Comment on data variability of data from provided dataset vs my own dataset.

From an initial overlook of the scatter plots, the general trends of both stress distribution and displacement results share a common trend across all datasets. However, a notable outlier in my runs—specifically in the Hole Beams test—appears to be the primary factor contributing to higher variability in my dataset compared to the provided datasets.

STRESS:

Mean Stress (MPA) for Holes 1mm setup		
Alex'sSet	DataSet2	DataSet1
434.8615385	469.21971	369.4786154

Stnd Deviation for Holes 1mm setup		
Alex'sSet	DataSet2	DataSet1
167.3145816	109.4749203	130.6876805

Coefficent of Variation for Holes 1mm setup		
Alex'sSet	DataSet2	DataSet1
38.47536902	23.33127073	35.37083745

Mean Stress (MPA) for MatA 1mm setup		
Alex'sSet	DataSet2	DataSet1
365.4230769	353.34876	328.7554615

Stnd Deviation for MatA 1mm setup		
Alex'sSet	DataSet2	DataSet1
87.32078937	66.21675577	65.32573181

Coefficent of Variation for MatA 1mm setup		
Alex'sSet	DataSet2	DataSet1
23.89580595	18.73977316	19.87061493

Mean Stress (MPA) for MatB 1mm setup		
Alex'sSet	DataSet2	DataSet1
251.9384615	296.05896	313.3071538

Stnd Deviation for MatB 1mm setup		
Alex'sSet	DataSet2	DataSet1
31.17126183	23.50406812	19.21923918

Coefficent of Variation for MatB 1mm setup		
Alex'sSet	DataSet2	DataSet1
12.37256973	7.938982154	6.134312269

Mean Stress (MPA) for Holes 5mm setup		
Alex'sSet	DataSet2	DataSet1
2174.338462	2346.0986	1847.393

Stnd Deviation for Holes 5mm setup		
Alex'sSet	DataSet2	DataSet1
836.3844347	547.3746123	798.6828421

Coefficent of Variation for Holes 5mm setup		
Alex'sSet	DataSet2	DataSet1
38.46615646	23.33127042	43.23296895

Mean Stress (MPA) for MatA 5mm setup		
Alex'sSet	DataSet2	DataSet1
1664.653846	1766.7437	1643.739231

Stnd Deviation for MatA 5mm setup		
Alex'sSet	DataSet2	DataSet1
558.939449	331.0836155	326.6503898

Coefficent of Variation for MatA 5mm setup		
Alex'sSet	DataSet2	DataSet1
33.57691753	18.73976497	19.87239726

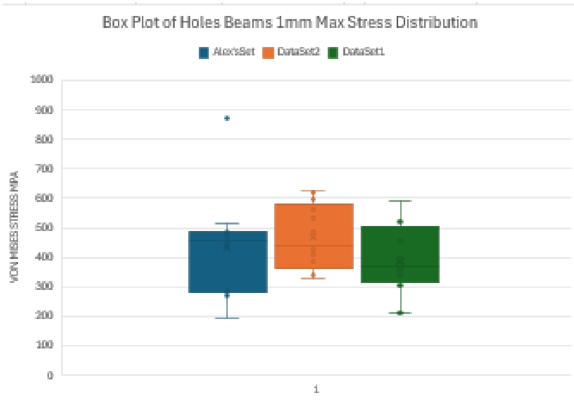
Mean Stress (MPA) for MatB 5mm setup		
Alex'sSet	DataSet2	DataSet1
1259.923077	296.05896	1566.538462

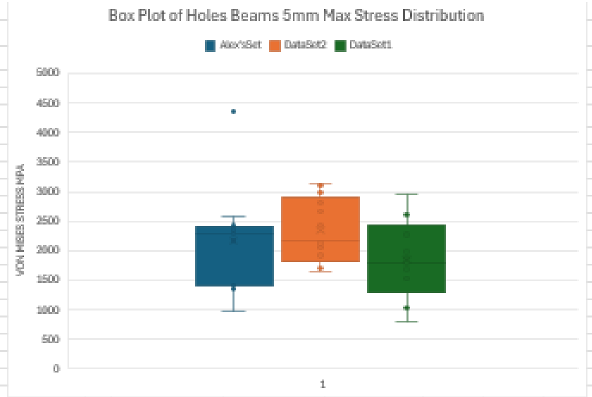
Stnd Deviation for MatB 5mm setup		
Alex'sSet	DataSet2	DataSet1
155.7099127	23.50406812	96.09679017

