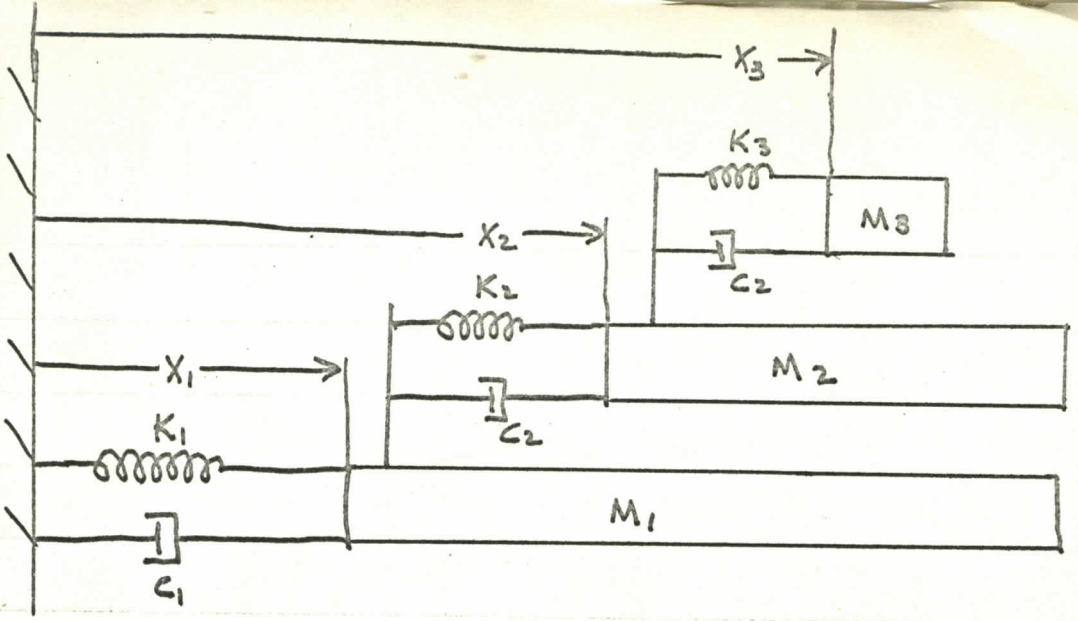


M_1 = TABLE & SPRING VIRTUAL OSCILLATING MASS

M_2 = BODY LESS VISCERA MASS

M_3 = VISCERA MASS

INITIAL TRIAL VALUES

$M_1 = 60$ lb $\quad M_2 = 128$ lb $\quad M_3 = 27$ lb

$K_1 = 5$ lb/in $\quad K_2 = 20$ lb/in $\quad K_3 = 9.15$ lb/in

$C_1 = 0 \quad C_2 = 1 \frac{\text{lb sec}}{\text{in}} \quad C_3 = 0.126$ lb sec/in

INITIAL CONFIGURATION - TWO DEGREE OF FREEDOM, CONSIDER BODY & PLATFORM ONE RIDGID MASS WITH VISCERA COUPLED THERETO.

	CASE I	CASE II
	$M_1 = 188$	200
	K_1 = values to obtain ½ - 6 sec periods	Same
	$C_1 = 0$	Same
(Visera)	$M_2 = 27$	15
	$K_3 = 9.15$	Same
	$C_3 = 0.126$	Same

$m_1 = 188$ $K_1 = \text{VARIOUS}$ $C_1 = 0$ (m_1 is 60 lb table + 128 lb body less visera)

$m_2 = 27$ $K_2 = 9.15$ $C_2 = 0.126$

5/23/67 (2)

DOUBLE RECORDED VALUES FOR ACTUAL PERIOD (↑)

