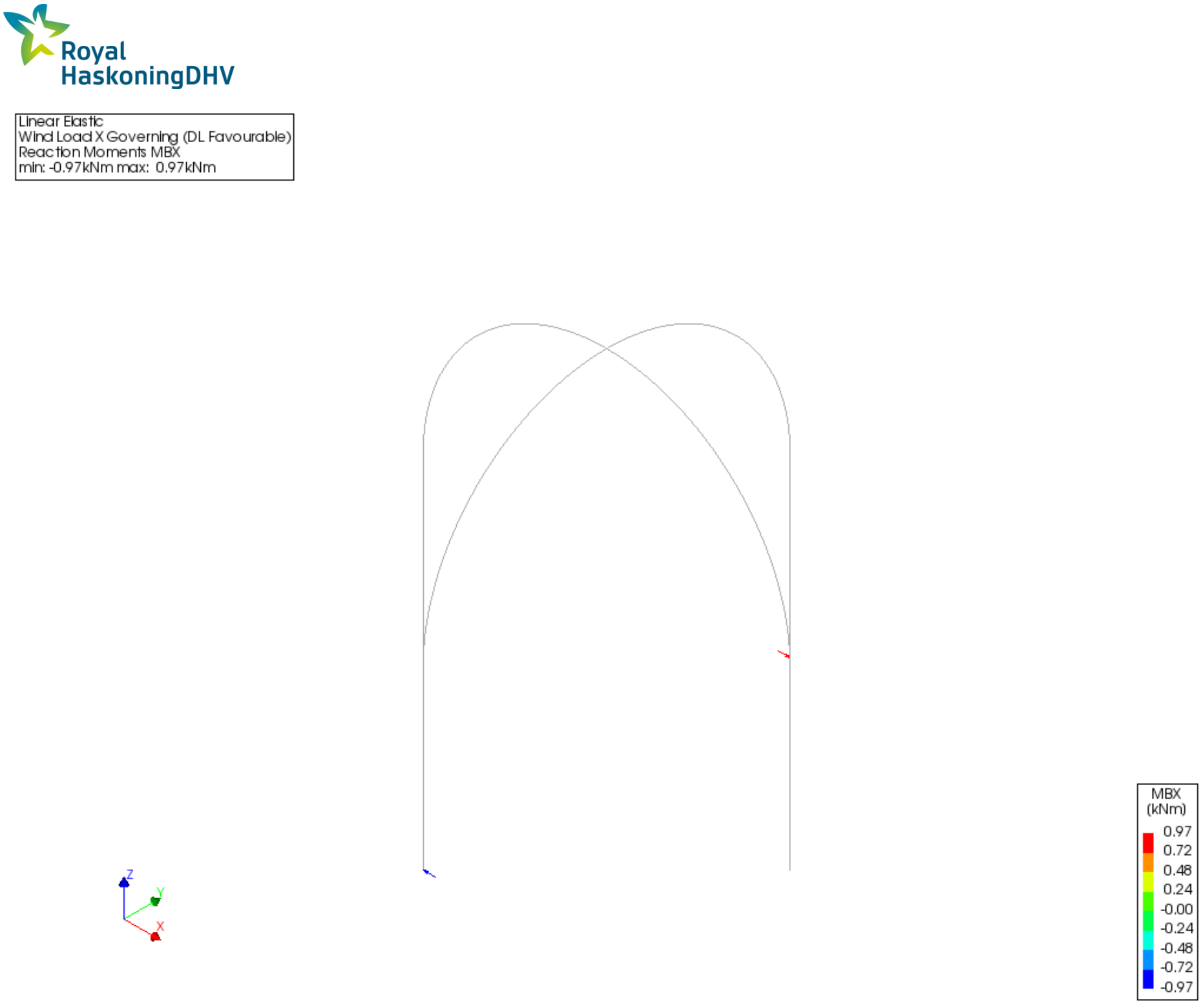


Figure 47: General - Reaction moment FBX - Wind Load X Governing (DL Favourable)

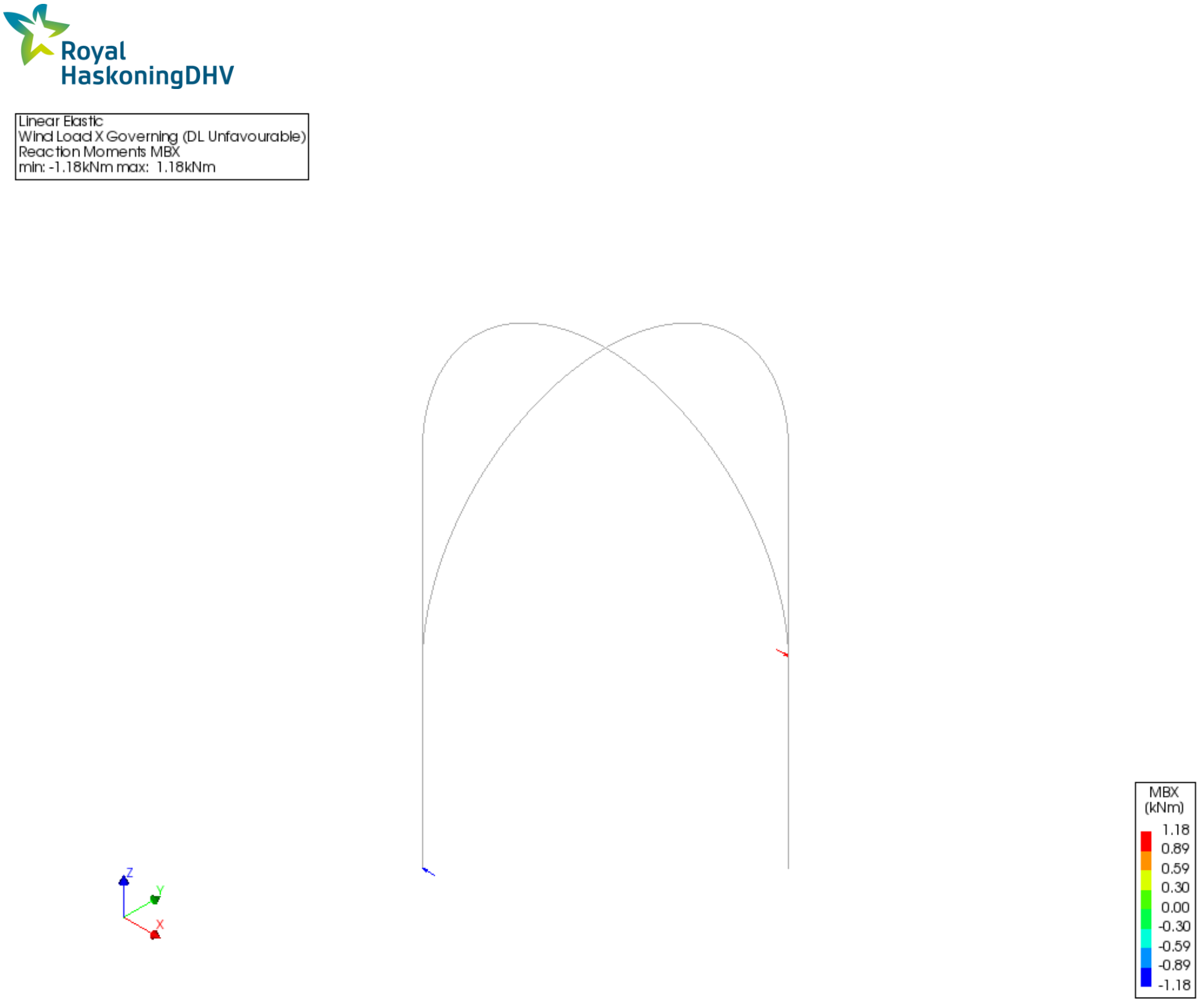


Figure 48: General - Reaction moment FBX - Wind Load X Governing (DL Unfavourable)

