CHAPTER IV

EXPERIMENTAL RESULTS

Tension Tests

Fig. 13 and 15 of the tension tests results are used for the determination of Young's Modulus. Three specimens with 2" gauge length were tested for each material. No measurement of Young's Modulus was made for cast-iron. The yield stresses were obtained from each four specimens of the type shown in Fig. 7.

The average properties of the three materials in tension are given in TABLE 1.

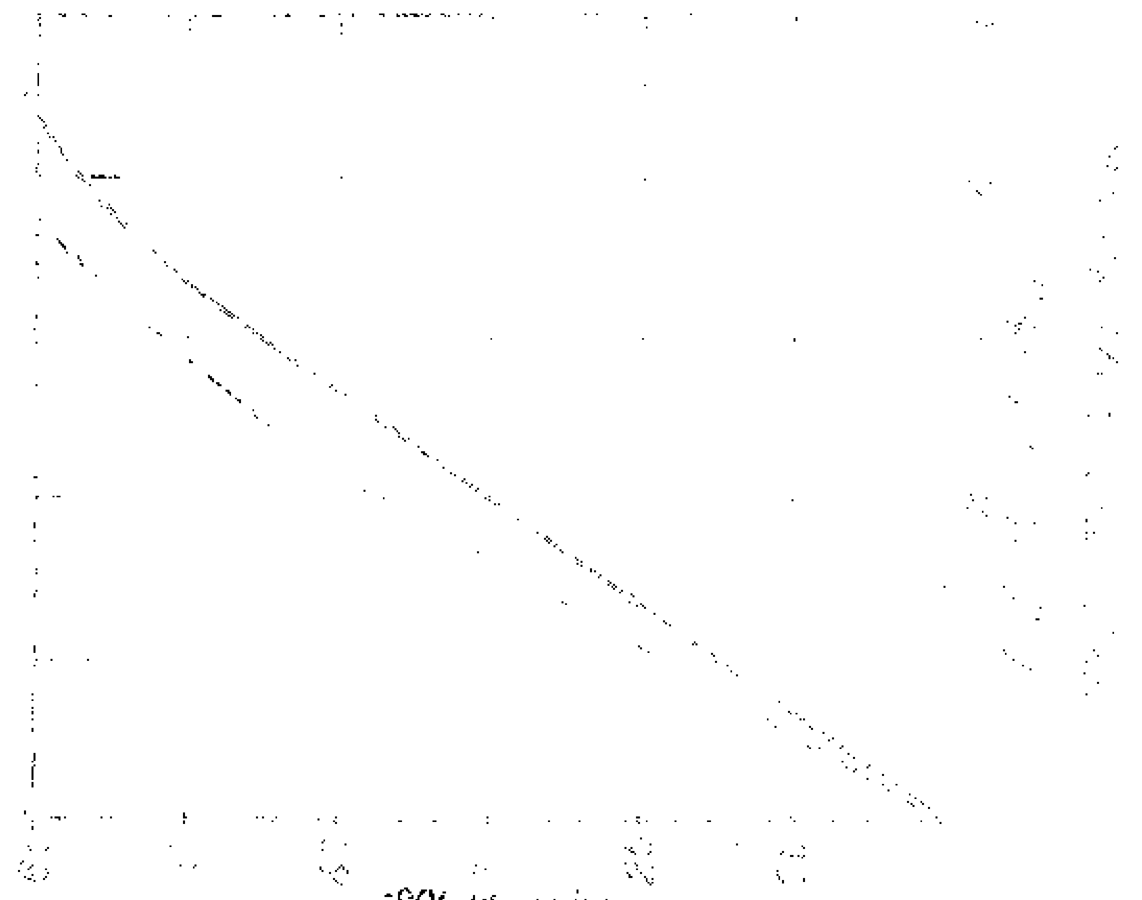
TABLE 1

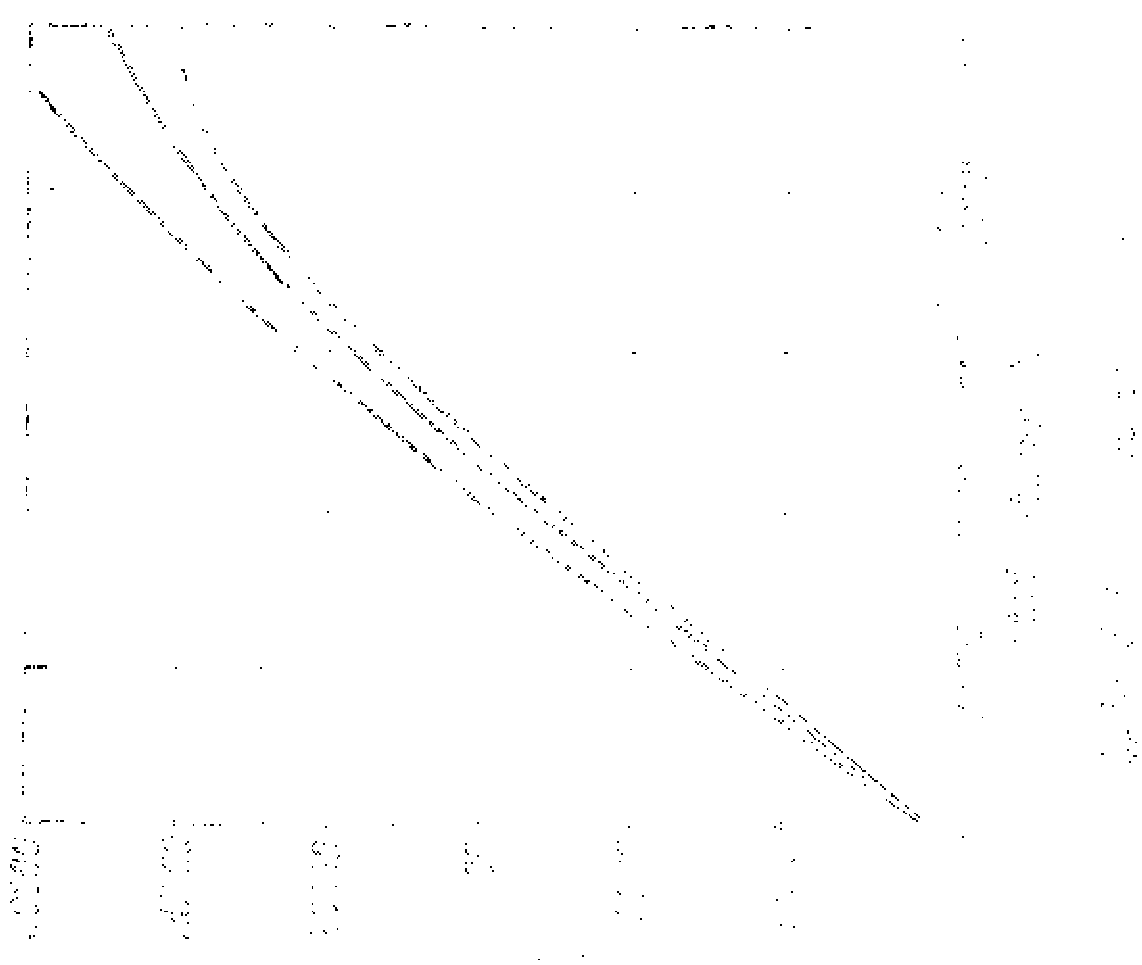
Average Properties of Materials in Tension Tests

Material	Yield Stress (psi)	Ultimate stress (psi)	Young's Modulus (psi)
Mild Steel	57300	64670	30×10^6
Brass	15030	63750	13.2×10^6
Cast-Iron	-	34500	-

Torsion Tests

Fig. 14 and 16 of the torsion tests results are used for obtaining the values of Modulus of rigidity. The values of Poisson's ratios were determined by using those G, and E values from the tension tests. Three specimens were needed for each kind of material. Unfortunately one data of the brass specimen was missing, so that there are two left.