K_1	$\uparrow$ (2 degree)	$\uparrow$ (1 degree)	$\Delta\uparrow$	$\frac{\Delta M}{M}$	$\frac{2\Delta\uparrow}{\uparrow}$ (%)
5	1.0558 2.1116	1.0510	.0048	1.26	.91
20	.5368 1.0736	.5254	.0114	6.03	4.34
2	1.6641 3.3282	1.6614	.0027	145	.326
1	2.3512 4.7024	2.3495	.0017	120	.145
0.5	3.3233 6.6466	3.3228	.0005	.042	.03
0.25	4.6988 9.3976	4.6982	.0006.		.025

2 DOF (1) RIGID MAN + LARGE VISERA

128
27
155
60
215

$\frac{215}{155} = 1.39$

$m_1 = 200$ $K_1 = \text{Various}$ $C_1 = 0$ (m_1 is 60 lb table + 140 lb body less visera)

$m_2 = 15$ $K_2 = 9.15$ $C_2 = 0.126$

K_1	$\uparrow$ (2 degree)	$\uparrow$ (1 degree)	$\Delta\uparrow$	$\frac{\Delta M}{M}$	$\frac{2\Delta\uparrow}{\uparrow}$ (%)
20	.5286 1.0572	.5255	.0031	1.64	1.18
5	1.0523 2.1046	1.0508	.0015	.140	.286
2	1.6621 3.3242	1.6613	.0008	.13	.096
1	2.3497 4.6994	2.3495	.0002	.02	.017
0.5	3.3227 6.6454	3.3227	0		0
0.25	4.6989 9.3978	4.6982	.0007		.03

2 DOF (2) RIGID MAN + SMALL VISERA

$\frac{215}{155} = 1.39$

5/23/07

(3)

$m_1 = 60$ K_1 = Various $C_1 = 0$

$m_2 = 128$ (SAM) K_2 = Determined to make periods match previous data $C_2 =$ 1.0

DOUBLE RECORDED VALUES FOR ACTUAL PERIOD (τ)

K_1	K_2	τ (2°)	τ (1°)	$\Delta\tau$	$\frac{2\Delta\tau}{\tau}$ %
5	50	1.0054	.9826	.0228	4.5
4.38	50	1.0712	1.0506	.0206	3.9%
4.38	100	1.0604	1.0506	.0098	1.87
4.38	200	1.0551	1.0506	.0045	.86

---

20 ✓	200	.5027	1.0054	.4914	.0113	4.5%
5		.9882	1.9764	.9827	.0055	1.12
2		1.5569	3.1138	1.5537	.0032	.41
1		2.1994	4.3988	2.1973	.0021	.19
0.5		3.1086	6.2172	3.1074	.0012	.08
0.25		4.3967	8.7934	4.3946	.0021	.095

2 DOF (3)

$m_1 = 60$ K_1 = Various $C_1 = 0$

$m_2 = 128$ $K_2 = 200$ $C_2 =$ ~~2.0~~

K_1	τ (2°)	τ (1°)	$\Delta\tau$	$\frac{2\Delta\tau}{\tau}$ %
20				
5	This run not valid due to large value of C_2 cannot be accomodated by present scale factors.			
2				
1				
0.5	3.1403	3.1075	.0328	2.1%
0.25	4.3988	4.3947	.0041	.19

(TABLE) $M_1 = 60$ $K_1 = \text{Various}$ $C_1 = 0$

(BODY) $M_2 = 150$ $K_2 = $ ~~[illegible]~~ $C_2 = 1.0$

(VISERA) $M_3 = 20$ $K_3 = 9.15$ $C_3 = 0.126$

5/23/67 (4)

