MODELING AND FEA ANALYSIS OF COMPRESSION SPRING FOR FEEDER IN CRUSHING PLANTS

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***Abstract*— This project describes design and FEA analysis of compression spring made of structural steel. The objective is to the load carrying capacity, elastic strain, deformation and stress steel compression spring. The dimensions of an existing conventional compression spring of a commercial screening machine are taken. The model of compression spring is created with the help of solid edge modelling software. Finite element analysis with full load on 3-D model of compression spring is done using ANSYS 14.**

***Keywords*— FEA, Structural steel, Screening machine, SOLID EDGE, ANSYS 14.**

I. INTRODUCTION

It's a crushing plant designed to reduce large rocks into smaller rocks, gravel, or rock dust. The other operations performed in this plant are to reduce the size, or change the form, of waste materials so they can be more easily disposed of or recycled, or to reduce the size of a solid mix of raw materials (as in rock ore), so that pieces of different composition can be differentiated.

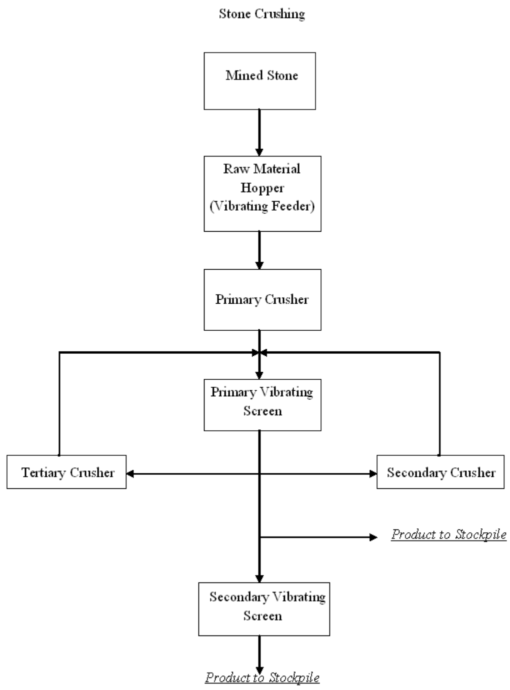
Stone crusher industry is an important industrial sector in the country. The crushed stone is used as raw material for various construction activities i.e. construction of roads, bridges, buildings and canals.

Over the last 10 years, the Construction sector has been registering strong growth rates in the range of 7-8%. Housing and construction is one of the major drivers of growth in many allied industries including STONE CRUSHING. There is a mass and consistent need of crushed stone across the country. Several projects are in progress and are being commenced which will have high demand of crushed stone all over the country which also include construction of Dams and Hydro –Electric Projects, construction of roads, flyovers, air terminals, metro-rails, bypasses, bridges, new houses, buildings, markets, etc resultantly gear up construction activities and more use of crushed stones. The aforementioned facts and statistics provide evidences, assuring a steep and continuous growth and investment opportunity in the STONE CRUSHING business.

Since it is an allied industry of the construction sector, growth in construction sector may be considered as proxy for the growth in stone crushing sector. i.e., 7-8%

The market scope for crushed stone is found to be encouraging in local market with the increased demand from building industry & construction fields. There is also a sufficient demand from Govt. Contractors for lying of roads and construction of industries etc. The entry in the target market is easy and there is a narrow gap in the supply and demand, which is expected to grow in the coming years.

II. PROCESS FLOW CHART



Big size stones are transferred to primary crusher through vibrating feeder from hopper for first crushing, then the crushed materials are transferred to impact crusher through belt conveyor for secondary crushing. The materials crushed will be transferred to the vibrating screen, and separated to different sizes. Those aggregate with suitable size will be transferred to the final product pile and those with unsuitable size will be transferred to the impact crusher for re-crushing. These forms a closed circuit manifold cycles. The sizes of final products will be graded and separated according to customers' requirements, and the Bag Dust Filter will be attached for the sake of environment protection.

III. Components of Crushing Plant

In crushing plants so many number of components are used for crushing the material, they are:

1. Hopper
2. Feeder
3. Conveyor
4. Crushers
5. Screening machines

The crushers are classified based on material final product size, they are:

a) Jaw crusher
b) Gyratory crusher
c) Cone crusher
d) Impact crusher

A. Feeder

The material from storage tankers, hoppers, Lorries etc. is dropped onto the feeder prior to the crusher. The feeder is used to control the rate of mixture entering the crusher. Thus majorly used to control the feed rate.