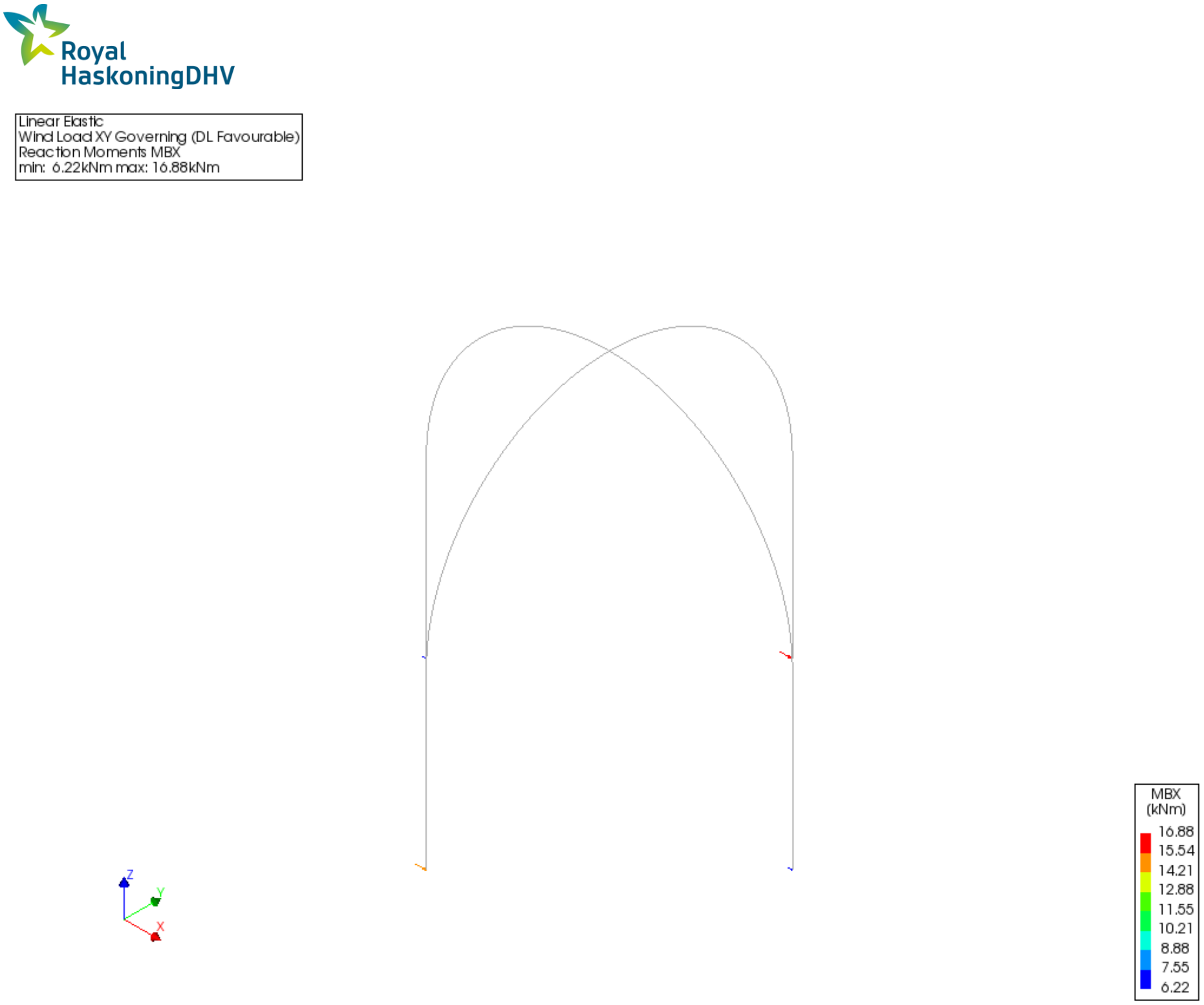


Figure 49: General - Reaction moment FBX - Wind Load XY Governing (DL Favourable)

