

Indian Institute Of Technology Kanpur

AE 351A

Experiments in Aerospace Engineering 2020-21
Semester II

Experiment No. 6B

Calibration of six component force balance

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March 05, 2021

- **Objective**

To study the calibration procedure of a six component force balance

- **Apparatus**

- Six component force balance
- Calibration body
- Calibration rig
- precise level gauge
- Dead weights
- NI SCXI-1520
- NI SCXI-1314
- Data acquisition card
- Labview software

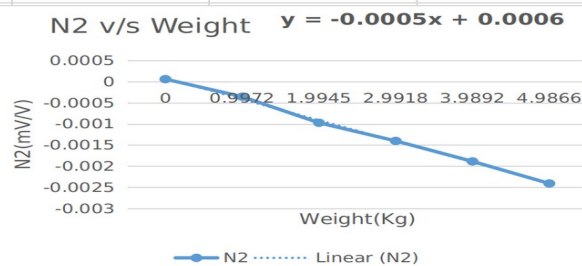
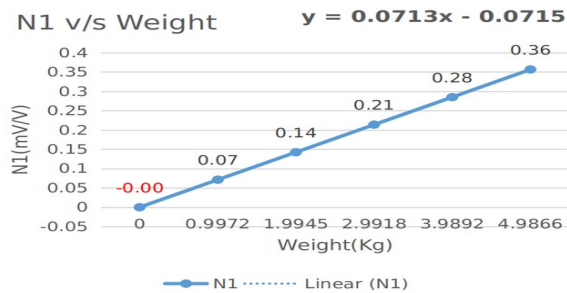
- **Procedure**

- Fix and connect force balance to DAQ system.
- Perform bridge nulling to remove force generated due to empty pan weight.
- Put load of 992 gm on pan and note down N1 force.
- Exceed load in step manner.
- Rotate force load balance by 90 deg .
- Perform bridge nulling to remove force generated due to empty pan weight.
- Put step loads on pan and note down S1 force.
- Measure the output voltages of the bridges at all locations (AX, N1, N2, S1, S2, RM) at each known applied load at a particular bridge location (say N1).
- Repeat steps to obtain other loads also.
- Evaluate the coefficients of calibration matrix using the data in step two and find its inverse.
- Write the equations for evaluating the orthogonal forces and moments at the force balance centre acted upon by a random force.
- Write the equations for real orthogonal forces and moments acting on a model (attached to the force balance) at a reference point by a random aerodynamic force in terms of loads measured by the force balance.

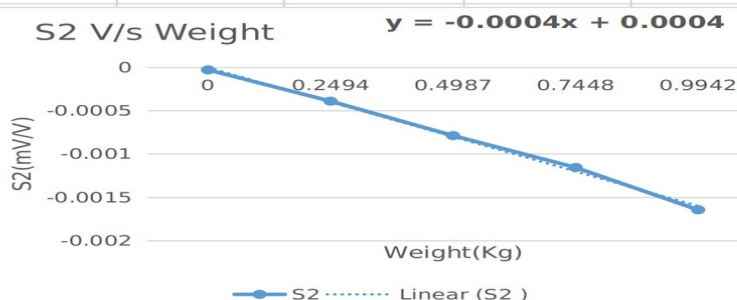
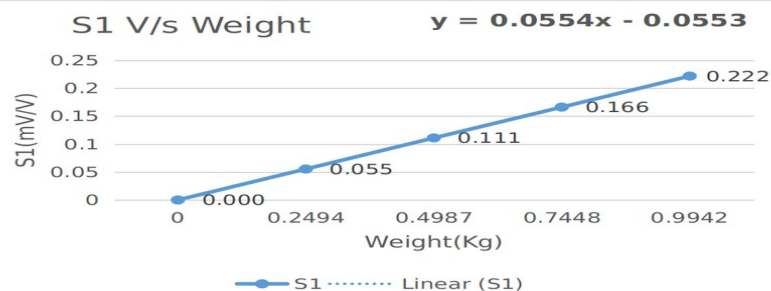
- Follow the detailed calibration procedure given in the force balance manual available in the low speed aerodynamic lab.