The average properties of the materials in torsion tests are given in TABLE 2

TABLE 2

Average Properties of Materials in Torsion Tests

Material	Yield Stress	Ultimate Stress (psi)	Modulus of Rigidity (psi)	Poisson's Ratio
Mild Steel	33000	65,000	11.1×10^6	0.347
Brass	13720	55,000	5.42×10^6	0.22
Cast-Iron	-	42,200	-	-

Hardness Tests

The tests were carried out by using the AVERY HARDNESS MACHINE with a ball size of 1/16 in. diameter. The average hardness of the materials are shown in TABLE 3

TABLE 3

Hardness of the Materials

Material	Mild Steel	Brass	Cast Iron
Rockwell H.	72.8	65.9	96.2

Combined Stresses Tests

The combined bending and torsion results are given in TABLE 4, 5 and 6. The combined bending, torsion, internal pressure are given in TABLE 7, 8 and 9. These results are plotted in graphs as shown in Fig. 17, 18 and 19

TABLE 4

Mild Steel Subjected to Combined Bending and Torsion

ϕ (deg.)	Spec. No.	d_o (in.)	W_o (lbs)	σ_1 (psi)	σ_2 (psi)	σ_1/σ_e	σ_2/σ_e
0	1	0.300	21.0	59400	0	1.037	0
15	2	0.298	20.0	56700	-981	0.990	-0.17
30	8	0.298	21.0	56400	-4060	0.985	-0.07
45	5	0.302	23.0	54600	-939	0.954	-0.16
60	6	0.300	23.6	50100	-16700	0.875	-0.29
75	9	0.302	24.2	42400	-24800	0.740	-0.43
90	3	0.299	20.2	28870	-28870	0.504	-0.50

TABLE 5

Brass Subjected to Combined Bending and Torsion

ϕ	Spec. No.	d_o (in.)	W_o (lbs)	σ_1 (psi)	σ_2 (psi)	σ_1/σ_e	σ_2/σ_e
0	5	0.301	5.5	15380	0	1.023	0
15	4	0.305	5.3	14600	-2522	0.971	-0.01
30	8	0.304	5.8	14700	-1058	0.977	-0.07
45	6	0.306	6.5	14510	-2495	0.965	-0.16
60	7	0.300	6.2	13160	-4380	0.875	-0.292
75	3	0.305	7.2	12220	-7190	0.8125	-0478
90	1	0.300	5.1	7215	-7215	0.480	-0.480

TABLE 6

Cast Iron Subjected to Combined Bending and Torsion

β (deg.)	Spec. No.	d_o (in.)	W (lbs)	σ_1 (psi)	σ_2 (psi)	$\frac{\sigma_1}{\sigma_e}$	$\frac{\sigma_2}{\sigma_e}$
0	-	0.300	18	50900	0	0.995	0
0	1	0.303	18	51500	0	1.007	0
15	2	0.300	19	52800	-913.5	1.032	-0.018
30	3	0.3025	20	51600	-3710	1.008	-0.073
45	4	0.311	23	49950	-20700	0.976	-0.405
60	5	0.306	26	52100	-17400	1.018	-0.340
75	6	0.297	29	53200	-31300	1.038	-0.611
80	7	0.301	31	51000	-35900	0.996	-0.701
90	9	0.299	31	44400	-44400	0.968	-0.868

TABLE 7

Mild Steel Subjected to Combined Bending, Torsion and Internal Pressure

β (deg.)	Spec. No.	d_o (in.)	W (lbs)	σ_1 (psi)	σ_2 (psi)	$\frac{\sigma_1}{\sigma_e}$	$\frac{\sigma_2}{\sigma_e}$
0	1	0.3454	10.1	60800	9500	1.062	0.175
15	2	0.3374	8.0	62890	11250	1.098	0.196
30	3	0.3374	8.0	60545	7245	1.056	0.126
45	4	0.3408	9.0	55816	-130	0.975	-0.003
60	5	0.3434	9.9	51150	-8830	0.893	-0.154
75	6	0.3374	8.0	45920	-16880	0.805	-0.294
90	7	0.3354	7.4	40145	-26525	-0.700	-0.463

TABLE 8

Brass Subjected to Combined Bending, Torsion and Internal Pressure

ϕ (deg.)	Spec. No.	d_o (in.)	W_o (lbs)	σ_1 (psi)	σ_2 (psi)	$\frac{\sigma_1}{\sigma_e}$	$\frac{\sigma_2}{\sigma_e}$
0	1	0.3451	2.90	17520	9580	1.165	0.637
15	2	0.3434	2.64	17558	8942	1.1675	0.594
30	3	0.3414	2.54	17812	8092	1.184	0.538
45	4	0.3454	2.84	16900	4620	1.123	0.307
60	5	0.3464	2.84	15795	1595	1.050	-0.106
75	6	0.3461	2.64	14518	-1242	0.965	-0.083
90	7	0.3464	2.25	12560	-3340	0.835	-0.222