The grizzly feeder has an arrangement of grizzly deck which holds grizzly bars. The grizzly bars are tapered and they are arranged on to the grizzly deck in rows with some specific distance in between each bar.

This arrangement of the grizzly bars help in the flow of bulk material into the crusher machine for crushing purpose and bypasses small rocks, stones and other particles into the crusher machine and all the other smaller particles, pebbles and sand, etc. fall off from the mixture through the tapered grizzly bars.

B. Working principle

The oscillations of a grizzly feeder are produced by unbalanced motors mounted on the extended shaft of the two motors. Motors are placed along a line symmetrically and right angle to the frame. The resultant forces of the two motors are along the line. Hence the line is called as drive line. The motors rotate at the same speed but in opposite direction.

At any instant of 360° rotation, there are forces generated individually on the motors along the drive line and right angle to it. The forces at right angle cancel out each other and the resultant force is along the drive line.

The two unbalanced motors which are placed along the main body and which drives the feeder is called an unbalance drive. The unbalanced drive is used to:

(a) Create linear oscillations to the grizzly feeder,
(b) The amplitude of the oscillations can be altered by displacing, adding or removing the additional weights.

IV. Components of feeder

1. Vibratory Motors
2. Drive
3. Deck
4. Bar
5. Wire – Mesh
6. Body
7. Liners
8. Springs

The major component of a feeder is the vibratory motors which is the source of vibration and creates the required amplitude. The vibratory motors are placed on the drive frame base and are locked onto the drive base frame with nuts and bolts.

Drive frame is placed in between two long body plates and is bolted to these body plates. The position of the drive base frame would be according to the centre of gravity of the final machine and is placed in between the bottom of the plates and the upper part has other plates and structures which carry all the bulk material from the hopper and passes it to the next part of the feeder which the grizzly deck and bar arrangement.

Bars are tapered and are positioned in rows on the grizzly deck with some specific distance in between them. Underneath the grizzly deck and bar arrangement lies the bottom deck assembly which consists of wire mesh assembly. The grizzly deck bar arrangement, bottom deck assembly are positioned in between the 2 main body plates.

Liners are placed on the upper half of the body plates where the bulk material falls from the hopper and falls on the feeder.

Finally, the springs are placed on the either side of the main body plates where the provision is allotted for the springs and they are held with spring holders.

A. Springs

Springs are used to remove any sudden shocks that are created due to the free fall of the bulk material onto the feeder. Thus the springs are used to reduce the effect of sudden shocks created and hence reducing the damage of the structure onto which the feeder is mounted. springs are placed outside of the main body. the calculation of the spring is mentioned later it the report with detailed description.

B. Types Springs

Springs are classified into 2 types

1. Compression spring
2. Extension spring

V. DESIGN OF SPRING

Given data:

(i) wire dia. (d) = 24 mm
(ii) mean dia. (d) = 136 mm
(iii) free length (l0) = 300 mm
(iv) no. of active coils (na) = 7
(v) no. of total coils (nt) = 8.5
(vi) system of 8 springs bearing total load of 2000 kgs
(vii) Material used – structural steel

