Vibration Analysis Of Double Roller Autofeeder Ginning Machine Seed Channel By Global Stiffness Matrices : Vibration Measurement & Its Effects

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Abstract— Noise is sound that is not wanted by the perceiver, because it is unpleasant, loud, or interferes with hearing. This results in the subjective discretion between sound and noise, where any sound may be considered noise depending on the perceiver. By extension, in experimental sciences, "noise" refers to any random fluctuations of data that makes more difficult the perception of an expected signal. Specifically, acoustic noise is any sound in the acoustic domain, either deliberate (music, speech, etc.) or unintended. In contrast, noise in electronics may not be audible to the human ear and often requires instruments for detection. Environmental is the accumulation of all noise present in a specified environment. The principal sources of environmental noise are surface motor vehicles, aircraft, trains and industrial sources. These noise sources expose millions of people to noise pollution that creates not only annoyance, but also significant health consequences such as elevated incidence of hearing loss and cardiovascular disease. There are a variety of mitigation strategies and controls available to reduce sound levels including source intensity reduction, land use planning strategies, noise barriers and sound baffles, time of day use regimens, vehicle operational controls and architectural acoustics design measures.

Keywords: stiffness matrix, global matrix, displacement matrix, quadratic equations material, measurement, seed channel parameters ginning machine, noise, vibration, ginning machine spares, operation

INTRODUCTION

Ginning machine is manufacturing in India and most of the economically low pay group people & working for their survivals .the operator continue with the dirty exposure and noisy condition ,they are also felt sick due to the environmental hazardous condition .out of these problem one major problem which is mostly and continuous exposure of ginning machine seed channel vibration ,it causes directly or indirectly affecting the normal working interest of machine operator .to control this machine vibration which may either during manufacturing or generated due to continuous operation of ginning machine over the period of time .we must understood the effect vibration on operator and machine performance as well .this is very important to find out the areas where the machine vibration may generated during design , manufacturing or during assembling of spares .once find out , selection of specific procedure to minimize it or make some changes in design textiles constitute an important component of India's economy. Ginning is the first and most important mechanical process by which seed cotton is separated into lint (fibre) and seed and machine used for this separation is called as gin. There are mainly two types of gins (i) roller gins- most commonly used in India, Egypt, Uganda, Tanzania etc. and (ii) saw gins- extensively used in countries like USA, China, Australia, Uzbekistan etc. Ginning machine which are used in Indian formats are Knife Roller Gin / Roller Gin, Saw Gin, Macarthy Gin ,Three Types Of Macarthy Gins :Single acting Macarthy Gin. , Macarthy Gin Double roller Macarthy Gin / Double Roller autofeeder Gin

Part s included in Ginning machine

Ginning machine consist of following parts

- Beater shaft,
- Auto feeder
- Roller assembly,
- Gear mesh, hopper,
- Gin stand,
- Power supply,
- Transmission system,

- Seed channels,
- Balance weight etc.


Seed channel

Seed channel exit path to the seeds, design and placement of this is very important

Following due care must be taken while design and ease to assembling

- Material selection
- Material mechanical and metallurgical properties
- Material strength
- Operating environment
- Design feasibility
- Assembly joining processes
- Vibration analysis
- Operator occupational health

MATERIAL SELECTION

MECHANICAL PROPERTIES

Details	301	304/304L	316/316L	310S	430	409
Density (gm/cm^3)	7.9	7.9	8.0	7.9	7.7	7.7
Modules of Elasticity (kg /mm^2)	19700	19700	19700	20300	20300	20300
Specific Heat Capacity Cal/gm/°C	0.12	0.12	0.12	0.12	0.11	0.11
Thermal conductivity (Cal/cm^2/Sec/°C/cm at 100°c	0.039	0.039	0.037	0.033	0.0625	0.0595
Specific Electrical Resistance (u cm3)	72	72	74	80	60	57
Coefficient of thermal expansion (°Cx10-6, 0-500 °C)	19.8	18.4	16.0	16.9	11.34	11.52
Melting Range (°C)	1400-1420	1400-1455	1370-1400	1400-1455	1430-1510	1430-1510

THICKNESS RANGES

Thick (mm)	300 series (Density: 8g/cc)	400 series (Density: 7.7 g/cc)
0.30	2.40	2.31
0.40	3.20	3.08
0.50	4.00	3.85
0.63	4.00	3.85
0.70	5.04	4.85
0.80	5.60	5.39
0.90	6.4	6.16
1.00	8.00	7.70
1.25	10.00	9.63

Material reference: Steel Authority of India Ltd, Cold rolled stainless steel: grade 300 series

