Windas Beam Axis and Forces Definition

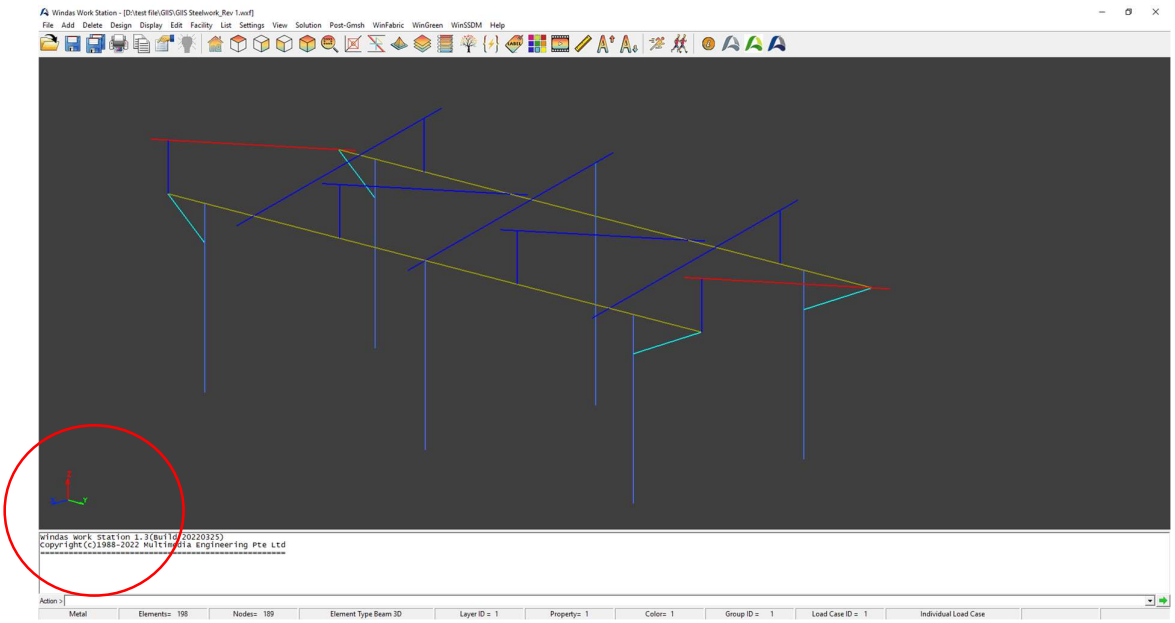
Windas Line element: Beam 3D

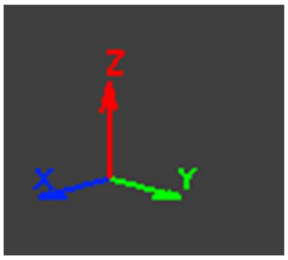
In this context, 'Beam' refers to a Windas line element in 3D space with a start point and end point both consisting of x,y,z coordinates. Which coordinate to be called start point or end point is to be defined by Windas.

Each of 'Beam' element must have section properties and material assigned.

After analysis, where loading and other boundary conditions are calculated, all 'beam' element are subjected to 6 member forces i.e axial force, shear-XX force, shear-ZZ force, bending moment-XY (weak axis), bending moment-ZZ (strong axis), and torsional force. How these forces are listed with respect to its corresponding axes will be discussed here.