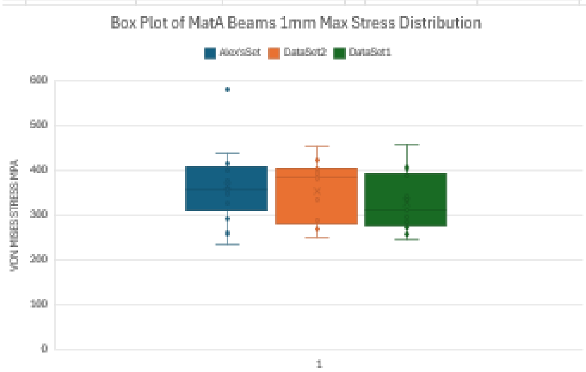
Coefficent of Variation for MatB 5mm setup		
Alex'sSet	DataSet2	DataSet1
12.35868408	7.938982154	6.134339662

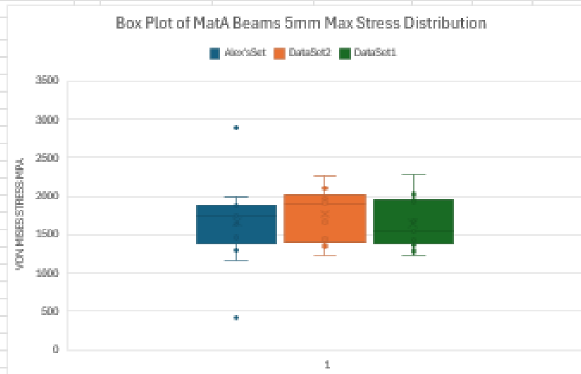
From the calculated Mean Stress, Standard Deviation, and Coefficient of Variation for the Max Stress runs, my dataset exhibits higher mean stress for the Hole Beams compared to the provided datasets, particularly in the 1mm runs.

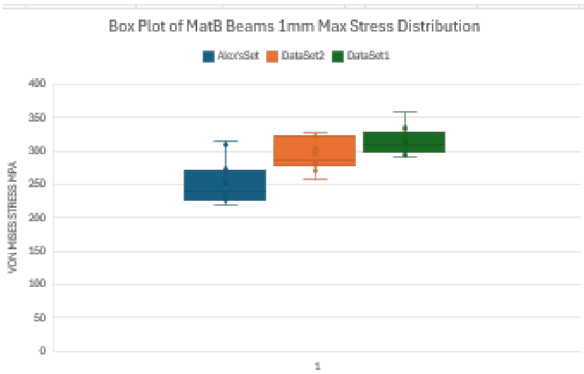
Additionally, my dataset shows a higher standard deviation and coefficient of variation for the Hole Beams across both setups. This increased variability likely results from the geometric configuration within the beam—specifically, a void placed too close to the beam's edge, which creates a large deviation in stress values