DESIGN ASSUMPTIONS

- Material must follows Hooks law
- Homogeneous material

- Uniform material thickness i.e. for 1.2 mm THK
- Thickness deviation+/- 0.08mm/meter
- No external load is applied
- Self weight is taken into considerations
- Material density is 7860gm/cc (***cold rolled SS***)
-

Abbreviations and Acronyms

All dimensions are in MM, force applied or self weight, F (N), material density in Kg/mm^3 stiffness in N/mm frequency in Hz

Units

Young's modulus (E) =210Gpa, Density (rho) =7860gm/cc Material thickness =1.2mm, Area =mm^{2,} Volume =mm^3

Length=mm , deflection (u) =µm

Equations

Global Stiffness matrix, K^G

$K^G = \sum K^1 + K^2 + K^3 + \ldots K^N$

Stiffness matrix (***section 1***), K =

$$k1 = \frac{EA1}{L1}\begin{bmatrix} 1 & -1 \\ -1 & 1 \end{bmatrix}\begin{matrix} u1 \\ u2 \end{matrix}$$

Global force matrix, (F^G) ==∑ External Force, F + ∑Body Self Weight, W

$(F^G) = \sum F^1 + F^2 + F^3 + \ldots K^N + \sum W^1 + W^2 + W^3 + \ldots W^N$

Self weight W (N)

$$W1 = \frac{rho \ x \ A1 \ x \ L1}{\square}\begin{pmatrix} 0.5 \\ 0.5 \end{pmatrix}$$

Final equation

$(F^G) = (K^G)\ (U)$

CALCULATION

Seed Channel assembly & stiffness Matrix

Expanded view of Seed Channel assembly

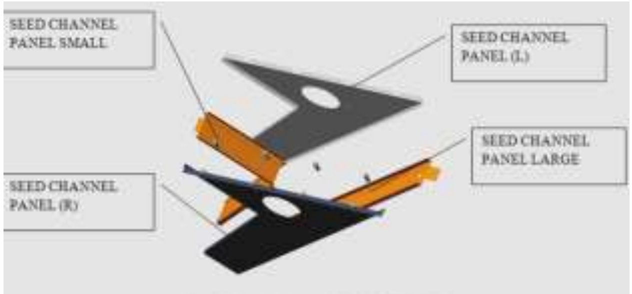


Figure: Expanded view of SEED CHANNEL

Part name	Volume (mm^3)	Density (kg/m^3)	Mass (kg)	E (kg/m^2)
Seed channel panel (L)	**223464.09**	7850 $x10^{-9}$	1.75	2.11 $x10^4$
Seed channel panel (R)	**223464.09**	7850 $x10^{-9}$	1.75	2.11 $x10^4$
Panel large	**306720**	7850 $x10^{-9}$	2.40	2.11 $x10^4$
Panel small	**191700**	7850 $x10^{-9}$	1.50	2.11 $x10^4$
inspection door (L)	$\pi\ x\ 75^2$x t **21195**	7850 $x10^{-9}$	0.16	2.11 $x10^4$
inspection door (R)	$\pi\ x\ 75^2$x t **21195**	7850 $x10^{-9}$	0.16	2.11 $x10^4$
SEED CHANNEL ASSEMBLY MASS= **7.72 KGs**				

1.2.1 CALCULATION FOR K1

a= 800 MM b= 314.4MM

(a+b)/2 = 242.8 MM

AREA = (242.8 X105) - (240.4X102.6)

A=25494-24665.04

A=**828.96** mm^2

K1 $= \frac{EA}{L} \begin{pmatrix} 1 & -1 \\ -1 & 1 \end{pmatrix}$

$= 828.96 \times (2.1 \times 10^4)/260 \begin{pmatrix} 1 & -1 \\ -1 & 1 \end{pmatrix}$

$K1 = 10^3 \times \begin{pmatrix} 66.95 & -66.95 \\ -66.95 & 66.95 \end{pmatrix}$

1.2.2 CALCULATION FOR K2

A_2= 314.4 MM B_2= 157.21 MM

(A2+B2)/2 = 78.6MM

AREA = (78.6 X105) - (76.2X 102.6)

A = 8253-8001 A = **252 mm^2**

K2 $= \frac{EA}{L} \begin{pmatrix} 1 & -1 \\ -1 & 1 \end{pmatrix}$

$= 252 \times (2.1 \times 10^4)/ 168.33 \begin{pmatrix} 1 & -1 \\ -1 & 1 \end{pmatrix}$