DOUBLE RECORDED VALUES FOR ACTUAL ↑

K_1	K_2	$\uparrow$ (3°)	$\uparrow$ (1°)	$\Delta\uparrow$	$\frac{2\Delta\uparrow}{\uparrow}$ %
2	200	1.7240 3.4480	1.7186 3.4372	.0054	.63
2	100	1.7287	1.7186	.0101	1.18
2	150	1.7255	1.7186	.0069	.81
2	125	1.7268	1.7186	.0082	.95
2	100	1.7287 3.4574	1.7186	.0101	1.18 ✓
1		2.4369 4.8738	2.4305	.0064	.53 ✓
0.5		3.4408 6.8816	3.4369	.0039	.23 ✓
0.25		4.8625 9.7250	4.8617	.0008	.033 ?
20		0.5785 1.1570	.5435	.0350	13.0 ✓
10		0.7930 1.5860	0.7686	.0244	6.34 ✓
5		1.1042 2.2084	1.0869	.0173	3.2 ✓

3 DOF (1)

5/24/67

DISCOVERED ALL PERIODS RECORDED TO DATE ARE ACTUALLY FOR ONE-HALF CYCLE – COUNTER IS STARTING ON (+) SLOPE AND STOPPING ON (–) SLOPE. THIS VERIFIED OTHERWISE BY INSPECTION OF STRIP CHART RECORDINGS. RESET CONTROLS OF COUNTER AS FOLLOWS TO GIVE CORRECT PERIOD COUNT FOR EVERY OTHER CYCLE:

START-STOP INPUT - COMM
START LEVEL (+) 2X - 4
STOP LEVEL (+) 2X - 6
DISPLAY TIME - TO HOLD ONE CYCLE
MANUAL GATE - OPEN
STD GATE TIME - 1 SEC

FUNCTION - PERIOD
TIME UNIT - μ SEC

5/24/67 (5)

~~3 DOF (1)~~

(TABLE) $M_1 = 60$ K_1 = VARIOUS $C_1 = 0$

(BODY) $M_2 = 150$ K_2 = TO BE DETERMINED TO MATCH EXP. DATA $C_2 = 1.0$

(VISERA) $M_3 = 20$ $K_3 = 9.15$ $C_3 = 0.126$

K_1	K_2	τ (3DOF)	τ (1DOF)	$\Delta\tau$	$\frac{2\Delta\tau}{\tau}$ (%)
2	250	3.4458	3.4364	.0094	0.545
2	300	3.4443	3.4364	.0079	0.46
2	325	3.4440	3.4364	.0076	0.44
2	~~350~~ 400	3.4428	3.4364	.0064	0.37
2	350	3.4436	3.4364	.0072	0.42

3 DOF (2)

						$\frac{\Delta M}{M}$
20	350	1.1139	1.0866	.0273	4.92	
5	↓	2.1860	2.1734	.0126	1.16	
2		3.4436	3.4364	.0072	0.42	
1		4.8650	4.8604	.0046	0.19	
0.5		6.8764	6.8737	.0027	0.079	
0.25						

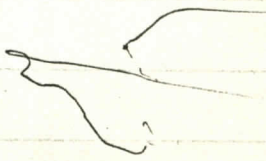
3 DOF (3)

20	400	1.1118	1.0866	.0252	4.54	6.15
5	↓	2.1849	2.1733	.0116	1.06	1.43
2		3.4430	3.4364	.0066	0.384	.52
1		4.8643	4.8600	.0043	0.177	.24
0.5		6.8753	6.8733	.0020	0.058	.079

MAN - AIR BRG ANALOG

$\frac{150}{20}$ $\frac{170}{60}$ $\frac{230}{170}$

$\frac{230}{170} = 1.35$



$M_1 = 60$ K_1 = VARIOUS $C_1 = 0$

$M_2 = 128$ (SAM) K_2 = TO BE DETERMINED TO FIT EXP. DATA $C_2 = 1.0$

5/24/67

K_1	K_2	τ (2DOF)	τ (1DOF)	$\Delta\tau$	$\frac{2\Delta\tau}{\tau}$ %
2	400	3.1096	3.1068	.0028	0.18
2	800	3.1078	3.1068	.0010	0.064
2	600	3.1083	3.1068	.0015	0.097