Global Axis



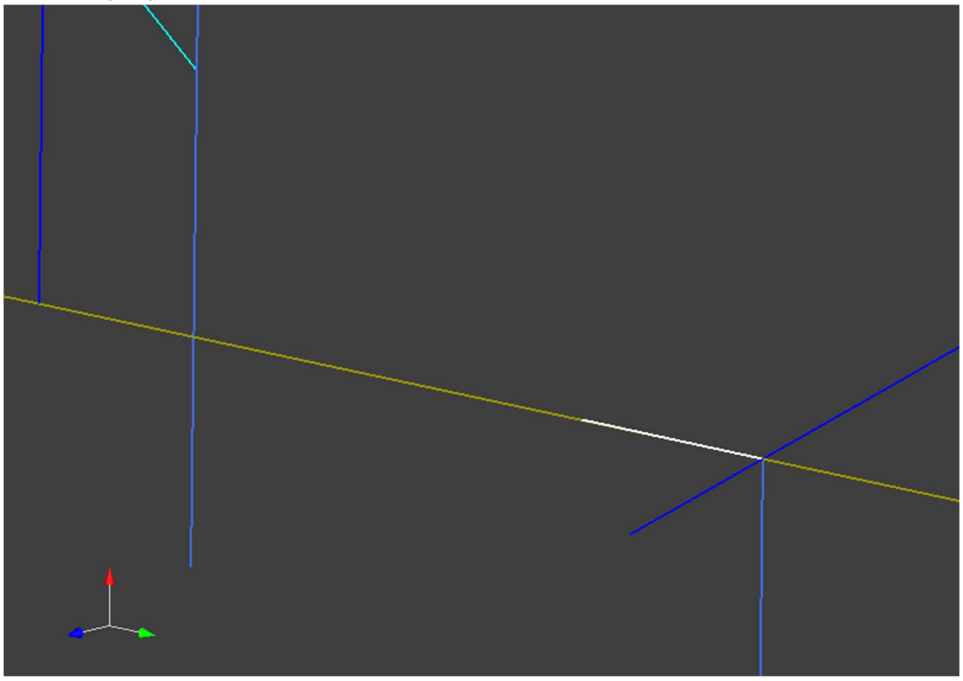


Refer to the xyz arrow indicator in the bottom left of Windas screen to find the global axis with respect to the analysis model geometry.

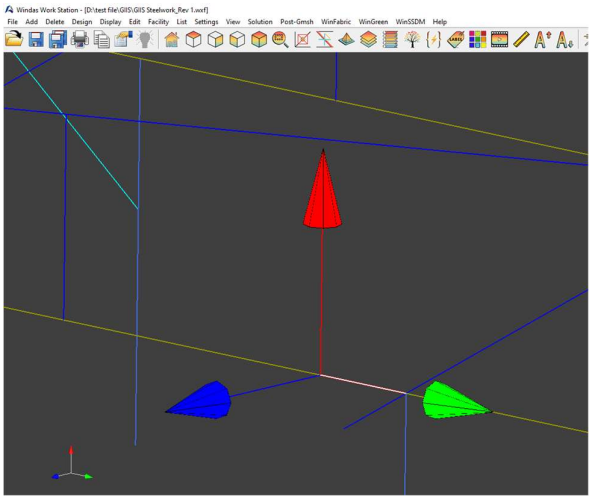
Local Axis

The local axis may be displayed in Windas Workstation by following these steps:

1. Select intended element by holding shift and window select the element. Selected element will be highlighted on the Windas screen.



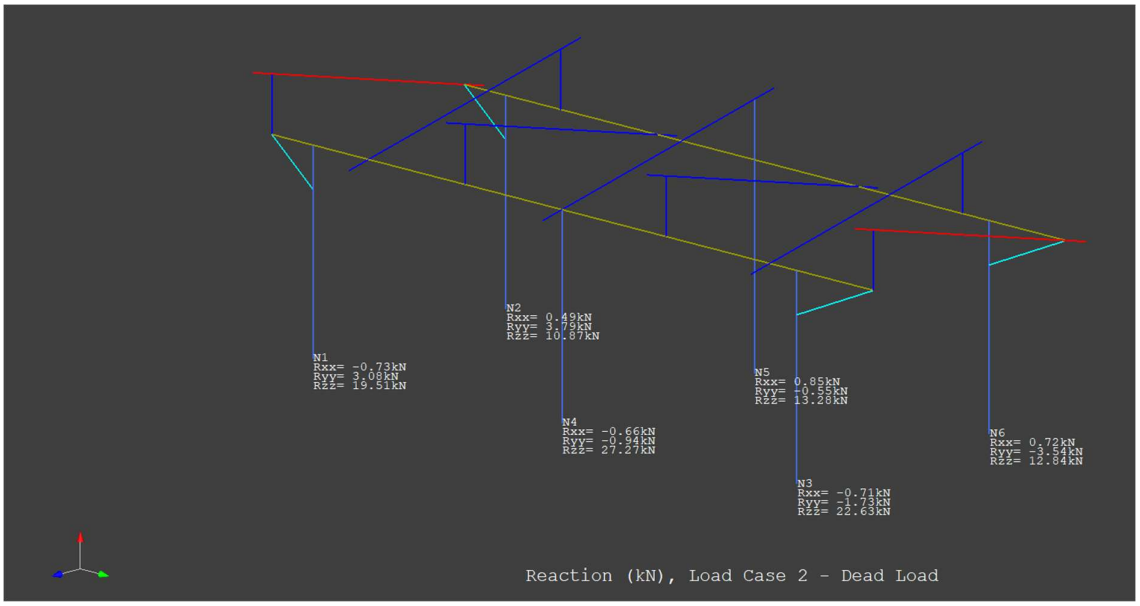
2. Choose Display |Beam Local Axis. The local axis shall be displayed for the selected element only. The axes color represents the axis name.
   Red = Z-Axis
   Blue = Y-Axis
   Green = X-Axis