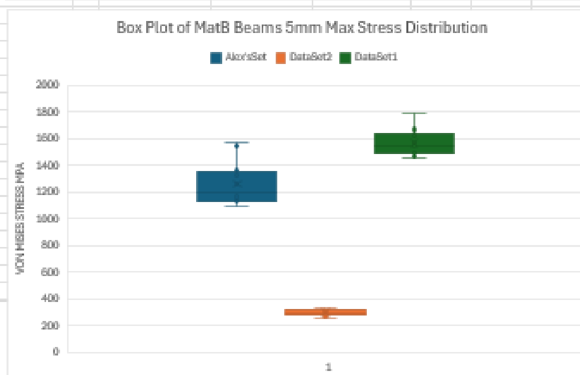






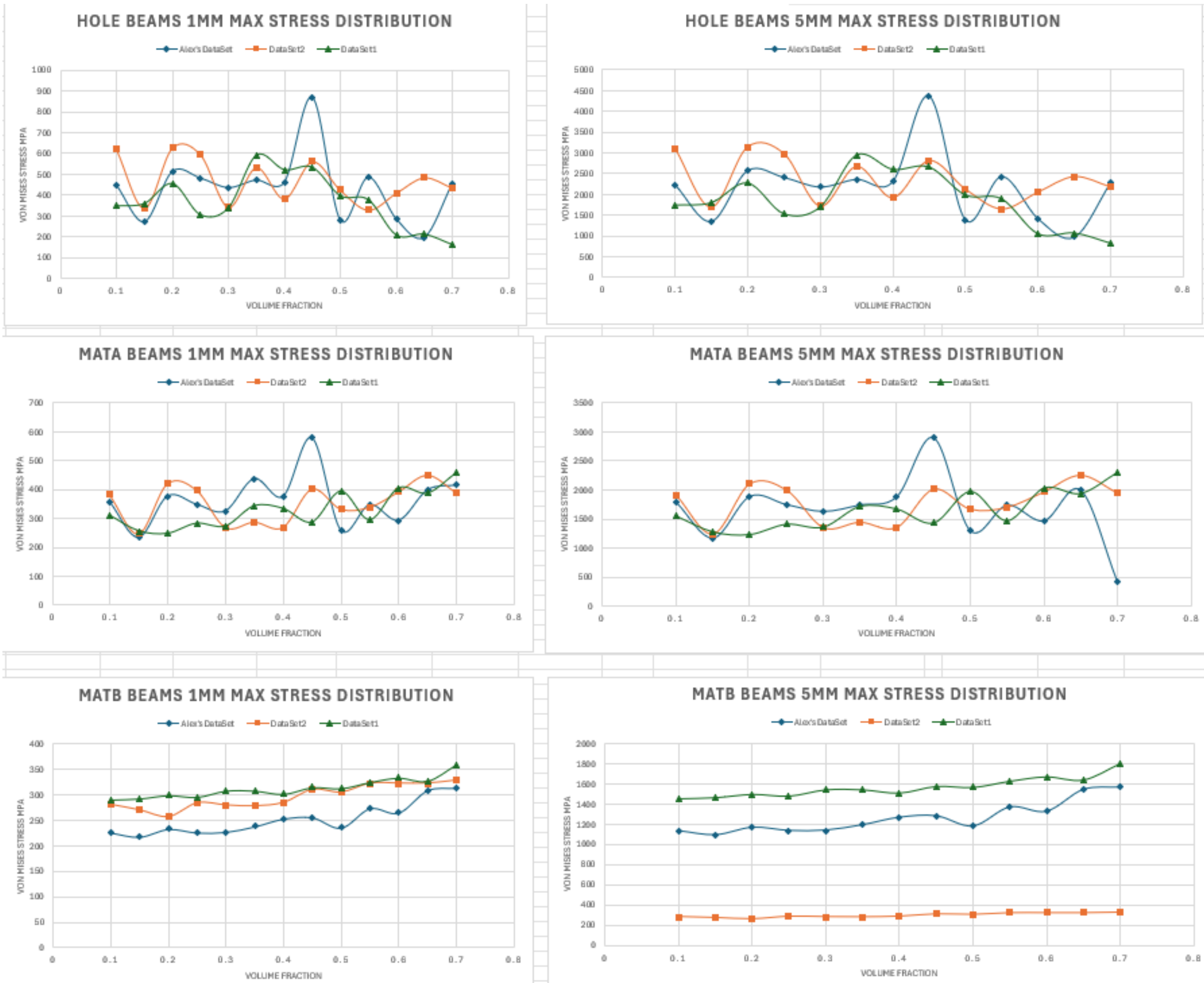




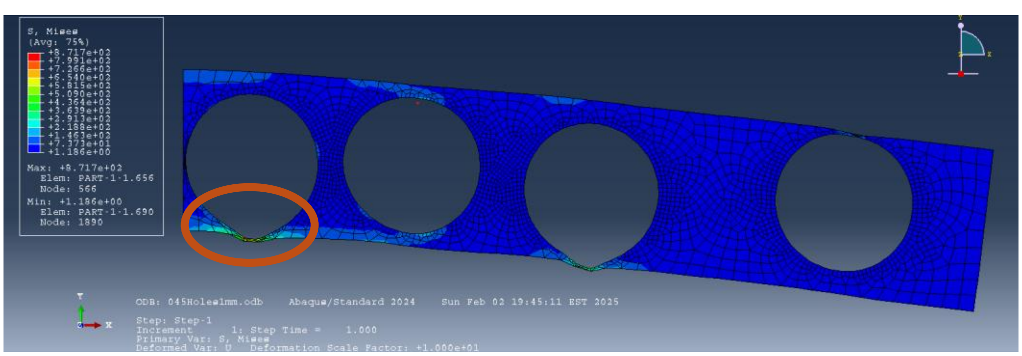


The box plots provide a visual representation of variability and distributions across datasets. For the **Hole Beams 1mm run**, my dataset has noticeably greater variability than Data Set 1 and Data Set 2. The **5mm run**, in contrast, has a similar stress distribution among all datasets, though my dataset still shows slightly higher variability.