2 DOF (4)

K_1	K_2	τ (2DOF)	τ (1DOF)	$\Delta\tau$	$\frac{2\Delta\tau}{\tau}$ %
10 ~~20~~	600	1.3945	1.3893	.0052	0.746
5	↓	1.9683	1.9649	.0034	0.345
2	↓	3.1083	3.1068	.0015	0.097
1	↓	4.3949	4.3940	.0009	0.041
0.5	↓	6.2144	6.2139	.0005	0.016

K_1	K_2	τ (2DOF)	τ (1DOF)	$\Delta\tau$	$\frac{2\Delta\tau}{\tau}$ %
10 ~~20~~	800	1.3932	1.3893	.0039	0.56
10 ~~20~~	1000	1.3923	1.3893	.0030	0.43

2 DOF (5)

K_1	K_2	τ (2DOF)	τ (1DOF)	$\Delta\tau$	$\frac{2\Delta\tau}{\tau}$ %	$\frac{\Delta M}{M}$
20 ~~40~~	1000	.9867	.9824	.0043	0.87	1.28
10 ~~20~~	↓	1.3923	1.3893	.0030	0.43	.63
5	↓	1.9668	1.9649	.0019	0.193	.283
2	↓	3.1074	3.1067	.0007	0.045	.066
1	↓					

SAM – AIR BRG ANALOG

$\frac{188}{128} = 1.47$

(MM-1)

MAN - CHAIR ANALOG

5/25/67 (7)

$m_1 = 20$ $K_1 =$ TO BE DETERMINED $c_1 = 0$

$m_2 = 150$ $K_2 =$ TO BE DETERMINED TO OBTAIN $\frac{\Delta M}{M} = .5\%$ $c_2 = 1.0$

$m_3 = 20$ (11.8% MM) $K_3 = 9.15$ $c_3 = 0.126$

First, using 1DOF with $m = 172.5 + 20 = 192.5$ lb, determine K_1 to obtain $\tau = \frac{6.0652}{3} = 2.0217$ (experimental value)

Obtained $\tau = 2.0213$, read $K_1 = 4.838$.

K_2	τ (3DOF)	τ (1DOF)	$\Delta\tau$	$\frac{2\Delta\tau}{\tau}$ (%)
400	2.0251	2.0091	.0160	1.57
1000	2.0192	2.0091	.0101	1.00%

Made $K_1 = 5$

1000	1.9869	1.9759	.0110	1.10%

K_2	K_3				
1000	10	1.9863	1.9759	.0104	1.04%
1000	100	1.9810	1.9759	.0051	0.515%

K_2	K_3	c_3	τ (3DOF)	τ (1DOF)	$\Delta\tau$	$\frac{2\Delta\tau}{\tau}$ (%)
1000	100	1.0	1.9810	1.9759	.0051	0.515%

MAN-CHAIR ANALOG

5/25/67

(3)

$m_1 = 20$ $K_1 = 5$ $C_1 = 0$

$K_2 = 1000$ $C_2 = 1.0$

$K_3 = 100$ $C_3 = 0.126$

m_m	m_2	m_3	τ (3DOF)	τ (1DOF)	$\Delta\tau$	$\frac{2\Delta\tau}{\tau}$ (%)
120	106	14	1.7001	1.6959	.0042	.49
140	124	16	1.8177	1.8132	.0045	.49
160	141	19	1.9282	1.9229	.0053	.55 ✓
170	150	20	1.9810	1.9759	.0051	.52 ✓
180	159	21				
200	177	23				
220	194	26				

m_m	m_2	m_3	K_1	τ (3DOF)	τ (1DOF)	$\Delta\tau$	$\frac{2\Delta\tau}{\tau}$ (%)
170	150	20	20	} Can't do this with SF's in use and existing m_1			
			10				
			5	1.9810	1.9759	.0051	.52 ✓
			2	3.1277	3.1244	.0033	.21 ✓
			1	4.4215	4.4185	.0030	.14 ✓