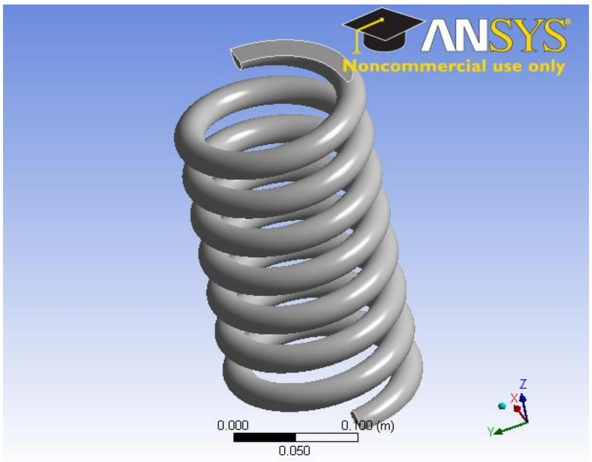
VI. RESULTS

A. Material

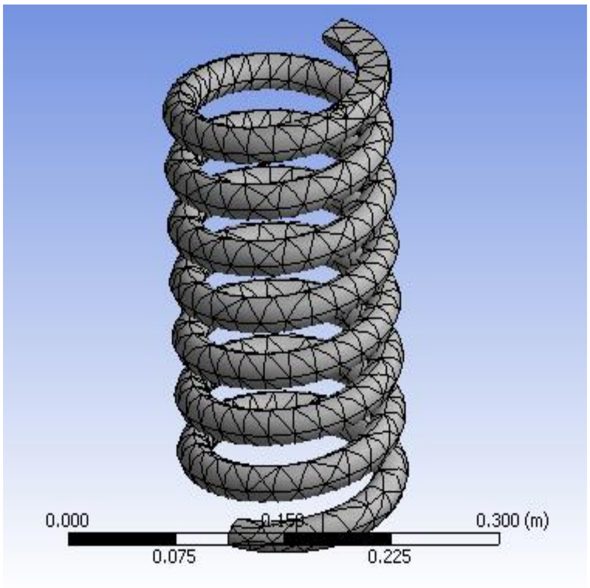
Physical properties	
Density	7850 kg m^-3
Coefficient of Thermal Expansion	1.2e-005 C^-1
Specific Heat	434 J kg^-1 C^-1
Thermal Conductivity	60.5 W m^-1 C^-1
Resistivity	1.7e-007 ohm m
Compressive Yield Strength Pa	2.5e+008
Tensile Yield Strength Pa	2.5e+008
Tensile Ultimate Strength Pa	4.6e+008
Reference Temperature C	22

Material Properties	
Volume	1.4258e-003 m³
Mass	11.192 kg
Centroid X	-2.3469e-008 m
Centroid Y	-2.3944e-003 m
Centroid Z	5.1119e-009 m
Moment of Inertia Ip1	0.10745 kg·m²
Moment of Inertia Ip2	0.10714 kg·m²
Moment of Inertia Ip3	5.2639e-002 kg·m²

B. Solid model



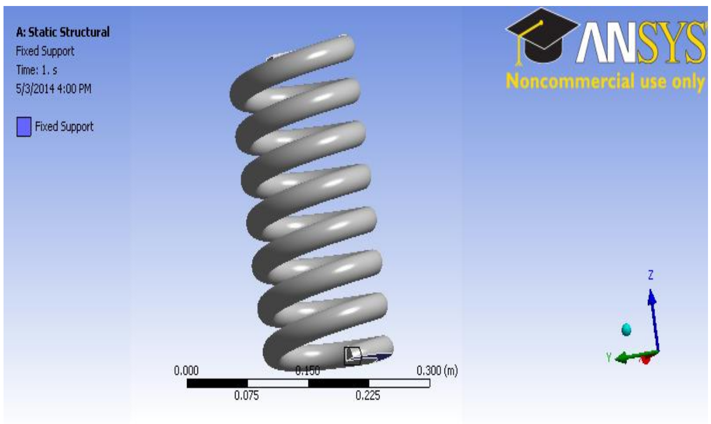
C. Meshing



D. Coordinate Systems

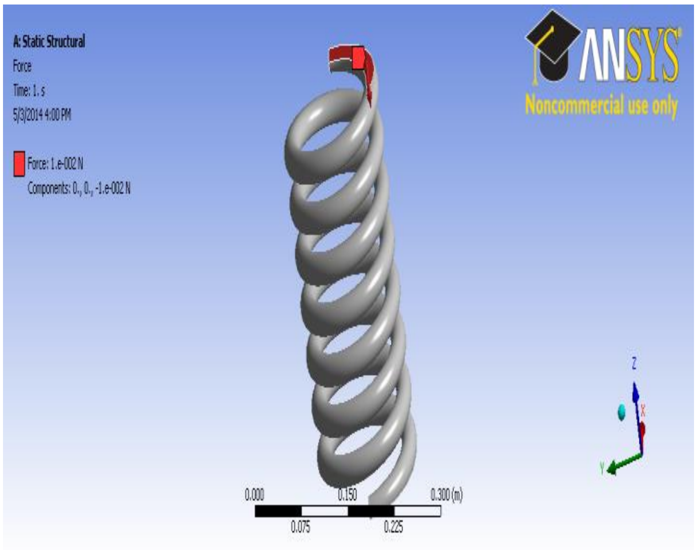
Object Name	*Global Coordinate System*
State	Fully Defined
Definition	
Type	Cartesian
Coordinate System ID	0.
Origin	
Origin X	0. m
Origin Y	0. m
Origin Z	0. m
Directional Vectors	
X Axis Data	[1. 0. 0.]
Y Axis Data	[0. 1. 0.]
Z Axis Data	[0. 0. 1.]