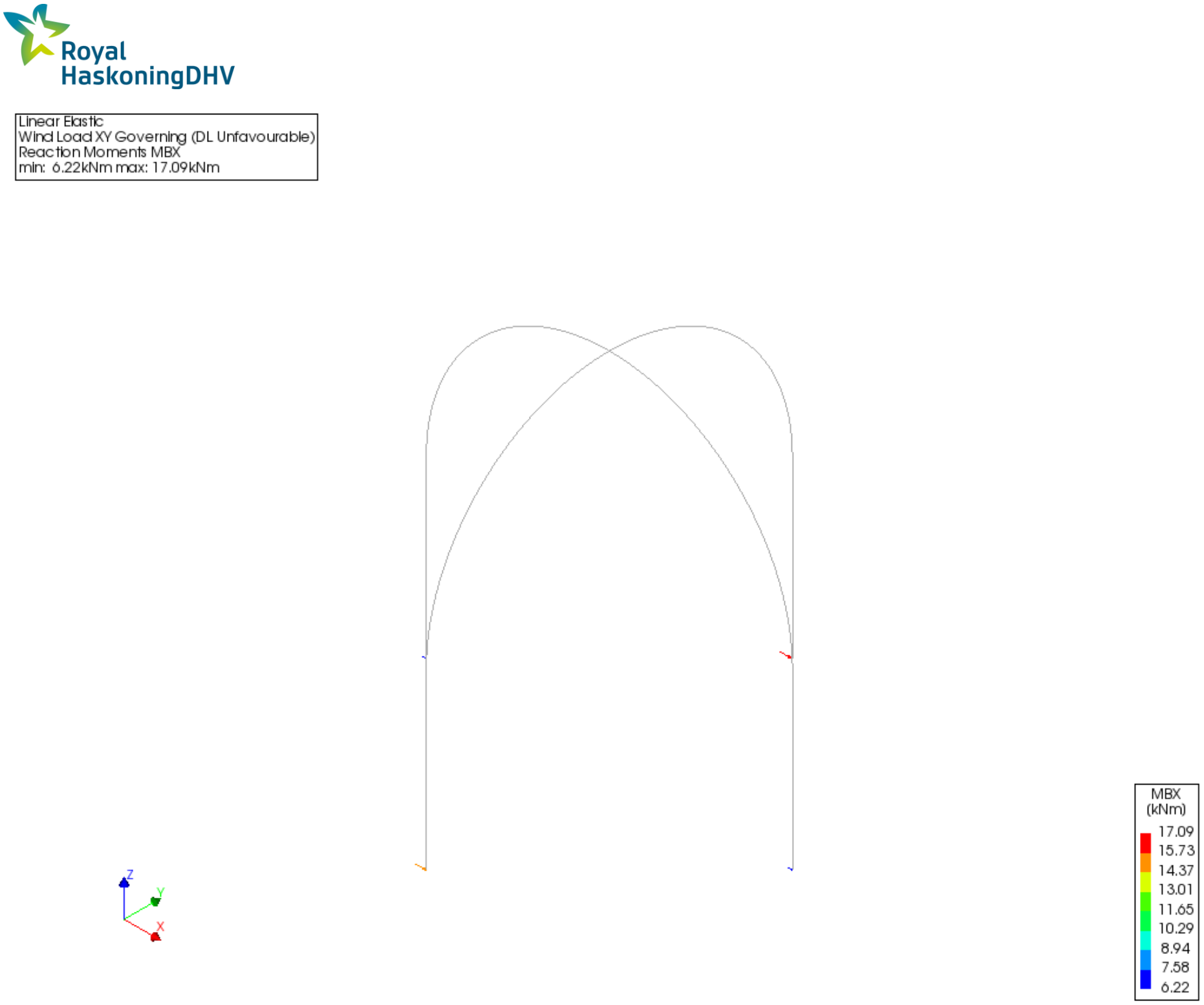


Figure 50: General - Reaction moment FBX - Wind Load XY Governing (DL Unfavourable)