$= 10^3 \times \begin{pmatrix} 31.43 & -31.43 \\ -31.43 & 31.43 \end{pmatrix}$

1.2.3 CALCULATION FOR K3

A_3= 195 MM, B3= 105 MM

(A3+B3)/2 = 45 MM

AREA = (45 X105) - (42.6X 102.6)

A=4725-4473

A = **252 mm^2**

K3 $= \frac{EA}{L} \begin{pmatrix} 1 & -1 \\ -1 & 1 \end{pmatrix}$

$= 252 \times (2.1 \times 10^4)/ 550 \begin{pmatrix} 1 & -1 \\ -1 & 1 \end{pmatrix}$

$= 10^3 \times \begin{pmatrix} 9.62 & -9.62 \\ -9.62 & 9.62 \end{pmatrix}$

1.2.4 Force Matrices

Note: no external force is applied; only self weight of each should be taken into consideration

F = 0

Self weight

Section	Density (kg/mm^3)	Area	Length (mm)	Self weight (kg)
Section A	7850 x10^{-9}	828.96	260	1.70/2
Section B	7850 x10^{-9}	252	168.33	0.33/2
Section C	7850 x10^{-9}	252	377.8	0.74/2

1.2.5 Force + [self weight] = [kg]. [u]

$$\begin{bmatrix} 66.95 & -66.95 & 0 & 0 \\ -66.95 & 98.38 & -31.43 & 0 \\ 0 & -31.43 & 41 & -9.62 \\ 0 & 0 & -9.62 & 9.62 \end{bmatrix} \text{X} \begin{bmatrix} U1 \\ U2 \\ U3 \\ U4 \end{bmatrix} = \begin{bmatrix} 0.85 \\ 1.015 \\ 0.165 \\ 0 \end{bmatrix}$$

At fixed point, displacement is zero

$$\begin{bmatrix} 66.95 & -66.95 & 0 & 0 \\ -66.95 & 98.38 & -31.43 & 0 \\ 0 & -31.43 & 41 & -9.62 \\ 0 & 0 & -9.62 & 9.62 \end{bmatrix} \text{X} \begin{bmatrix} U1 \\ U2 \\ U3 \\ U4 \end{bmatrix} = \begin{bmatrix} 0.85 \\ 1.015 \\ 0.165 \\ 0 \end{bmatrix}$$

1.2.5.1 **Quadratic Equations after boundary conditions**

$$98.38\, u2 - 31.43\, u3 = 1.015$$

$$-31.43\, u2 + 41\, u3 - 9.62\, u4 = 0.165$$

$$-9.62\, u3 + 9.62\, u4 = 0$$

1.3 **Displacement**

U2 = 0.01890 MM = 18.90 µM

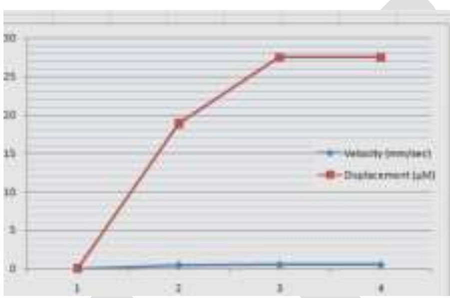
U3 = 0.02427 MM = 24.27 µM

U4 = 0.02427 MM = 24.27 µM

1.4 Frequency & velocity

Frequency =1/6.28 (sqrt(g/u))

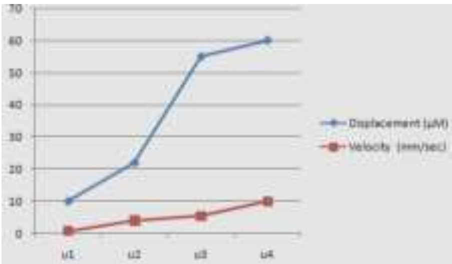
position	**Frequency (Hz)**	**Angular velocity (rad/sec)**	**Velocity (mm/sec)**	***Displacement* (µM)**
U1	**0**	**0**	**0**	**0**
U2	**3.62**	**21.8**	**0.41202**	**18.90**
U3	**3.20**	**20.1**	**0.487827**	**27.47**
U4	**3.20**	**20.1**	**0.487827**	**27.47**



1.5 ON SITE READINGS

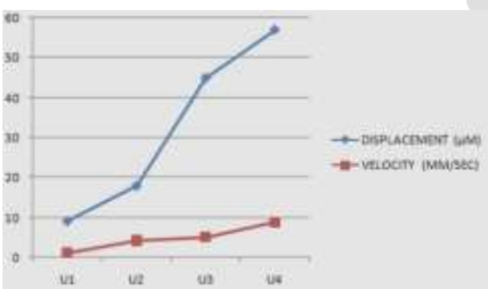
1.5.1 SEED CHANNEL READINGS WITHOUT LOADING OF GINNING MACHINE

position	**Displacement (µM)**	**Velocity (mm/sec)**
u1	**10**	**0.8**
u2	**22**	**4**
u3	**55**	**5.5**
u4	**60**	**10**