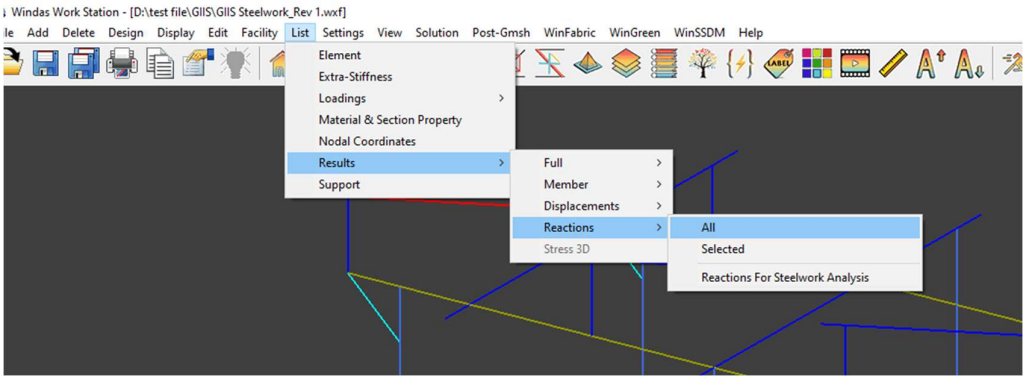
Reaction Forces

The reaction forces in Windas Workstation are always refering to the **global axis**.

To display the reaction forces on the display port, choose Display | Reaction forces.



To have the full list, click List | Results | Reactions | All



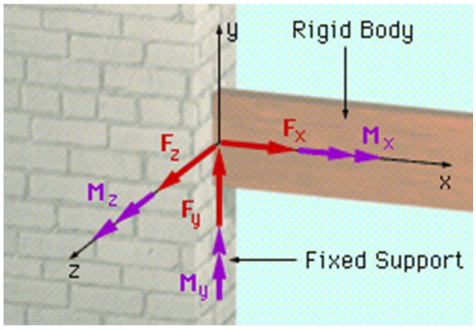
Project : D:\test file\GIIS\GIIS Steelwork_Rev 1
Reaction forces listing

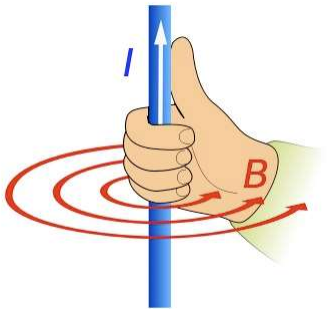
Load Case	Node Number	COORDINATES X-COORD	Y-COORD	Z-COORD	Fixity Code	REACTION(kN) Rxx	Ryy	Rzz	Mxx	Myy	Mzz
1	1	2959.900	1273.813	-5480.979	111111	-0.800	2.970	23.620	-3.240	-1.470	-0.050
2						-0.730	3.080	19.510	-3.840	-1.590	-0.190
3						-0.530	2.740	10.160	-3.360	-0.750	-0.130
4						-0.840	3.890	21.380	-4.950	-1.860	-0.160
5						-0.660	3.680	12.340	-4.660	-1.060	-0.090
1	2	-2959.899	1273.813	-5480.979	111111	0.860	4.360	23.560	-5.550	1.220	0.130
2						0.490	3.790	10.870	-5.190	0.630	-0.600
3						0.680	5.500	18.800	-7.620	1.070	0.070
4						0.600	4.390	12.880	-6.000	0.780	-0.660
5						0.800	6.190	21.140	-8.570	1.240	0.000
1	3	2959.900	16144.260	-5480.979	111111	-0.740	-1.260	27.300	3.030	-1.200	0.080
2						-0.710	-1.730	22.630	3.290	-1.370	0.330
3						-0.550	-2.110	11.500	3.700	-0.580	0.090
4						-0.800	-2.340	24.740	4.260	-1.590	0.390
5						-0.660	-2.810	13.960	4.840	-0.840	0.160
1	4	2959.899	8930.299	-5480.979	111111	-0.770	-1.490	30.850	3.500	-1.000	-0.080
2						-0.660	-0.940	27.270	2.200	-0.680	-0.070
3						-0.980	-0.570	13.030	1.480	-0.940	-0.090
4						-0.600	-1.080	30.920	2.500	-0.550	-0.080
5						-0.910	-0.730	17.290	1.830	-0.780	-0.090
1	5	-2959.900	8930.299	-5480.979	111111	0.540	-1.430	29.270	3.180	0.970	-0.010
2						0.850	-0.550	13.280	1.240	1.640	0.010
3						0.720	-0.880	23.500	1.920	1.520	-0.010
4						0.790	-0.680	16.760	1.500	1.490	0.010
5						0.640	-1.030	27.560	2.230	1.360	-0.010
1	6	-2959.900	16144.260	-5480.979	111111	0.880	-3.010	27.510	5.150	1.430	-0.180
2						0.720	-3.540	12.840	5.430	1.190	0.280
3						0.740	-4.590	22.130	7.130	1.360	-0.030
4						0.800	-3.980	15.120	6.110	1.290	0.270
5						0.840	-5.100	24.780	7.920	1.480	-0.050