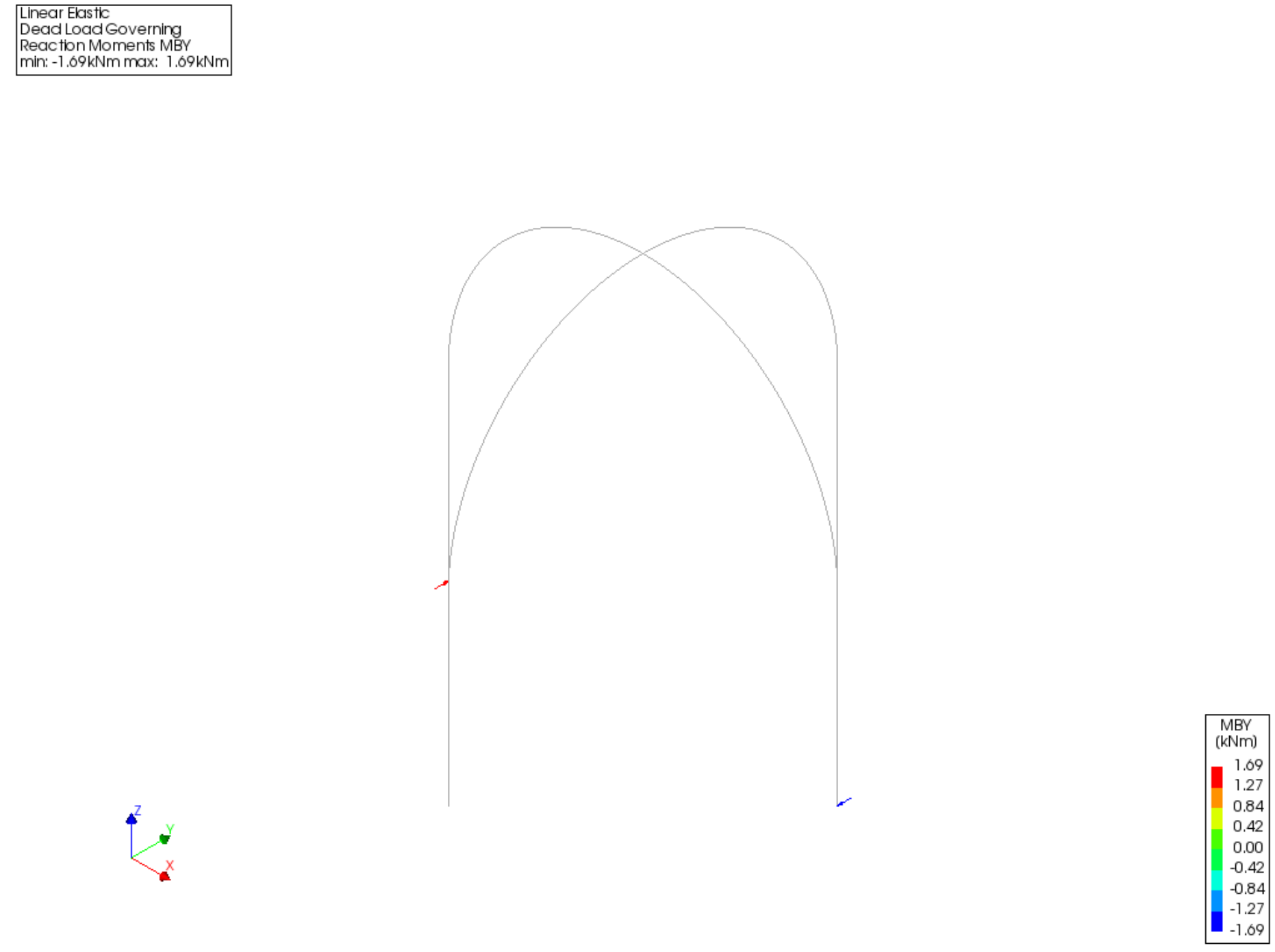


Figure 51: General - Reaction moment FBY - Dead Load Governing

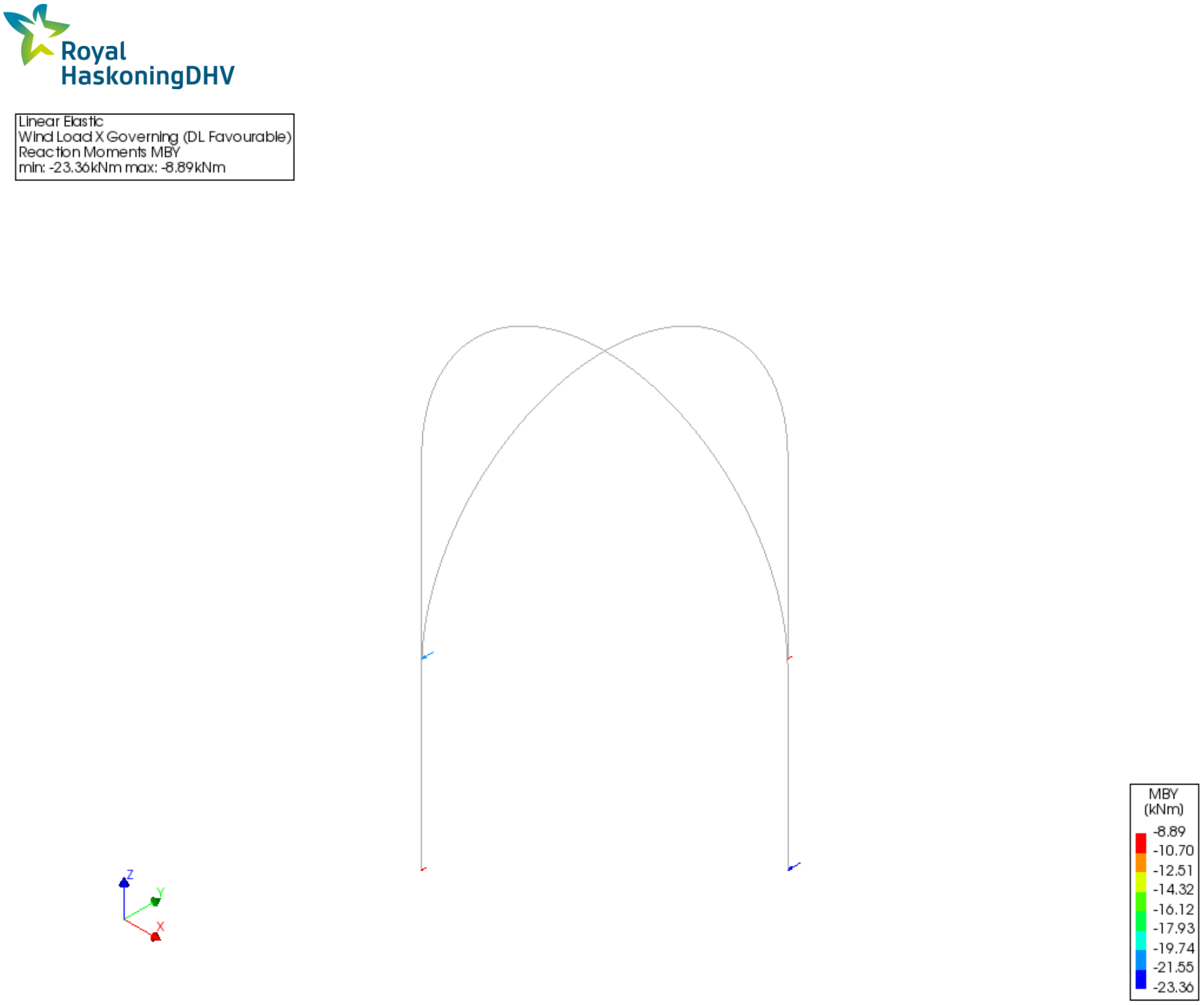


Figure 52: General - Reaction moment FBY - Wind Load X Governing (DL Favourable)

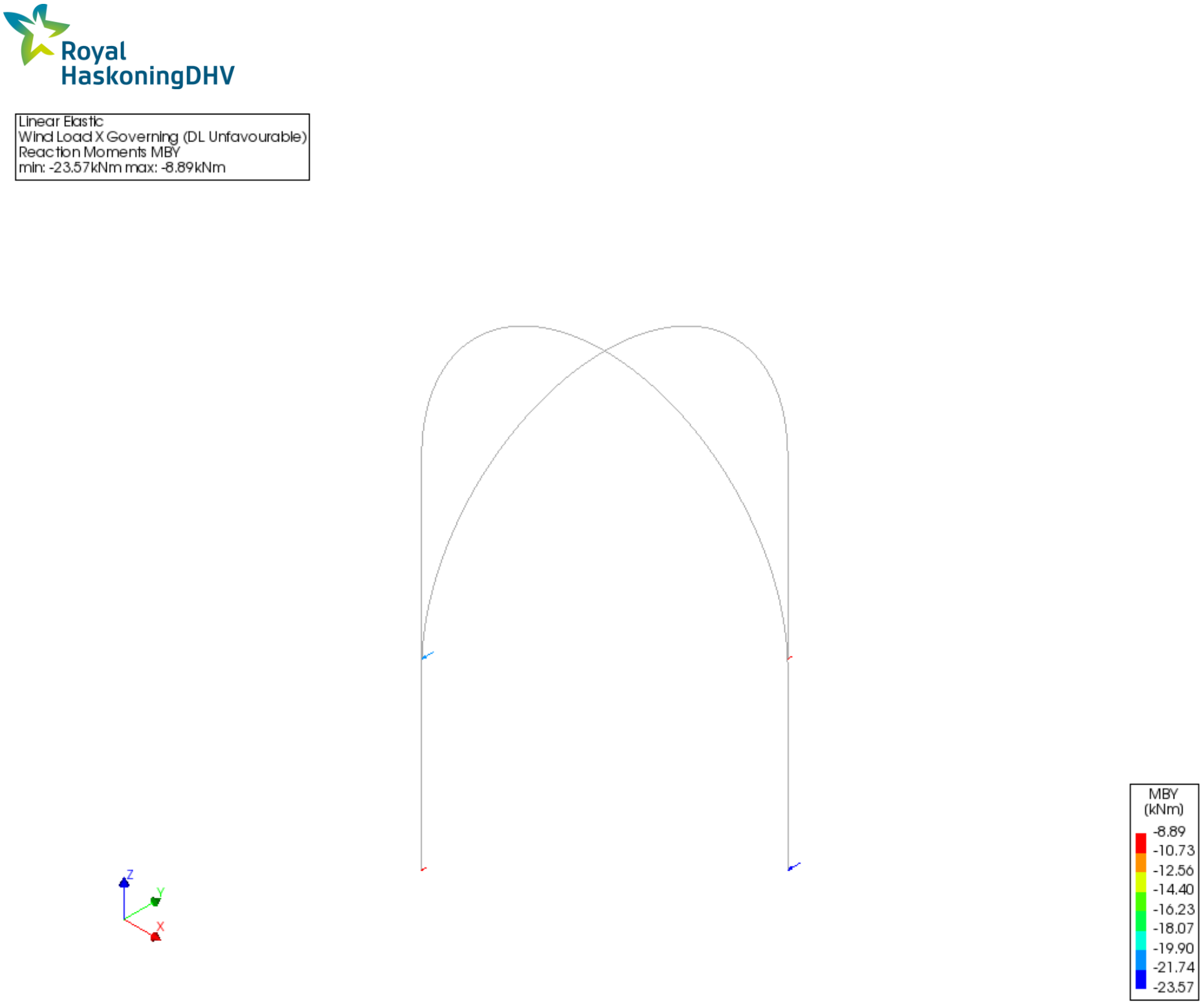


Figure 53: General - Reaction moment FBY - Wind Load X Governing (DL Unfavourable)

