# Design of Impact Load Testing Machine for COT

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**Abstract:** this paper describes the design of a new pneumatically load applied machine that has been specifically design for studying the dynamic mechanical behavior of COT (wooden bed). Such type of equipment has been used to generate simple and measurable fracture processes under moderate to fast loading rates which produce complicated crack patterns that are difficult to analyze. We are developing the machine as a facility to provide experimental data to validate numerical data of impact load on COT that observe kinetic energy during collision. The machine consists of two main parts, the mechanical structure and the data acquisition system. The development process included the design, development, fabrication, and function tests of the machine.

**Keywords:** component; load; impact; design;

## I. INTRODUCTION

The starting point for the determination of many engineering timber properties is the standard short duration test where failure is expected within a few minutes. During the last decades much attention is given to study the behavior of timber and timber joints with respect to damaging effect of sustained loads, the so-called duration of load effect. In the design process of wooden structures is like a cot. To increase human safety, some parts of automotive structure made by wood are designed to absorb kinetic energy during collision. These components are usually in the form of columns which will undergo progressive plastic deformation during collision. The impact force, i.e. the force needed to deform the cot, determines the deceleration of the load during collision and indicates the capability of the cot to absorb kinetic energy. The value of impact force is determined by the geometry and the material of the cot. For this purpose advance impact testing machine is required for checking the adult sleeping cot. Impacts are made on different desired positions (depending on the size of the cot and location specified by quality engineers) with specified load. This assures the cot is safe and is ready for the customer use. The test also provides assurance of mechanical safety and prevents from serious injury through normal functional use as well as misuse that might reasonably expected to occur. For this purpose, in this project this impact testing machine for testing adult sleeping cot is fabricate. Developing the interface for controlling the machine is one of the most important parts of control system which includes the software analysis, design, and development and testing. Here we are going to develop a program for controlling the fabricated wireless impact testing for testing sleeping cot.

## II. DESIGN PROCEDURE

The aim of this is to give the complete design information about the impact testing machine. In this, the explanations and some other parameters related to the project are included. With references from various sources as journal, thesis, design data book, literature review has been carried out to collect information related to this project.

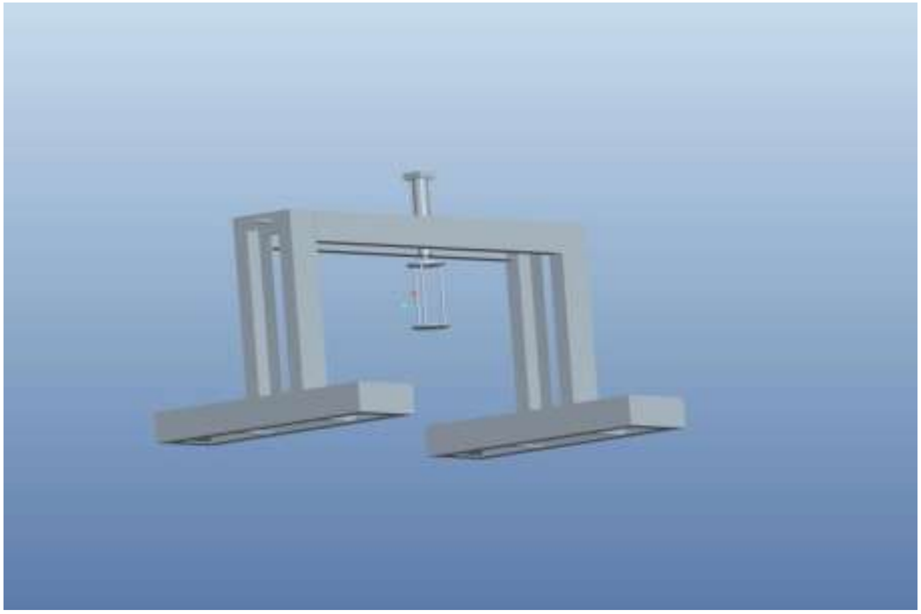

Fig.-1: Modeling of machine

### A. Design consideration

- Considered element
- Standard size of COT
- Material of COT plywood
- Maximum weight applied to the surface of COT.
- Height of impact

### B. Design calculations

Determination of impact force

Impact force = (1/2 mv2) /d

Where,

m = mass

v = velocity

d = distance travel by material after impact

$d = WL^3/ 48EI$ (data book, table I-7)

### C. Cylinder specification

Force acting by cylinder

F = DLP

Where,

D = bore diameter

L = length of stroke

P = pressure

## D. Design of Plate

T = thickness of plate
D = circular diameter of plate

Consider,
Shear of plate at joint.