For the **Material A Beam 1mm run**, variability in my dataset is also higher, though the mean stress value remains close to those in Data Set 1 and Data Set 2. Interestingly enough, across all datasets, the variability is the smallest for the Material B runs, which is not unusual, given Material B is the stiffest material.



A detailed look at the scatter plots reveals that my runs follow similar trendlines as the provided datasets. However, an unusual variance occurs around the **0.45 volume fraction**, likely due to a void being too close to the beam's edge, leading to an unrealistic stress value. When the stiffest material (Material B) is applied, my data tends to align more closely with the general trend, likely due to improved stiffness in the beam.



DISPLACEMENT:

It should be noted that, when it came to comparing datasets for displacement, it was only possible to compare Data Set 2 runs with my own data runs, since the displacement measured was the magnitude U, whereas Data Set 1 utilized U U2 Displacement.

Mean U Displ for Holes 100N setup	
Alex'sSet	DataSet2
2.73	1.989842337

Stnd Deviation for Holes 100N setup	
Alex'sSet	DataSet2
2.656051396	1.465919674

Coefficent of Variation for Holes 100N setup	
Alex'sSet	DataSet2
97.22742789	73.67014192

Mean U Displ for MatA 100N setup	
Alex'sSet	DataSet2
1.16	1.085658917

Stnd Deviation for MatA 100N setup	
Alex'sSet	DataSet2
0.366369616	0.310058345

Coefficent of Variation for MatA 100N setup	
Alex'sSet	DataSet2
31.56935204	28.5594619

Mean U Displ for MatB 100N setup	
Alex'sSet	DataSet2
0.57	0.580917835

Stnd Deviation for MatB 100N setup	
Alex'sSet	DataSet2
0.057206594	0.057761058

Coefficent of Variation for MatB 100N setup	
Alex'sSet	DataSet2
10.12065156	9.94306846

Mean U Displ for Holes 500N setup	
Alex'sSet	DataSet2
13.65	11.93905405

Stnd Deviation for Holes 500N setup	
Alex'sSet	DataSet2
13.27524902	8.795518294

Coefficent of Variation for Holes 500N setup	
Alex'sSet	DataSet2
97.26882345	73.67014385