MAN - MMI ANALOG ↗ 3DOF (4)

5/25/67

(9)

(1) $M_1 \ddot{X}_1 + C_1 \dot{X}_1 - C_2 (\dot{X}_2 - \dot{X}_1) + K_1 X_1 - K_2 (X_2 - X_1) = 0$

(2) $M_2 \ddot{X}_2 + C_2 (\dot{X}_2 - \dot{X}_1) - C_3 (\dot{X}_3 - \dot{X}_2) + K_2 (X_2 - X_1) - K_3 (X_3 - X_2) = 0$

(3) $M_3 \ddot{X}_3 + C_3 (\dot{X}_3 - \dot{X}_2) + K_3 (X_3 - X_2) = 0$

Note - Correct $\frac{2\Delta T}{T} \times \frac{MT}{Mm} = \frac{\Delta M}{M}$

5/25/67 (10)

MAN-AIR BRG DATA
EXTRACTED FM DUMP BOOKS

K_1 (lb/in)	M_M (lb)	T (sec)	$\frac{\Delta M}{M}$ (%)	DATE	Conditions
1	175	5.07	.43	4-15-66	Supine, foot rest + gripping side
1	196.2	5.28	.34	4-19-66	
1	138	4.67	.26	"	
1	136.8	4.87	.15 .21	"	
1	147.5	4.77	.31	4-20-66	
~~1~~	~~147.5~~				
2	~~143.5 (65.3 (kg))~~ 143.5	3.32	.43	4-21-66	
2	~~174~~ 174	3.56	.46	"	
1	174	5.02	.22	4-21-66	
1	143	4.68	.27	"	Corrected for buoyancy
1	132	4.54	.35	"	Corrected for buoyancy
1	182	5.10	.36	"	
1	173	5.01	.38	4-29-67	Corrected for buoyancy
1	143.	4.68	.21	" " " "	
1	174	5.02	.30	" " " "	
2	153	3.40	.45	4-29-67	- 10 msec SPREAD
2	168.5	3.44	.40	"	
2	143	~~3.30~~	.40		Average - 5×10^{-3} SEC SPREAD
1	143	4.68	.18		Average - 7×10^{-3} SEC SPREAD

Correction factor:
1.09 X M_M(Kg) = Buoyancy Correction IN gm (+)
(ADD TO ACTUAL WT)

The above data of questionable value due to off-center load on the air bag.

5/25/67 (11)

MAN - AIR BRG DATA

DATE	M_m (lb)	K (lb/in)	$\hat{T}$ (SEC)	$\frac{\Delta M}{M}$ (%)	CONDITIONS
5-19-66	126.6	20	1.00	1.18	SUPINE, FOOT REST AND HOLDING SIDES
5-20-66	123.55	10	1.39	.476	← SAM ✓
"	144	10	1.47	1.25 ✓	
"		10	1.64	1.09 ✓	
"	124	10	1.40	1.40 ✓	
"	218.2	10	1.72	1.04 ✓	
5-23-66	123.6	4	2.20	0.20	← SAM ✓
	143.6	4	2.31	.68 ✓	
	124.8	4	2.21	.76 ✓	
5-25-66	217	4	2.70	.60 ✓	
	125.9	4	2.21	.78 ✓	
	123.6	4	2.20	.19	← SAM ✓
	197	4	2.60	.61 ✓	
5-26-66	123.6	2	3.13	.098	← SAM ✓
	142	2	3.30	.48 ✓	
	125	2	3.15	.53 ✓	
	125	2	3.15	.48 ✓	
	199	2	3.73	.49 ✓	
5-26-66	132	2	3.13	.34	4 FT² SAIL + SAM's Mass of Pb
	132	2 (?)	2.19	.33	4 FT² SAIL " " "
5-20-66	132	10	1.39	.37	4 FT² SAIL + SAM's mass of Pb
	8	20	.58	.58	4 FT² SAIL ONLY
~~5-19-66~~	~~126~~	~~20~~	~~1.00~~	~~1.18~~	
5-7-66	125.9	20	1.00	3.43 ✓	
5-7-66	144	20	1.04	2.36 ✓	