Shear stress produced = Fc/Aj

Material used for plate - mild steel
Yield point stress (Syt)
Factor of safety (fos)

Shear strength = (0.5 Syt)/fos

Shear stress induced < Permissible stress
Then the plate is safe in compression and shear.

## E. Design of Lead Screw

Type of thread used = square thread
Nominal diameter of sq. screw; d
Material for lead screw: Hardened steel - Cast Iron.
Syt = 330 N/mm2
Coefficient of friction, μ= 0.15

Therefore force on the lead screw= F ( max) + self-weight of screw and impactor assembly.

Lead angle = α= 150
Nut material: FG200
Sut = 200 N/mm2

Torque required for the motion of impactor ( T);

T=P x dm /2
Where,
dm: Mean diameter of lead screw
dm = d - 0.5P
d:outside diameter of lead screw
p: pitch

## F. Design of Screw

$\sigma_c = P / (\prod/4 \times dc2)$

Where,

$\sigma_c$ = direct compressive stress.

dc = root dia. of square thread screw.

$\sigma_c = Syt / FOS$

Let FOS= 2

Therefore we take dc from data book for safety.

Also; Torsional shear stress

$(\tau_s) = 16T / \prod dc3$ ----- (1)

$\tau_s = 0.5\ Syt/2$

Also screw will tend to shear off the threads at the root diameter.

Shear area of one thread= ∏ dc x t x z

Where

z: no. of threads in engagement with nut.

Transverse shear;

$\tau_s = P/\prod \times dc \times t \times z$

As, t = p/2

Therefore we take standard size of z

## G. Design of nut

The nut is subjected to shear off due to P.

Total shear area of nut = ∏x d x t x z

Also

$\tau_n = 0.5\ Sut / FOS$

t = pitch / 2

z: No. of threads;

Therefore

We take standard value of z from data book for safety

Length of nut= 5 x pitch

## H. Design of compression spring

P = Force on each spring

∂L= Deflection of spring
Therefore

Stiffness of spring = p / ∂L

Material of the spring = cold drawn steel.

Ultimate tensile strength, Sut =1050 N/mm2

Modulus of rigidity, G = 81370 N/mm2.

Therefore shear stress = 0.30 Sut

Assume spring index = C

Therefore, Wahl shear factor,

$$k = \{(4c-1)/ (4c-4)\} + \{(0.615)/(c)\}$$

We know,

Shear stress = k x $\{(8PC)/\prod d^2\}$

Coil diameter of spring, D = cd

Number of active coils (N)
We know,

$$\partial l = \{8P (d^3) N\}/ (Gd^4)$$

Spring used is square and ground end.

Therefore

Nt = actual no. of active coil = N-2

Solid length of spring = Nt x d

Assume gap between the coils (when the total compression)
Therefore,

Total gap = (Nt-1) x 2

Free length of the spring,

Free length = solid length + total gap + ∂l

Pitch of the coil (p)

P = free length / (Nt-1)

We know when,
Free length/mean coil diameter (D) ≤2.6 guide not necessary

Free length /mean coil diameter (D) ≥2.6 guide is required

## III. FABRICATION

Mechanical components

- C- channel ( for column and beam)
- Lead screw: ( 3 nos)
- Pneumatic cylinder : ( 1 nos)
- Guide ways: ( 3 nos)
- Compressor: ( 1 nos)
- Bearings
- Spring(3 nos)
- Base plate of impactor (1 nos)

## IV. CONCLUSION

Automatic technology used for testing the machine and requires very less human assistance which further reduces the labor cost for quality testing of sleeping beds. Thus the objectives such as testing the quality of adult sleeping bed can reduce the human efforts for testing the quality of bed.

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