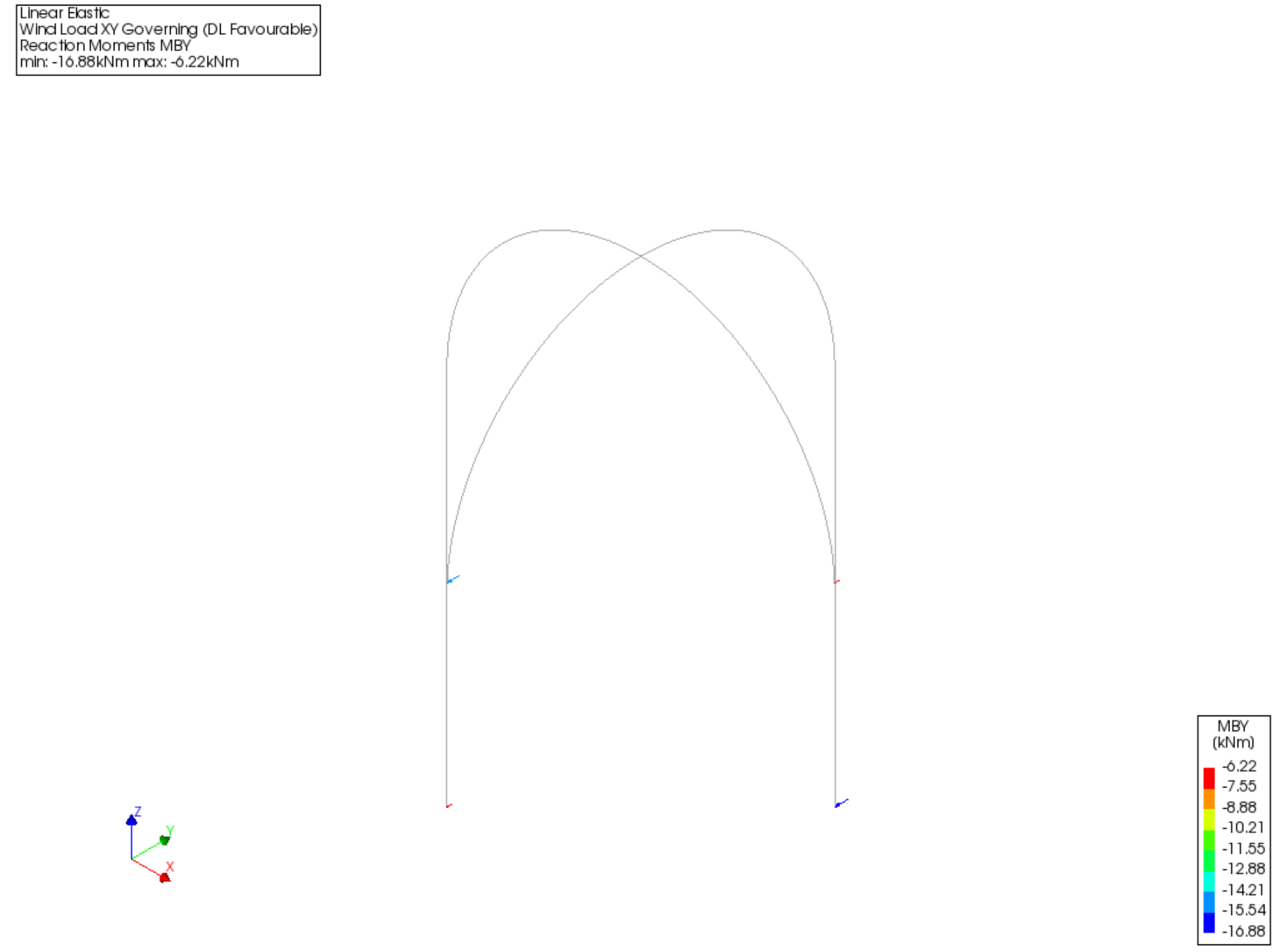


Figure 54: General - Reaction moment FBY - Wind Load XY Governing (DL Favourable)

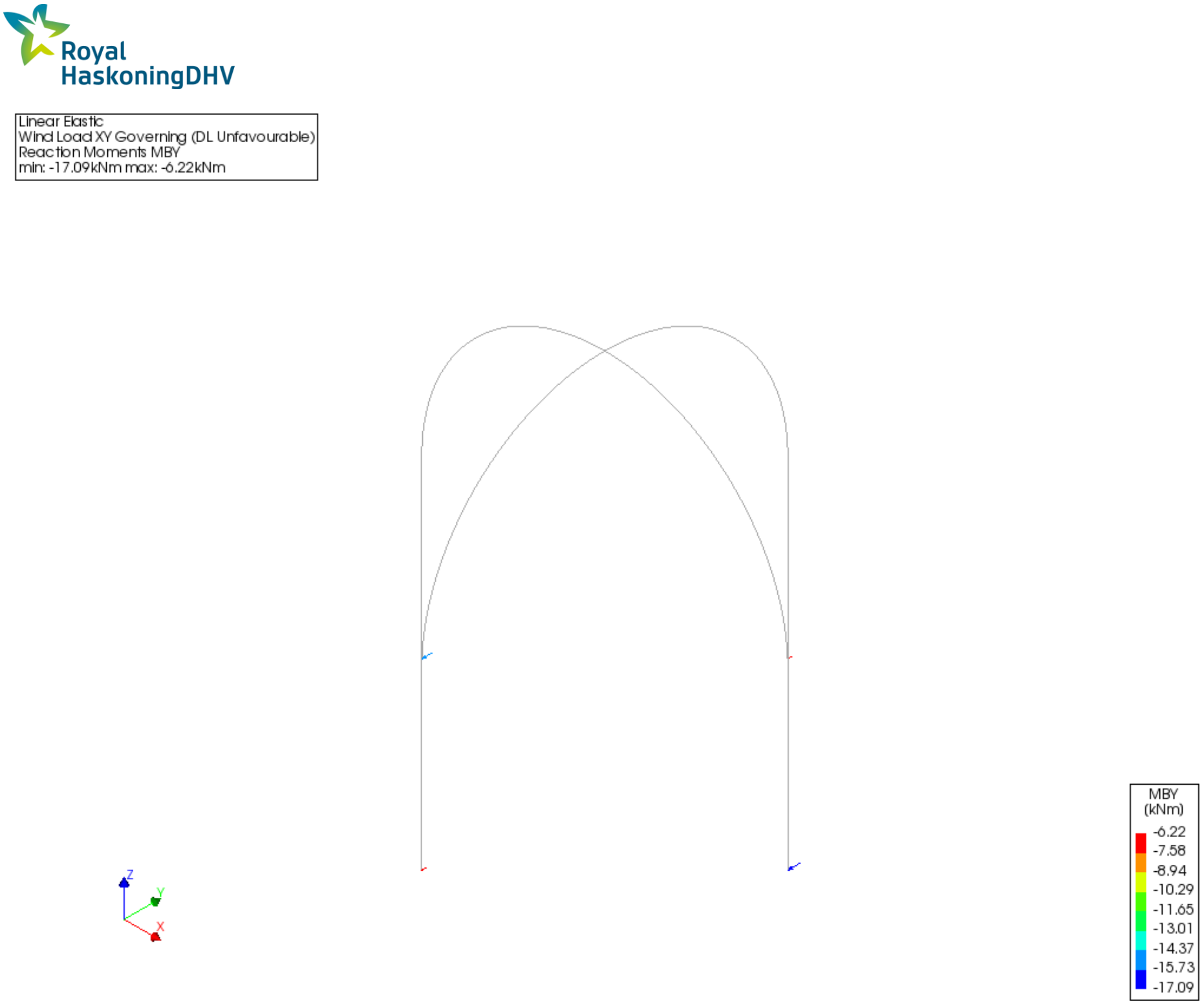


Figure 55: General - Reaction moment FBY - Wind Load XY Governing (DL Unfavourable)

