Detected Resonant Frequencies (0-200 Hz):
16
52
66
88
116
122
148
188

Estimated Damping Ratios:
Mode near 16.00 Hz → ζ = 0.1250
Mode near 52.00 Hz → ζ = 0.0385
Mode near 66.00 Hz → ζ = 0.0303
Mode near 88.00 Hz → ζ = 0.0227
Mode near 116.00 Hz → ζ = 0.0259
Mode near 122.00 Hz → ζ = 0.0246
Mode near 148.00 Hz → ζ = 0.0203

Normalized Mode Shapes (0-200 Hz):

Mode at 16.00 Hz:
X: 0.068∠170.4°
Y: 0.083∠34.2°
Z: 1.000∠171.3°

Mode at 52.00 Hz:
X: 0.049∠-112.6°
Y: 0.033∠-113.0°
Z: 1.000∠-112.0°

Mode at 66.00 Hz:
X: 0.118∠139.2°
Y: 0.537∠-124.2°
Z: 1.000∠0.9°

Mode at 88.00 Hz:
X: 0.037∠74.7°
Y: 1.000∠167.5°

Z: 0.387∠-152.1°

Mode at 116.00 Hz:
X: 0.391∠144.6°
Y: 0.099∠140.3°
Z: 1.000∠137.8°

Mode at 122.00 Hz:
X: 0.330∠89.2°
Y: 0.043∠84.7°
Z: 1.000∠83.5°

Mode at 148.00 Hz:
X: 0.247∠18.5°
Y: 0.474∠-91.5°
Z: 1.000∠17.0°

Mode at 188.00 Hz:
X: 0.140∠-23.4°
Y: 0.492∠144.7°
Z: 1.000∠6.2°

=== Modal Parameter Summary (0-200 Hz) ===

Freq_Hz	Damping	Phi_X	Phi_Y	Phi_Z
16	0.125	-0.06665+0.01128i	0.068933+0.046829i	-0.98857+0.15078i
52	0.038462	-0.018775-0.045128i	-0.013096-0.030822i	-0.37406-0.92741i
66	0.030303	-0.089609+0.077387i	-0.30233-0.44438i	0.99988+0.015461i
88	0.022727	0.0098825+0.036166i	-0.97626+0.21661i	-0.34216-0.18108i
116	0.025862	-0.31909+0.22674i	-0.076167+0.063183i	-0.74137+0.67109i
122	0.02459	0.0047297+0.32994i	0.0039285+0.042642i	0.11388+0.99349i
148	0.02027	0.23464+0.078528i	-0.012037-0.47393i	0.95624+0.29258i
188	NaN	0.12821-0.055432i	-0.40122+0.28446i	0.99408+0.10862i

Detected Resonant Frequencies (0-200 Hz):
16
52
66
88

116
122
148
188

Estimated Damping Ratios:
0.1250
0.0385
0.0303
0.0227
0.0259
0.0246
0.0203
NaN

=== Modal Summary (0-200 Hz) ===
Mode 1: f=16.00 Hz, Damping=0.1250, k_dyn_X=4217962.41 N/m, k_dyn_Y=3421415.21 N/m, k_dyn_Z=285125.19 N/m
Mode Shape (X,Y,Z): 0.068∠170.4°, 0.083∠34.2°, 1.000∠171.3°
Mode 2: f=52.00 Hz, Damping=0.0385, k_dyn_X=81564933.63 N/m, k_dyn_Y=119045893.53 N/m, k_dyn_Z=3986719.80 N/m
Mode Shape (X,Y,Z): 0.049∠-112.6°, 0.033∠-113.0°, 1.000∠-112.0°
Mode 3: f=66.00 Hz, Damping=0.0303, k_dyn_X=662772108.15 N/m, k_dyn_Y=146000558.14 N/m, k_dyn_Z=78472075.63 N/m
Mode Shape (X,Y,Z): 0.118∠139.2°, 0.537∠-124.2°, 1.000∠0.9°
Mode 4: f=88.00 Hz, Damping=0.0227, k_dyn_X=3342431489.07 N/m, k_dyn_Y=125314581.96 N/m, k_dyn_Z=323709951.74 N/m
Mode Shape (X,Y,Z): 0.037∠74.7°, 1.000∠167.5°, 0.387∠-152.1°
Mode 5: f=116.00 Hz, Damping=0.0259, k_dyn_X=96143926.31 N/m, k_dyn_Y=380298821.74 N/m, k_dyn_Z=37634951.31 N/m
Mode Shape (X,Y,Z): 0.391∠144.6°, 0.099∠140.3°, 1.000∠137.8°
Mode 6: f=122.00 Hz, Damping=0.0246, k_dyn_X=56525995.41 N/m, k_dyn_Y=435566812.24 N/m, k_dyn_Z=18651892.24 N/m
Mode Shape (X,Y,Z): 0.330∠89.2°, 0.043∠84.7°, 1.000∠83.5°
Mode 7: f=148.00 Hz, Damping=0.0203, k_dyn_X=328220015.29 N/m, k_dyn_Y=171306065.75 N/m, k_dyn_Z=81213482.83 N/m
Mode Shape (X,Y,Z): 0.247∠18.5°, 0.474∠-91.5°, 1.000∠17.0°
Mode 8: f=188.00 Hz, Damping=NaN, k_dyn_X=1187170069.95 N/m, k_dyn_Y=337153498.96 N/m, k_dyn_Z=165820572.95 N/m

Mode Shape (X,Y,Z): 0.140∠-23.4°, 0.492∠144.7°, 1.000∠6.2°