Mean U Displ for MatA 500N setup	
Alex'sSet	DataSet2
5.80	6.513953502

Stnd Deviation for MatA 500N setup	
Alex'sSet	DataSet2
1.831661786	1.860350076

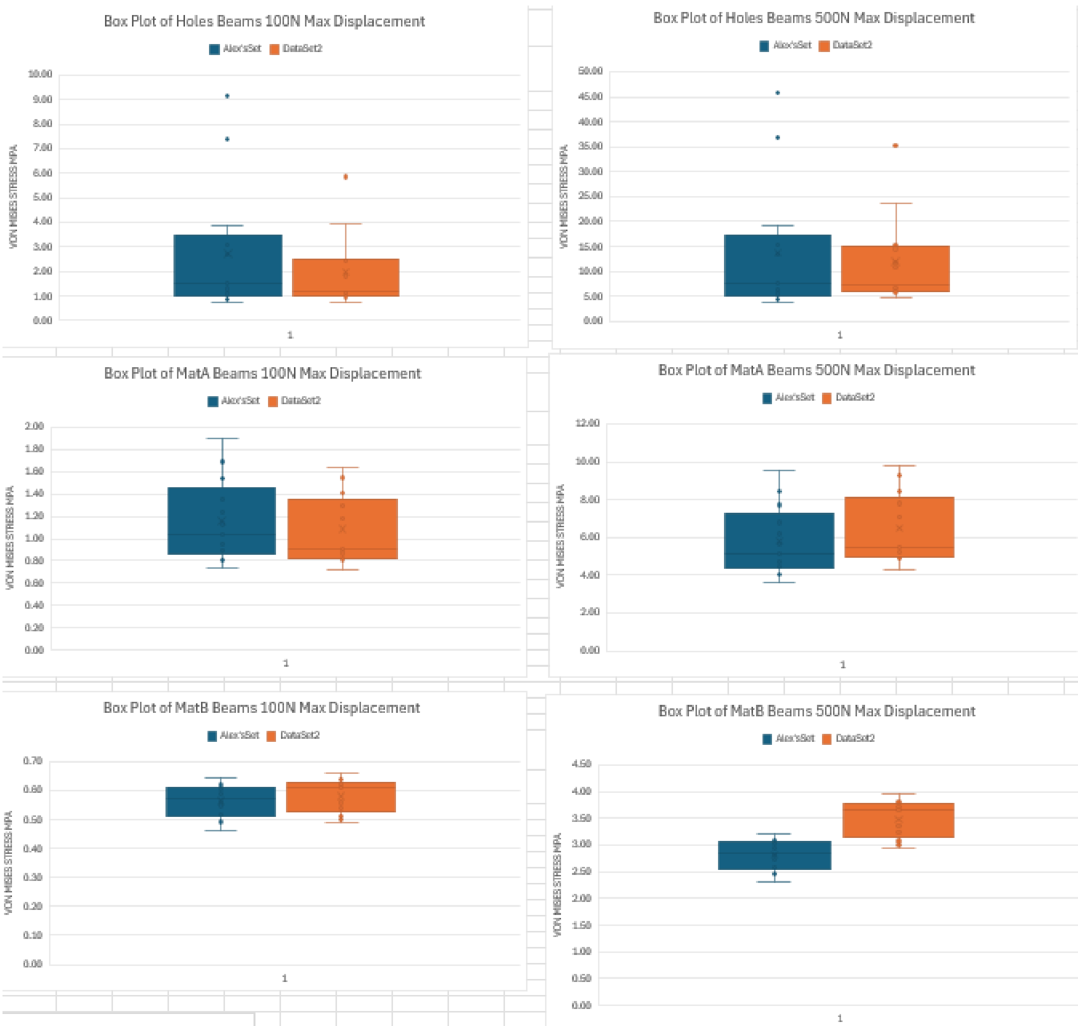
Coefficent of Variation for MatA 500N setup	
Alex'sSet	DataSet2
31.56781548	28.55946202

Mean U Displ for MatB 500N setup	
Alex'sSet	DataSet2
2.83	3.485507012

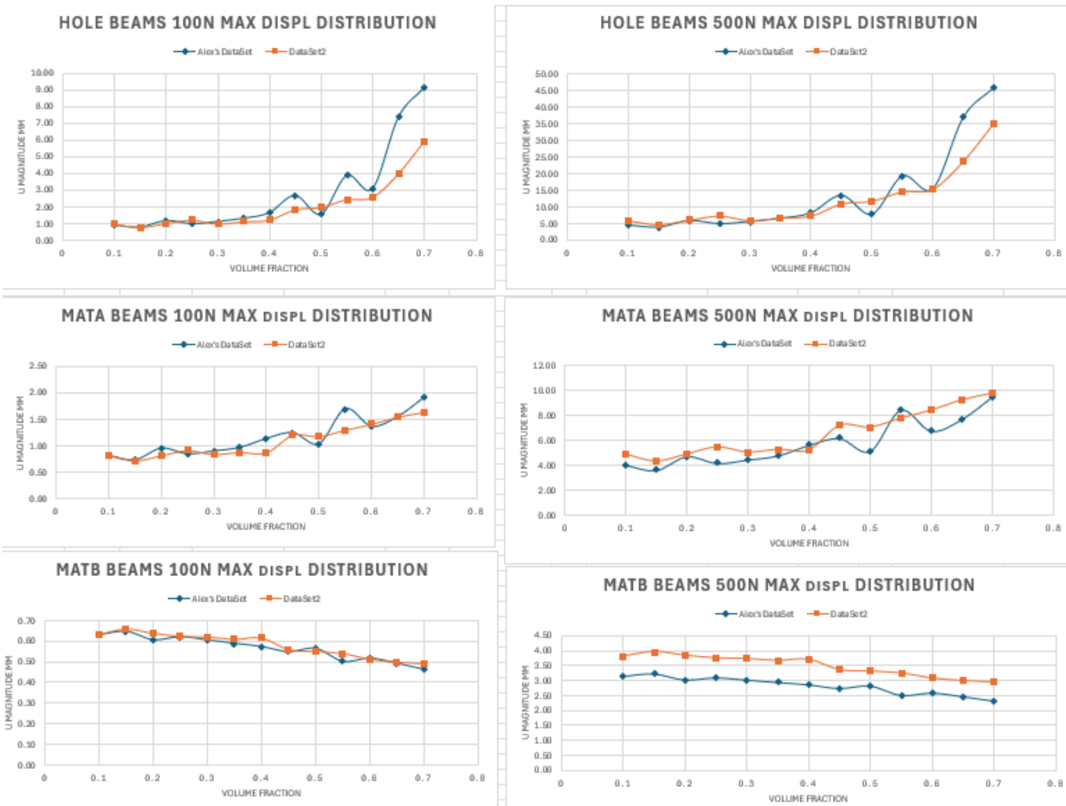
Stnd Deviation for MatB 500N setup	
Alex'sSet	DataSet2
0.285884413	0.346566321