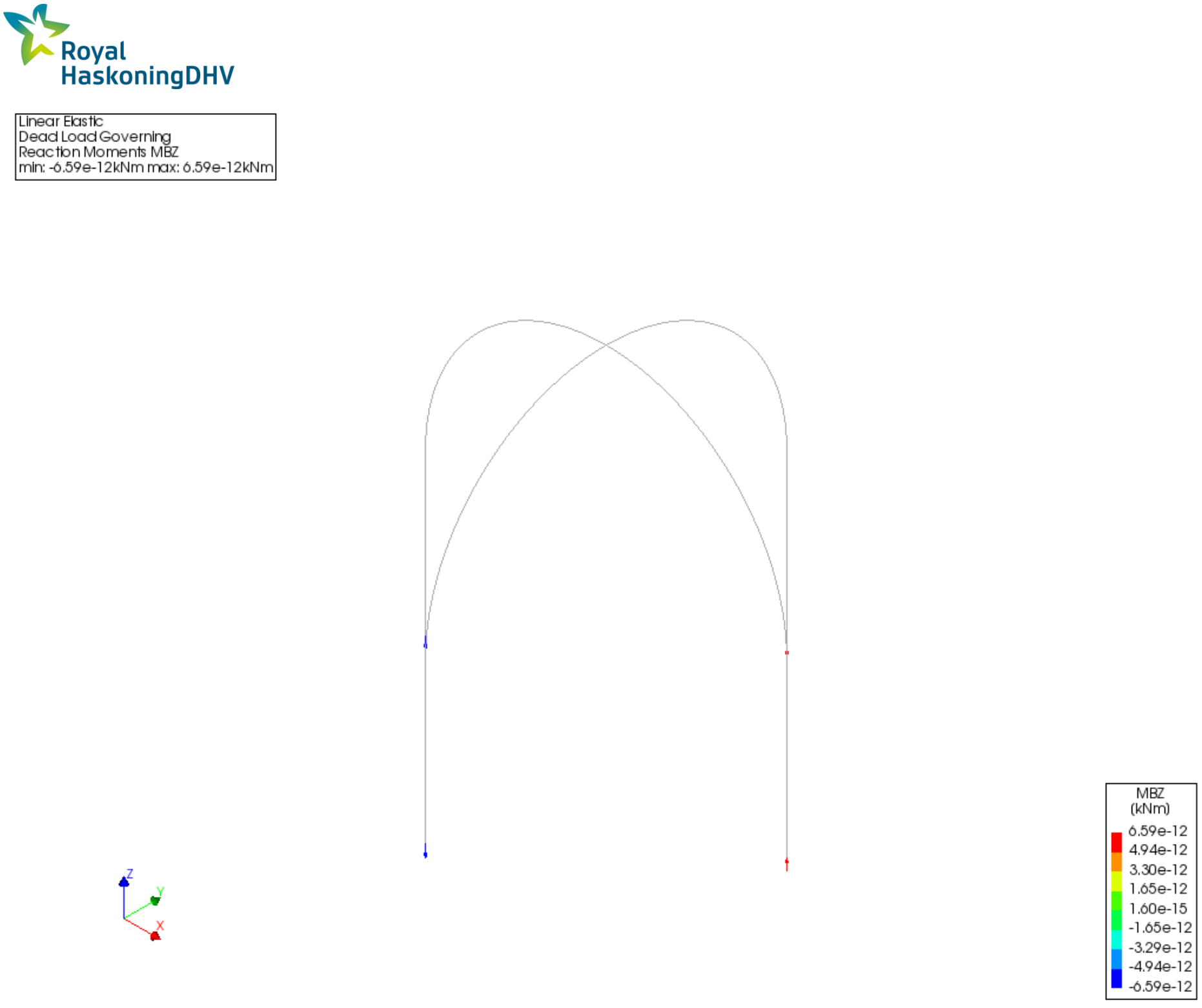


Figure 56: General - Reaction moment FBZ - Dead Load Governing

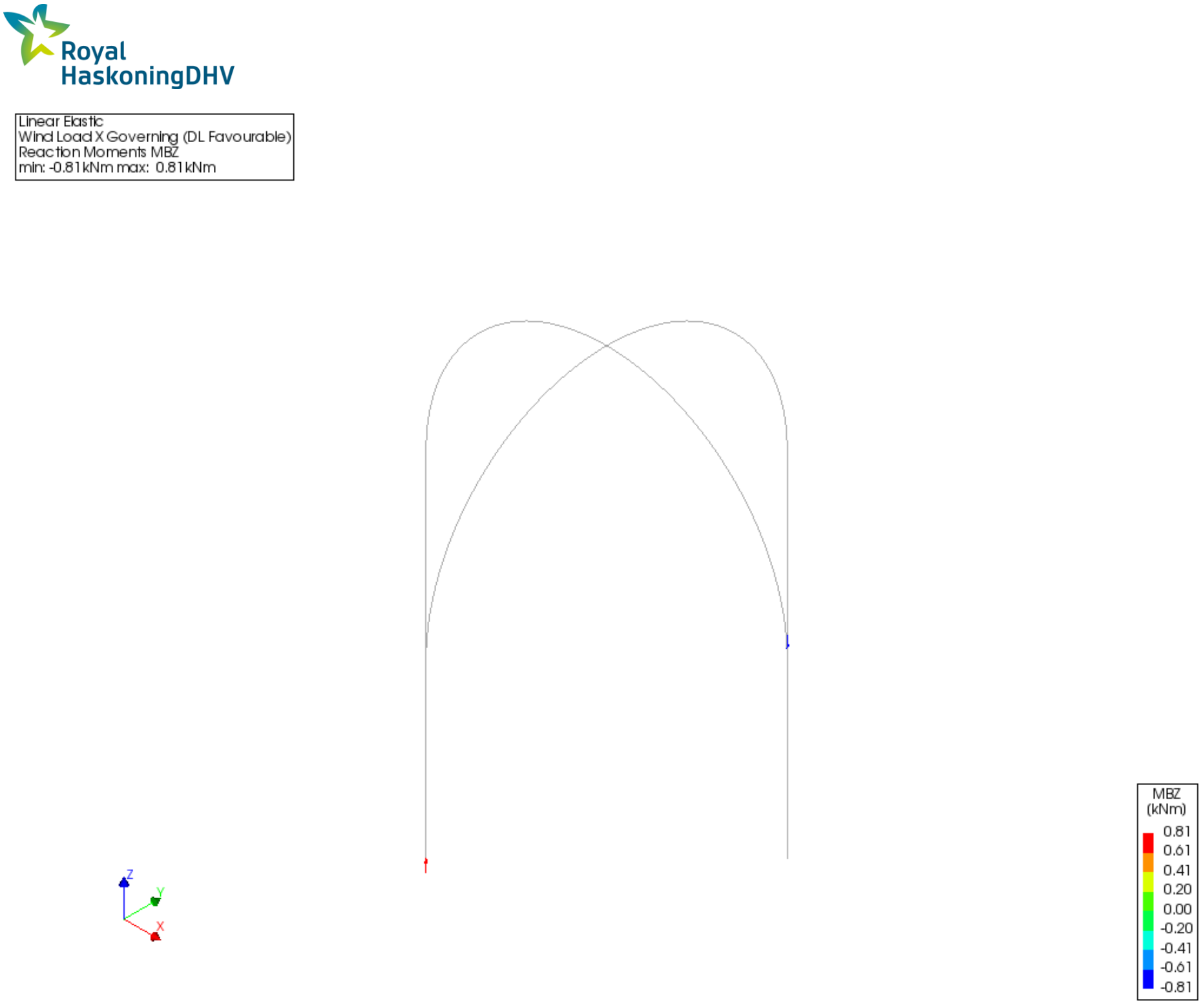


Figure 57: General - Reaction