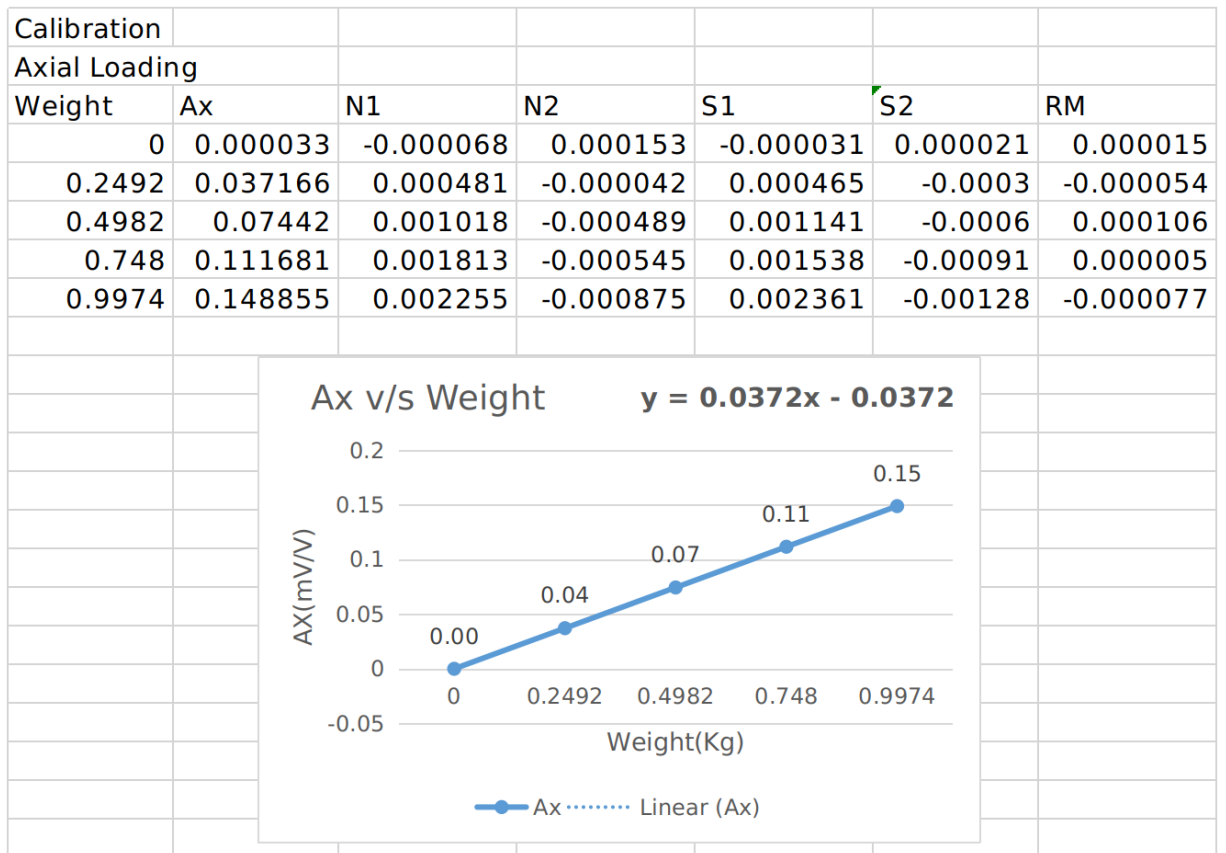
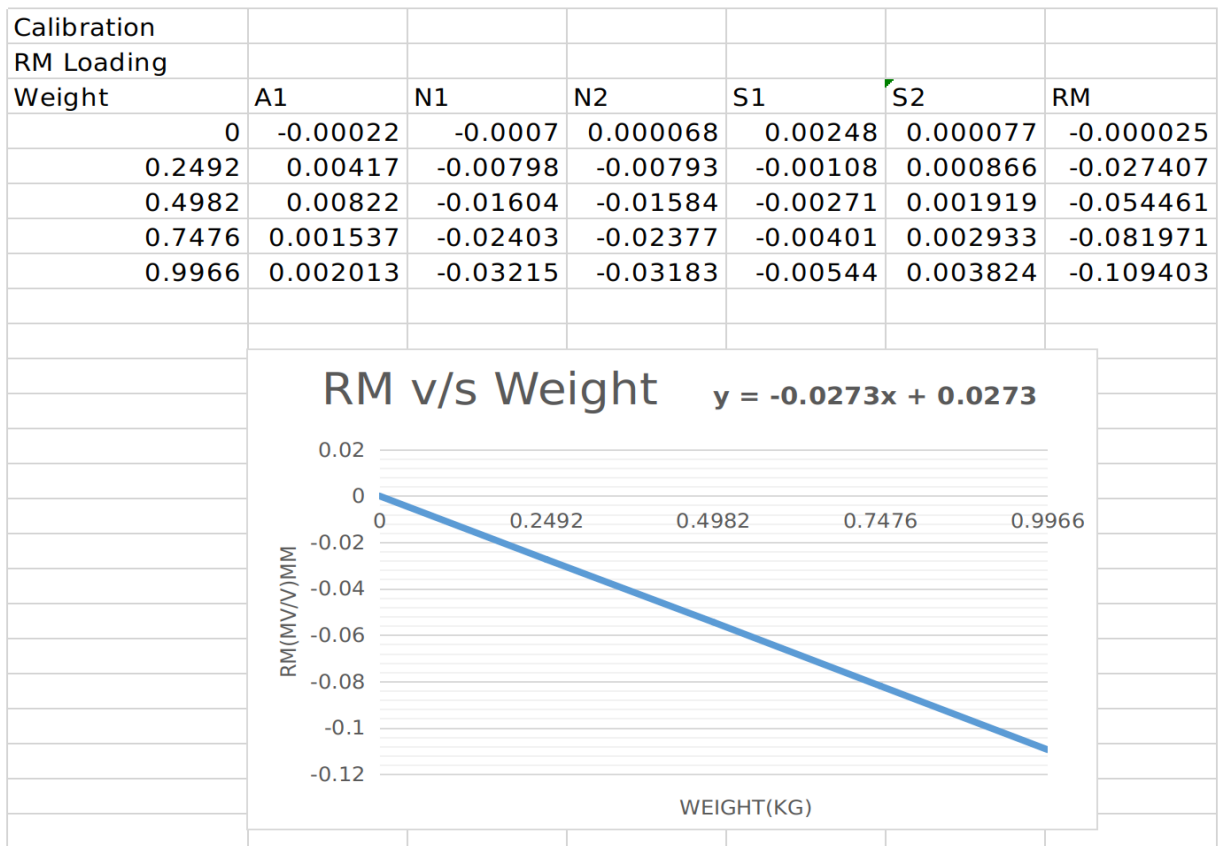
• Result and Discussion