Coefficent of Variation for MatB 500N setup	
Alex'sSet	DataSet2
10.11511993	9.943067667

The displacement mean and standard deviation values were much closer between my dataset and the given dataset than they were in the stress analysis. This reduced variation might be attributed to the lower overall magnitudes of displacement compared to stress values.



Again, visually, the data variability trends for both datasets, decreased as the voids got filled with stiffer material. The lowest variability was found in the Material B runs, like the Stress simulation runs.



Visually, the data variability trends across all datasets show a decrease as voids are filled with stiffer material. The lowest variability occurs in the **Material B run**, consistent with the stress simulation findings.

For the **Hole Beams runs**, my displacement values diverge from Data Set 2, especially at **higher volume fractions (>0.6)**, where my dataset exhibits larger displacement values. While the overall trends are similar, the divergence is more pronounced under higher loads.

For the **Material A Beam runs**, displacement values closely align with Data Set 2, with minor variations beginning around **volume fractions greater than 0.6**.

For the **Material B Beam runs**, variability is minimal compared to the other setups, likely due to the increased stiffness ensuring a consistent load-carrying capacity. This reduces sensitivity to imperfections, such as voids being positioned too close to the edge of the beam.

Across all runs, Material B beams exhibit less variability, most likely due to high stiffness ensuring a **consistent load-carrying capacity**, reduces sensitivity to imperfections such as being too close to the edge of the beam. In contrast, Material A and void beams are less stiff and more susceptible to **localized effects** and geometric discontinuities, leading to greater variability in both displacement and stress results.

CORRELATION ANALYSIS

To determine the appropriate correlation coefficient, several factors were considered, including the relationship between void density and stress/displacement results, as well as skewness in the data distribution.

Skewness, Distribution Considerations

An analysis of skew coefficients across the datasets revealed that the raw data exhibited both left and right skewness, indicating that it does not fully follow to a normal distribution. This is relevant because the Pearson correlation assumes normally distributed data, whereas Spearman correlation does not.

Pearson vs. Spearman Decision

Both Pearson and Spearman correlation coefficients were calculated and compared. The absolute values of each coefficient were examined across all columns. The primary decision rule used was:

- If **|Spearman| > |Pearson|**, the relationship is **monotonic but not exactly linear**.
- If **|Pearson| > |Spearman|**, the relationship is **linear**.

From this analysis, my Stress dataset predominantly exhibited a **monotonic relationship**, whereas the two provided datasets were dominated by a **linear relationship**. This further suggests that the void near the beam's edge in my runs created an unrealistic stress distribution.

For the **displacement runs**, an interesting observation was that a **monotonic relationship dominated all datasets**, reinforcing the consistency of this trend.

The comprehensive tables that contain more information is in the Raw Data Excel sheet and briefly discussed in detail.

Alex Set	Units for Max Stress MPA						
	Max stress at 1 mm cantilever end displacement			Max stress at 5 mm cantilever end displacement			
Volume Fraction	Holes	Mat A	Mat B	Holes	Mat A	Mat B	
0.1	447.3	357	226	2236	1785	1130	
0.15	270.9	233.6	217.9	1355	1168	1090	
0.2	513.7	377.3	233.1	2568	1887	1165	
0.25	481.6	349.2	226.1	2408	1746	1133	
0.3	435.5	325.5	227.4	2178	1628	1137	
0.35	472.1	438	238.2	2361	1740	1191	
0.4	461.6	376.3	253.3	2308	1881	1266	
0.45	871.7	580.1	256	4358	2900	1280	
0.5	278.2	258.8	235.6	1391	1294	1178	
0.55	485.6	347.2	273.7	2428	1736	1369	
0.6	284.1	293	265.1	1421	1465	1326	
0.65	195.5	399	309	977.4	1995	1545	
0.7	455.4	415.5	313.8	2277	415.5	1569	
	1.2357647	0.959243407	1.081596621	1.235474899	-0.1044068	1.084013971	SKEW