1.5.2 SEED CHANNEL READINGS WITH LOADING OF GINNING MACHINE

POSITION	DISPLACEMENT (μM)	VELOCITY (MM/SEC)
U1	9.2	1.2
U2	18	4.2
U3	45	5.1
U4	57	8.8

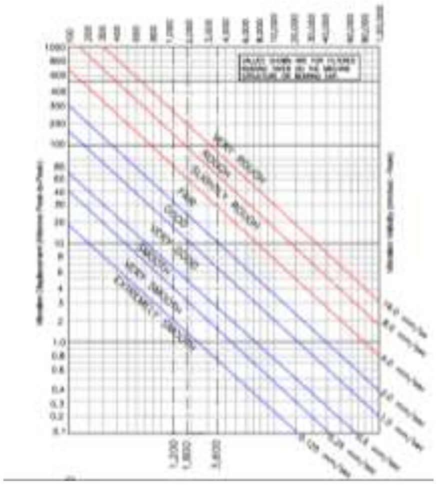


NOTE: Measuring Instrument-IRD306 PORTABLE ANALOG VIBRATION METER

1.6 **Severity Chart**

Instrumental Intensity	Acceleration (g)	Velocity (cm/s)	Perceived Shaking	Potential Damage
I	< 0.0017	< 0.1	Not Felt	None
II-III	0.0017 - 0.014	0.1 - 1.1	Weak	None
IV	0.014 - 0.039	1.1 - 3.4	Light	None
V	0.039 - 0.092	3.4 - 8.1	Moderate	Very light
VI	0.092 - 0.18	8.1 - 16	Strong	Light
VII	0.18 - 0.34	16 - 31	Very Strong	Moderate
VIII	0.34 - 0.65	31 - 60	Severe	Moderate to Heavy
IX	0.65 - 1.24	60 - 116	Violent	Heavy
X+	> 1.24	> 116	Extreme	Very Heavy

1.7 GENERAL MACHINERY VIBRATION SEVERITY CHART (METRIX)



Working Environment

RESULT & CONCLUSION

Remarkable advancement has taken place in the ginning technologies in during and post TMC era in India. It has kept the momentum of modernization of cotton ginning & pressing sector of India. Increased productivity of ginning machines, reduction of manpower and electrical power, reduction in contamination and improved cotton quality are benefits of these developments which resulted in increased export of cotton from India. Further, the developments taken in the cotton ginning & pressing technologies in India have made India a net exporter of these technologies, machinery and turnkey projects to various countries. Roller ginning technology would be a viable alternative for ginning the cotton produced in

Bangladesh.

The effects of whole-body vibration are usually greatest at the lower end of the range, from 0.5 to 100 Hz. For hand-transmitted vibration, frequencies as high as 1,000 Hz or more may have detrimental effects. Frequencies below about 0.5 Hz can cause motion sickness The transmissibility of the body is highly dependent on vibration frequency, vibration axis and body posture. Vertical vibration on a seat causes vibration in several axes at the head; for vertical head motion, the transmissibility tends to be greatest in the approximate range of 3 to 10 Hz.The broader frequency range associated with whole-body vibration (between 0.5 and 100 Hz) compared to that for natural motion (between 2 and 8 Hz for voluntary movements, and below 4 Hz for locomotion) is a further difference that helps to explain reactions of the neuromuscular control mechanisms at very low and at high frequencies. Electromyography data suggest that an increased spinal load can occur due to reduced muscular stabilization of the spine at frequencies from 6.5 to 8 Hz and during the initial phase of a sudden upward displacement. In spite of weak EMG activity caused by whole-body vibration, back muscle fatigue during vibration exposure can exceed that observed in normal sitting postures without whole-body vibration. Tendon reflexes may be diminished or disappear temporarily during exposure to sinusoidal whole-body vibration at frequencies above 10 Hz. Minor changes of postural control after exposure to whole-body vibration are quite variable, and their mechanisms and practical significance are not certain. Experiments with short-term and prolonged combined exposures to noise and whole-body vibration, seem to suggest that vibration has a minor synergistic effect on hearing. As a tendency, high intensities of whole-body vibration at 4 or 5 Hz were associated with higher additional temporary threshold shifts (TTS)

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