5/25/66 (12)

MAN - AIR BRG DATA

DATE	M_m (lb)	K (lb/in)	$\uparrow$ (sec)	$\frac{\Delta M}{M}$ (%)	
5-26	124	1	4.45	.16 ✓	
	200	1	5.27	.147	
	142	1	4.65	.16 ✓	
	132	1	4.42	.16	$4\,FT^2$ SAIL + Pb
	123	1	4.43	.1 ← SAM ✓	
	123	20	.985	.81 ← SAM ✓	

3DOF (5)

$m_1 = 60$ $K_1 = \text{Var}$ $c_1 = 0$

$m_2 = 150$ $K_2 = \text{To be det}$ $c_2 = 1.0$

$m_3 = 20$ $K_3 = 9.15$ $c_3 = 0.126$

$\frac{2\Delta\tau}{\tau} \times 1.35 = \frac{\Delta m}{m}$

K_1	K_2	τ (3DOF)	τ (1DOF)	$\Delta\tau$	$\frac{2\Delta\tau}{\tau}$ (%)	$\frac{\Delta m}{m}$ (%)
5	400	2.1856	2.1737	.0119	1.09	1.47
5	1000	2.1811	2.1737	.0074	0.68	0.92

It doesn't seem reasonable that K_2 should be any larger - the other alternative is make K_3 larger.

K_1	K_2	K_3	τ (3DOF)	τ (1DOF)	$\Delta\tau$	$\frac{2\Delta\tau}{\tau}$ (%)	$\frac{\Delta m}{m}$ %	
5	1000	18.3	2.1787	2.1737	.0050	0.46	0.62	
5	2000	9.15	2.1795	2.1735	.0060	0.55	0.75	
20	↓	↓	1.0999	1.0865	.0134	2.44	3.29	
2	↓	↓	3.4392	3.4362	.0030	.174	.236	
1	↓	↓	4.8616	4.8595	.0021	.0864	.117	
.5	↓	↓	~~6.8729~~ 6.8719	6.8719	.0010	.029	.0393	3DOF(5)
20	1000	10	1.1016	1.0865	.0151	2.75	3.71	
5	↓	↓	2.1799	2.1732	.0067	.615	.83	
2	↓	↓	3.4392	3.4357	.0035	.204	.275	3DOF(6)
1	↓	↓	4.8611	4.8592	.0019	.078	.106	
20	1000	12	1.0998	1.0864	.0134	2.44	3.29	
5	↓	↓	2.1791	2.1731	.0060	.55	.74	3DOF(7)
2	↓	↓	3.4388	3.4357	.0031	.18	.243	
1	↓	↓	4.8611	4.8592	.0019	.078	.106	
20	1000	15	1.0988	1.0865	.0116	2.12	2.86	
5	↓	↓	2.1783	2.1727	.0056	.52	.70	
2	↓	↓	3.4384	3.4357	.0027	.157	.212	
1	↓	↓	4.8608	4.8592	.0016	.066	.089	3DOF(8)

5/26/67 (14)

Using 3DOF(7) with $K_1 = 5$ ($T = 2.1791$)

To simulate vibration:

Introduced a sinusoidal acceleration of >100% amplitude of the steady state value @ 100 cps. The effect was not measureable, ie, the periods measured were same as before and the same from one period to the next.

To simulate lower freq effects, such as ventilation air currents, etc:

Introduced a sinusoidal acceleration of 1% amplitude @ 5 cps (lower limit of oscillator in use). The effect was noticeable to the extent that the measured period would scatter a total of about 1 millisecond, but when averaged over 7 readings gave the same value as previously obtained.

44
90
88
92
95
90
86
1635
91