Data Set 1							
Direction Down	Max stress at 1 mm cantilever end displacement			Max stress at 5 mm cantilever end displacement			
Volume Fraction	**Holes**	**Mat A**	**Mat B**	**Holes**	**Mat A**	**Mat B**	
0.1	347.613	310.234	291.05	1738.07	1551.17	1455.25	
0.15	359.08	256.346	293.229	1795.4	1281.73	1466.15	
0.2	454.594	247.325	299.539	2272.97	1236.63	1497.7	
0.25	305.303	282.48	296.22	1526.51	1412.4	1481.11	
0.3	337.884	272.717	308.474	1689.42	1363.58	1542.37	
0.35	589.65	343.193	308.453	2948.25	1715.97	1542.26	
0.4	520.482	334.245	302.148	2602.42	1671.22	1510.74	
0.45	532.067	286.829	315.039	2660.34	1434.15	1575.19	
0.5	396.119	394.028	313.111	1980.59	1970.14	1565.56	
0.55	377.361	294.543	325.115	1886.8	1472.21	1625.58	
0.6	208.163	405.615	333.695	1040.81	2028.08	1668.48	
0.65	212.252	387.345	327.577	1061.26	1936.73	1637.89	
0.7	162.654	458.921	359.343	813.269	2294.6	1796.72	
	0.0799044	0.645456802	1.141165051	0.079908428	0.645613333	1.141212188	**SKEW**

The following three tables are for the Stress runs, and my dataset has a primary Monotonic relationship, but Data Set 1 and 2 were primarily a Linear relationship.

Alex Set						
Max stress at 1 mm cantilever end displacement				**Max stress at 5 mm cantilever end displacement**		
Volume Fraction	**Holes**	**MatA**	**MatB**	**Holes**	**MatA**	**MatB**
1	6	7	2	6	9	2
2	2	1	1	2	2	1
3	12	9	5	12	11	5
4	10	6	3	10	8	3
5	5	4	4	5	5	4
6	9	12	7	9	7	7
7	8	8	8	8	10	8
8	13	13	9	13	13	9
9	3	2	6	3	3	6
10	11	5	11	11	6	11
11	4	3	10	4	4	10
12	1	10	12	1	12	12
13	7	11	13	7	1	13
Spearman	-0.153846154	0.21428571	0.93956044	-0.15385	-0.16484	0.93956044
Pearson	-0.147049041	0.2067003	0.88368823	-0.14703	-0.20321	0.88390066
	(Monotonic)	(Monotonic)	(Monotonic)	(Monotoni	(Linear)	(Monotonic)

DataSet1						
Max stress at 1 mm cantilever end displacement				**Max stress at 5 mm cantilever end displacement**		
Volume Fraction	**Holes**	**MatA**	**MatB**	**Holes**	**MatA**	**MatB**
1	6	7	1	6	7	1
2	7	2	2	7	2	2
3	10	1	4	10	1	4
4	4	4	3	4	4	3
5	5	3	7	5	3	7
6	13	9	6	13	9	6
7	11	8	5	11	8	5
8	12	5	9	12	5	9
9	9	11	8	9	11	8
10	8	6	10	8	6	10
11	2	12	12	2	12	12
12	3	10	11	3	10	11
13	1	13	13	1	13	13
Spearman	-0.346153846	0.75824176	0.96153846	-0.34615	0.758242	0.96153846
Pearson	-0.418267991	0.78703362	0.91370176	-0.41827	0.786882	0.91370168
	(Linear)	(Linear)	(Monotonic)	(Linear)	(Linear)	(Monotonic)