moment FBZ - Wind Load X Governing (DL Favourable)

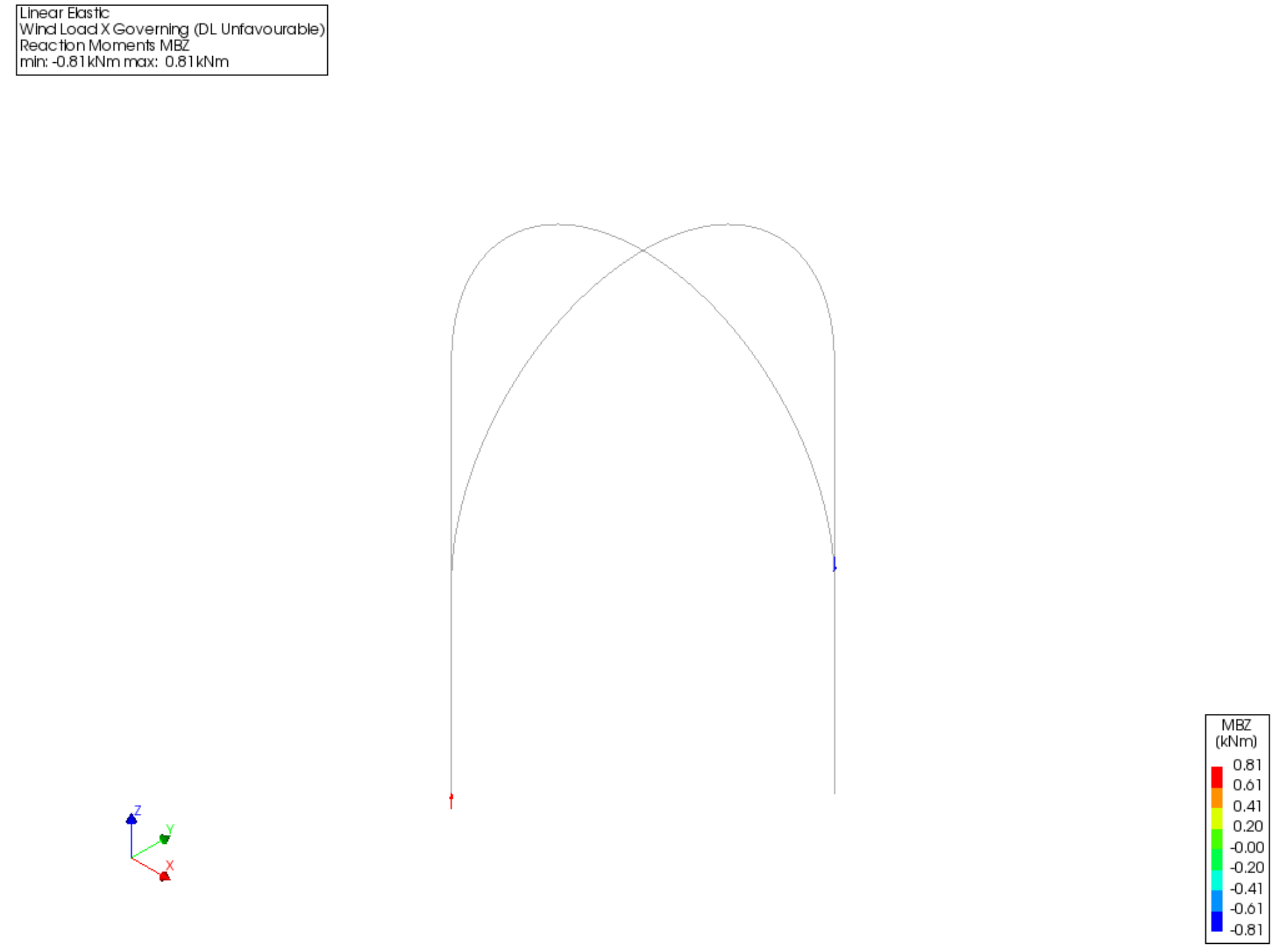


Figure 58: General - Reaction moment FBZ - Wind Load X Governing (DL Unfavourable)