===== Minimum and Maximum Reactions

Minimum Rxx =	-0.980kN at Node 4	Maximum Rxx =	0.880kN at Node 6
Minimum Ryy =	-5.100kN at Node 6	Maximum Ryy =	6.190kN at Node 2
Minimum Rzz =	10.160kN at Node 1	Maximum Rzz =	30.920kN at Node 4
Minimum Mxx =	-8.570kN/m at Node 2	Maximum Mxx =	7.920kN/m at Node 6
Minimum Myy =	-1.860kN/m at Node 1	Maximum Myy =	1.640kN/m at Node 5
Minimum Mzz =	-0.660kN/m at Node 2	Maximum Mzz =	0.390kN/m at Node 3

Still with respect to the global axis, all moment forces are following right-hand rule to each assigned axis. For the right-hand rule application, the said axis will be the direction of thumb. Refer to the picture below for reference.

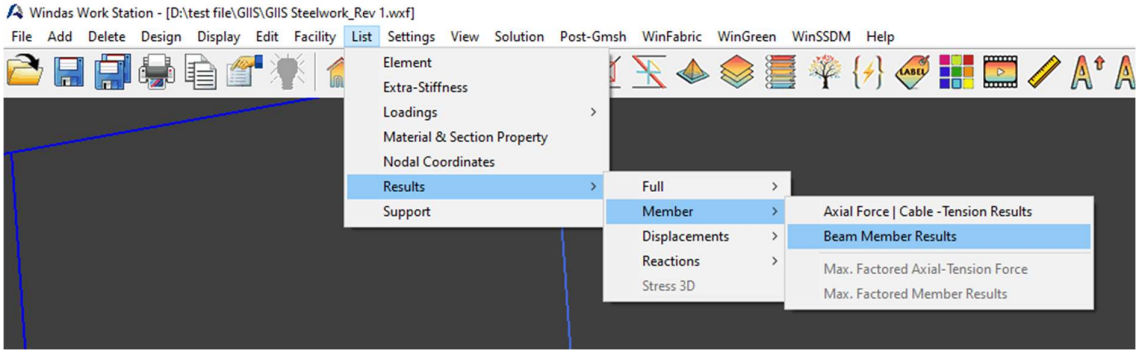




Beam Member Forces

To list the member forces, select the intended element, and then select Results > Member > Beam Member Results. There we will be able to observe the member forces happen in all specified load combinations.

For this example's purposes, we will focus only on the first load combination for elementID 76.



FACTORED LOAD COMBINATION NUMBER= 1 TITLE= 1.20Prestress + 1.20Dead Load + 1.20Wind Load CW

Element ID	AXIAL (kN)	SHEAR-XX (kN)	SHEAR-ZZ (kN)	XY-PLANE MOM. (kNm)	ZZ-PLANE MOM. (kNm)	TORSION (kNm)	COORDINATES		
76	-25.44	-0.14	-19.10	-0.09	-16.63	-1.05	2959.90	8186.11	-680.98
76	-25.44	-0.14	-19.10	-0.19	-30.85	-1.05	2959.90	8930.30	-680.98

The interpretation of this list is similar to the one explained for reaction forces, only the reference axis is **the local axis**.

Refer to below image for reference.