DataSet2						
Max stress at 1 mm cantilever end displacement				**Max stress at 5 mm cantilever end displacement**		
Volume Fraction	**Holes**	**MatA**	**MatB**	**Holes**	**MatA**	**MatB**
1	12	7	5	12	7	5
2	2	1	2	2	1	2
3	13	12	1	13	12	1
4	11	10	6	11	10	6
5	3	2	4	3	2	4
6	9	4	3	9	4	3
7	4	3	7	4	3	7
8	10	11	9	10	11	9
9	6	5	8	6	5	8
10	1	6	10	1	6	10
11	5	9	11	5	9	11
12	8	13	12	8	13	12
13	7	8	13	7	8	13
Spearman	-0.302197802	0.3021978	0.9010989	-0.3022	0.302198	0.9010989
Pearson	-0.363141268	0.3284945	0.91136175	-0.36314	0.328494	0.91136175
	(Linear)	(Linear)	(Linear)	(Linear)	(Linear)	(Linear)

For displacement runs, all three datasets demonstrated a Monotonic relationship, and this was rather consistent across all runs and setups.

Displacement exhibited a consistently monotonic relationship across all datasets, likely due to its dependence on stiffness. As material stiffness increased, displacement decreased in a predictable manner, making it less sensitive to localized void placement and unrealistic geometry displacements in one case.

In contrast, stress showed a mix of linear and monotonic relationships. The provided datasets followed a more linear trend, suggesting a proportional response to void fraction. However, my dataset exhibited stronger monotonic behavior due to stress concentrations caused by voids placed near the beam's edge. These localized effects introduced greater variability in stress results, whereas displacement, as a global structural response, remained more stable.

Overall, stress demonstrated higher variability than displacement due to its sensitivity to localized geometric changes, while displacement followed a smoother trend dictated by material stiffness.

Alex Set

	Displacement at cantilever end at 100 N end			Displacement at cantilever end at 500 N end		
Volume Fraction	**Holes**	**MatA**	**MatB**	**Holes**	**MatA**	**MatB**
1	2	2	12	2	2	12
2	1	1	13	1	1	13
3	5	5	10	5	5	10
4	3	3	11	3	3	11
5	4	4	9	4	4	9
6	6	6	8	6	6	8
7	8	8	7	8	8	7
8	9	9	5	9	9	5
9	7	7	6	7	7	6
10	11	12	3	11	12	3
11	10	10	4	10	10	4
12	12	11	2	12	11	2
13	13	13	1	13	13	1
Spearman	0.956043956	0.94505495	-0.978022	0.956044	0.945055	-0.978022
Pearson	0.817101918	0.89838857	-0.9644833	0.816675	0.898322	-0.9643483
	(Monotonic)	(Monotonic)	(Monotonic)	(Monotoni	(Monotoni	(Monotonic)

DataSet2

	Displacement at cantilever end at 100 N end			Displacement at cantilever end at 500 N end		
Volume Fraction	**Holes**	**MatA**	**MatB**	**Holes**	**MatA**	**MatB**
1	2	2	11	2	2	11
2	1	1	13	1	1	13
3	4	3	12	4	3	12
4	6	7	10	6	7	10
5	3	4	9	3	4	9
6	5	6	7	5	6	7
7	7	5	8	7	5	8
8	8	9	6	8	9	6
9	9	8	5	9	8	5
10	10	10	4	10	10	4
11	11	11	3	11	11	3
12	12	12	2	12	12	2
13	13	13	1	13	13	1
Spearman	0.967032967	0.95054945	-0.978022	0.967033	0.950549	-0.978022
Pearson	0.841818491	0.94123705	-0.9613989	0.841818	0.941237	-0.9613989
	(Monotonic)	(Monotonic)	(Monotonic)	(Monotoni	(Monotoni	(Monotonic)

DataSet1

	Displacement at cantilever end at 100 N end			Displacement at cantilever end at 500 N end		
Volume Fraction	**Holes**	**MatA**	**MatB**	**Holes**	**MatA**	**MatB**
1	13	12	1	13	12	1
2	10	13	2	10	13	2
3	12	11	3	12	11	3
4	11	10	4	11	10	4
5	9	9	5	9	9	5
6	8	8	6	8	8	6
7	7	6	8	7	6	8
8	6	7	7	6	7	7
9	5	5	9	5	5	9
10	4	4	10	4	4	10
11	3	3	12	3	3	12
12	2	2	11	2	2	11
13	1	1	13	1	1	13
Spearman	-0.983516484	-0.989011	0.98901099	-0.98352	-0.98901	0.98901099
Pearson	-0.507159043	-0.964191	0.97792904	-0.50716	-0.96419	0.97793016
	(Monotonic)	(Monotonic)	(Monotonic)	(Monotoni	(Monotoni	(Monotonic)