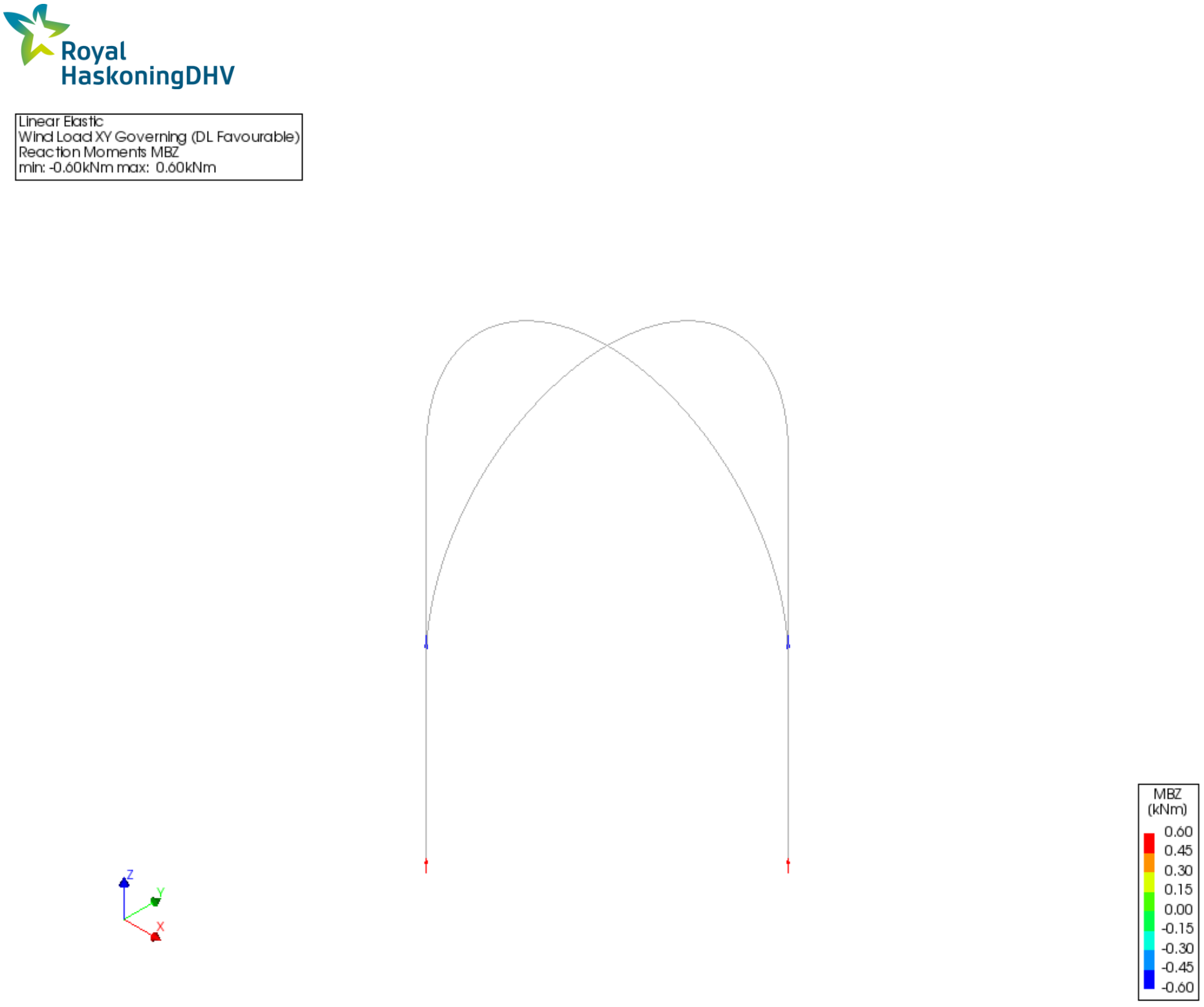


Figure 59: General - Reaction moment FBZ - Wind Load XY Governing (DL Favourable)

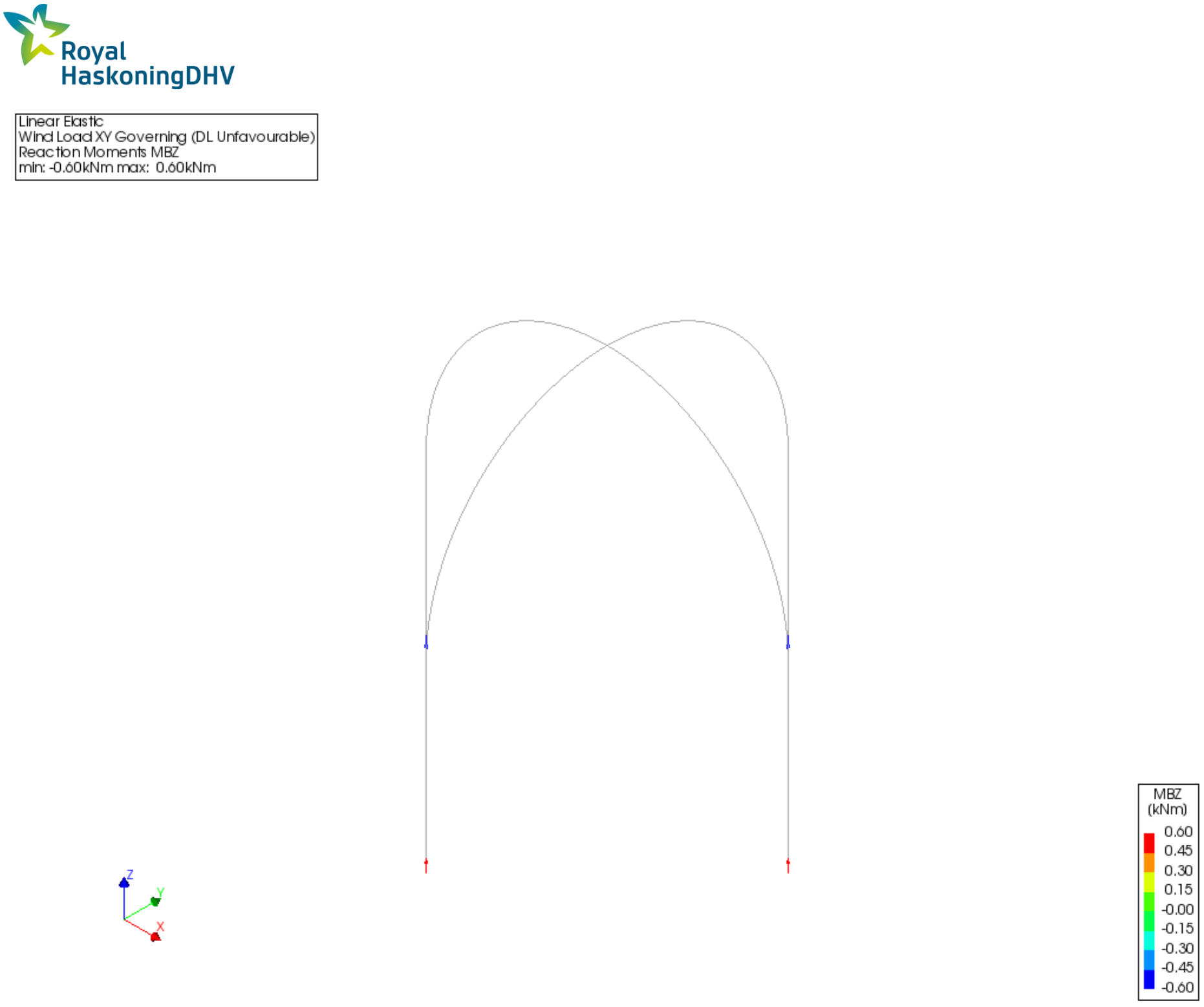


Figure 60: General - Reaction moment FBZ - Wind Load XY Governing (DL Unfavourable)