TABLE 9

Cast Iron Subjected to Combined Bending, Torsion and Internal Pressure

ϕ (deg.)	Spec. No.	d_o (in.)	W_o (lbs)	σ_1 (psi)	σ_2 (psi)	$\frac{\sigma_1}{\sigma_e}$	$\frac{\sigma_2}{\sigma_e}$
0	1	0.3450	5.8	35080	9670	1.017	0.279
15	2	0.3439	5.6	34905	9105	1.011	0.264
30	3	0.3444	5.8	34272	6515	0.993	0.189
45	4	0.3469	6.8	34765	1765	0.999	0.051
60	5	0.3468	7.4	34410	-4150	0.996	-0.120
75	6	0.3449	7.8	33735	-11865	0.976	-0.344
90	7	0.3441	8.5	33240	-23360	0.935	-0.676

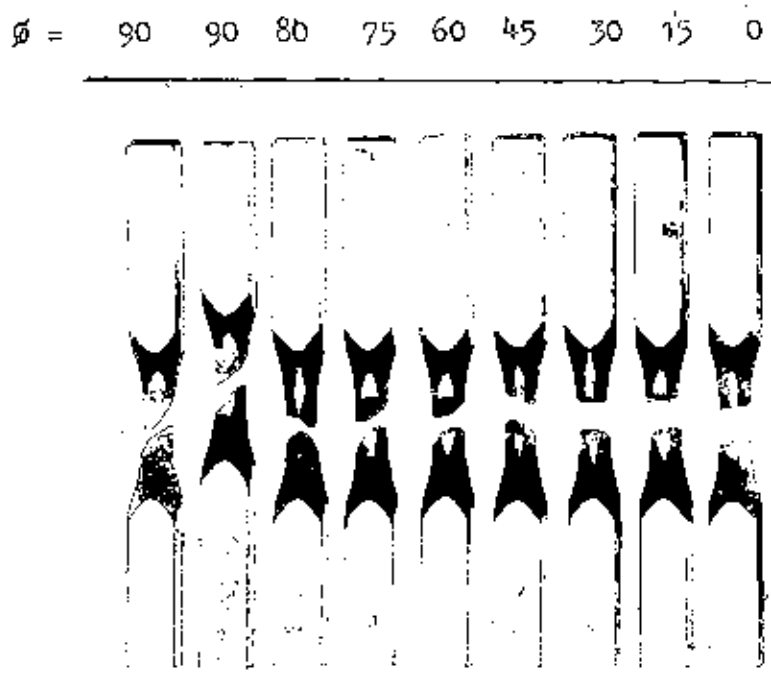


Fig.20 Failures of Cast-Iron Specimens.

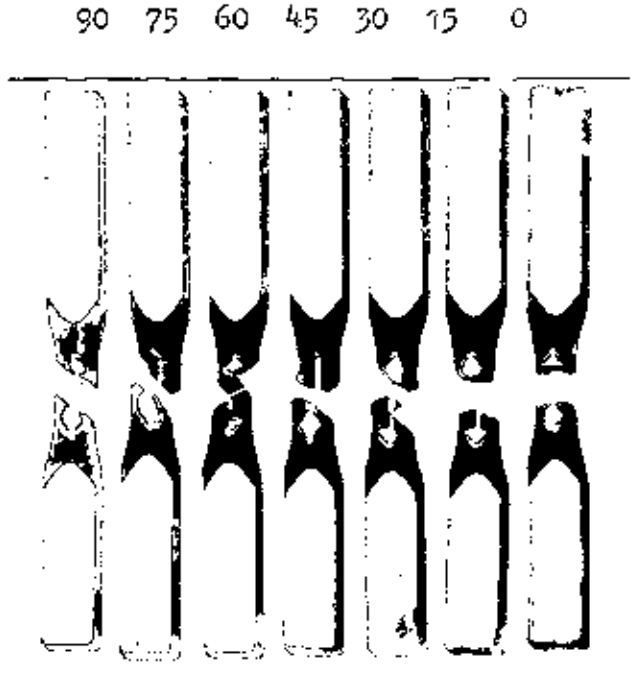


Fig.21 Failures of Cast-Iron Specimens (Hollow).