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Mechanical Part Design of Vibration Platform

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The vibration system contain 3 main parts; the frequency convertor, the driving motor and the vibrating platform. The frequency convertor allows signal input and give a specific current out to the motor. The motor's shaft can be connected to the vibrating platform by gears as the medium of transmitting power. With the rotation of the cam, the platform will accelerate/decelerate in sine wave form up to the stated frequency as it will hurt both the machine and subject if it accelerate/decelerate too rapid. The vibrator can generate a sine wave form peak-to-peak stroke of 10 mm. In order to support up to 130 kg, the vibrator's platform is connected to a 4 kW, 960 rpm motor with the gear ratio of 1/1.54.

Frequency required (Hz)	Frequency required output from the frequency convertor(Hz)
1.6	7.7
2	9.63
2.5	12.03
3.15	15.16
4	19.25
5	24.06
6.3	30.32
8	38.50
10	48.13

Table 1: Frequency conversion .

S.No.	Degree Θ =	Distance of cam from the axis of rotation (mm)	Displacement of the client (mm)
1	0	29.58	4.58
2	15	30.9	5.9
3	30	32.19	7.19
4	45	33.33	8.33
5	60	34.23	9.23
6	75	34.8	9.8
7	90	35	10
8	105	34.8	9.8
9	120	34.23	9.23
10	135	33.33	8.33
11	150	32.19	7.19
12	165	30.9	5.9
13	180	29.58	4.58
14	195	28.31	3.31
15	210	27.19	2.19
16	225	26.26	1.26
17	240	25.57	0.57
18	255	25.14	0.14
19	270	25	0
20	285	25.14	0.14
21	300	25.57	0.57
22	315	26.26	1.26
23	330	27.19	2.19
24	345	28.31	3.31
25	360	29.58	4.58

Table 2: Displacement of the platform.

The motor chosen was a 4 kW, with 960 rpm. A pair of gear with 1/1.54 gear ratio was linked to the motor shaft to reduce the angular speed and increase the resulting torque and power.

The vibration unit can operate at nine frequencies from 1.6 Hz to 10 Hz [1]. In the vibration unit, the lowest frequency chosen is 1.6 Hz

The motor required rpm=1.6×60×1.54=147.84 rpm

$$\frac{50}{960}=\frac{f}{147.84}$$

f=7.7 Hz

∴7.7 Hz is the frequency required given out from the frequency convertor.

The highest required frequency for the vibration platform=10 Hz

The motor required rpm, 10×60×1.54=924 rpm

$$\frac{50}{960}=\frac{f}{924}$$

f=48.125 Hz

∴ 48.125 Hz is the frequency required given out from the frequency convertor.

From the above calculation, we can find that the motor can cover all the frequency required in the test (Tables 1,2 and Figures 1,2).

Reference

1. Subashi GHMJ, Nawayseh N, Matsumoto Y, Griffin MJ (2009) Nonlinear subjective and dynamic responses of seated subjects exposed to horizontal whole-body vibration. J Sound Vib 321: 416-434

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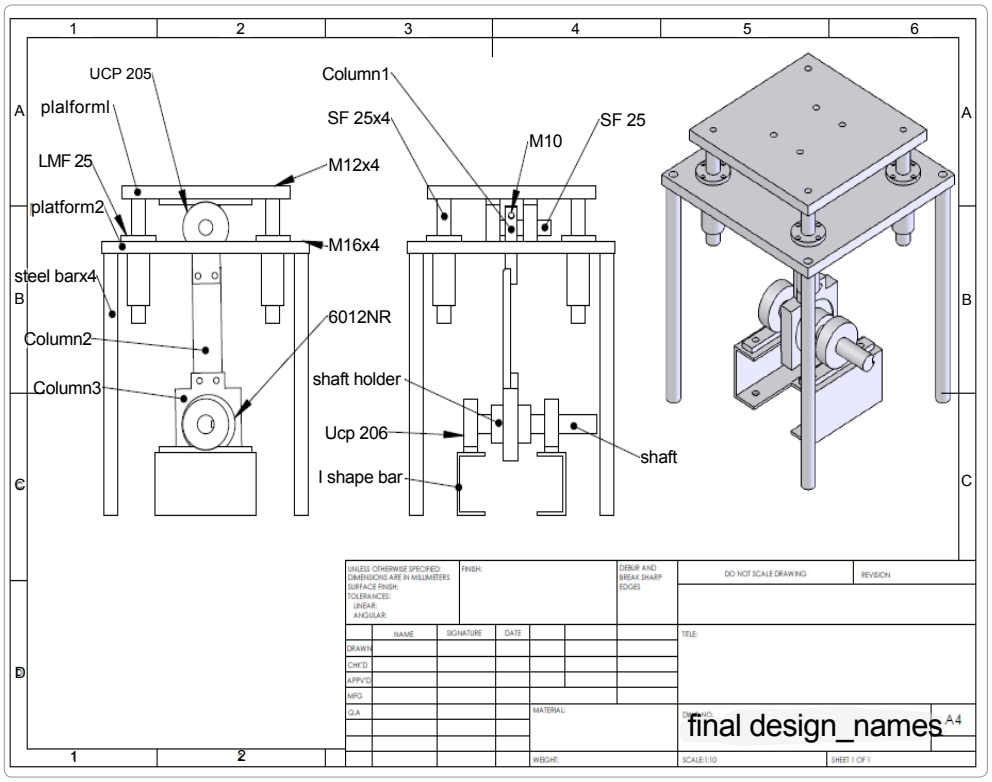

Figure 1: Mechanical part of Vibration platform.

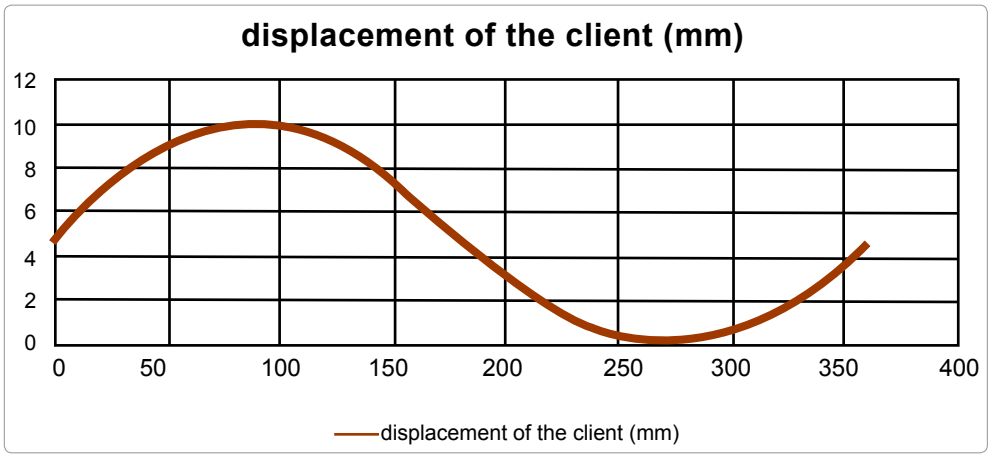

Figure 2: Displacement of the client.