Calibration N1 Loading Weight	A1	N1	N2	S1	S2	RM
0	0.000071	-0.000167	0.000061	-0.000087	0.000047	-0.000045
0.9972	-0.00037	0.071126	-0.000355	0.003382	0.000035	-0.00064
1.9945	-0.001032	0.142133	-0.000973	0.006941	-0.0001	-0.001196
2.9918	-0.001816	0.213486	-0.001403	0.010444	-0.00109	-0.001947
3.9892	-0.002451	0.284649	-0.001888	0.014045	-0.00019	-0.002478
4.9866	-0.003621	0.356253	-0.002411	0.017526	-0.00014	-0.003114



Calibration S1 Loading Weight	A1	N1	N2	S1	S2	RM
0	-0.00002	-0.000027	0.000184	0.000021	-0.000031	-0.000059
0.2494	0.000461	-0.001861	0.000198	0.055423	-0.000392	-0.000107
0.4987	0.000744	-0.03644	0.000238	0.110942	-0.000789	-0.000161
0.7448	0.001402	-0.005476	0.00028	0.166075	-0.001157	-0.000226
0.9942	0.001747	-0.007397	0.000337	0.221599	-0.001645	-0.000249





Calibration constants	value(mv/v/Kg)
C_{N1}	0.0713
C_{N2}	-0.0005
C_{S1}	0.0554
C_{S2}	-0.0004
C_{Ax}	0.0372
C_{RM}	-0.0273

- **References**



Figure 1: Installed Load cell (for N1 force measurement)