E. Fixed support

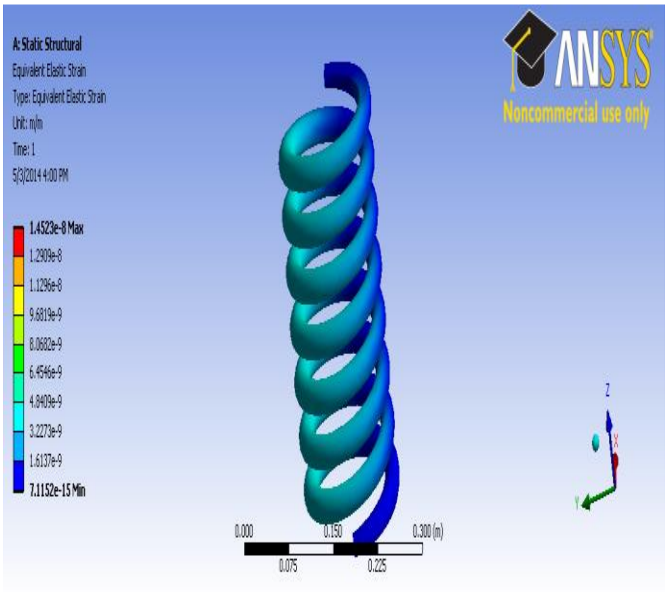


F. Loads

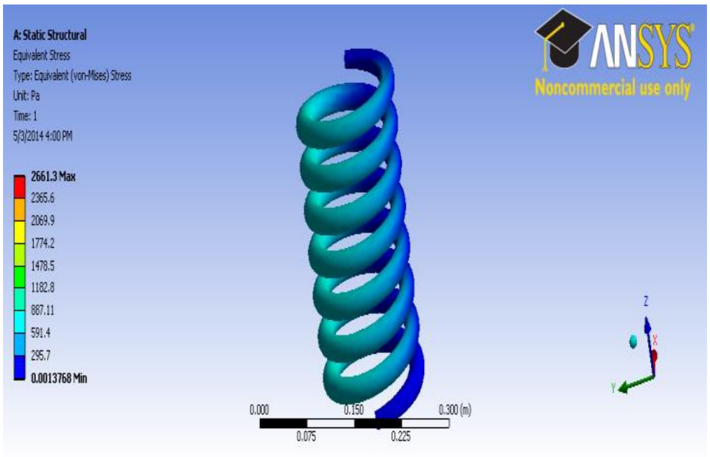
Load Definition		
Type	Fixed Support	Force
Suppressed	No	
Define By		Components
Coordinate System		Global Coordinate System
X Component		0. N (ramped)
Y Component		0. N (ramped)
Z Component		-1.e-002 N (ramped)



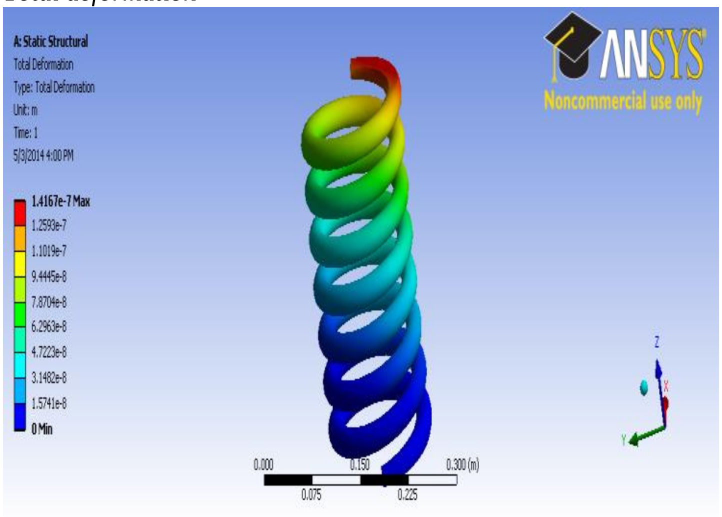
G. Equivalent elastic strain



H. Equivalent (von-Mises) stress



I. Total deformation



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