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Modeling & Structural Analysis of Hydraulic Tire Curing Press

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ABSTRACT

This project includes structural construction of hydraulic tire curing press, mold assembly, and also hydraulic power pack to operate machine in automotive way. In this project work all these three main sub assemblies are clubbed together and with the proper hydraulic loads application on the machine along with self loads and gravitational forces .then we start the structural analysis over the frame of hydraulic tire curing press during opening and closing of top platen to the bottom platen, in order to close the mold with different closing times and speeds with the help of hydraulic power pack.

Main aim of this project is to observe the stress distribution and deflections on structure at various loads,with the help of static and model analysis on the main frame. Then by verifying the results we can estimate the stability of machine main frame to with stand for working, so that we can rectify the sudden breakdowns of machines and that affects the production loses.

Modeling is done by using solid works 2016.and for analysis we used ansys16.0 software.

Main components of Hydraulic tire press:

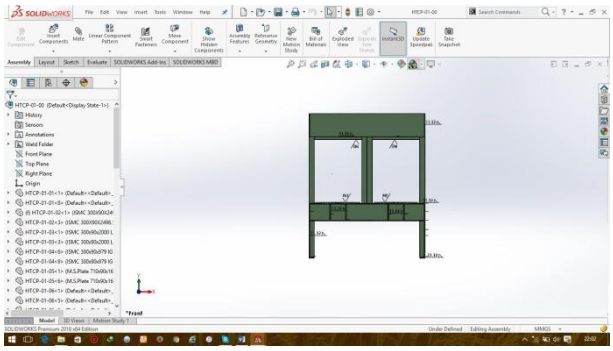
1.Hydraulic cylinders.
2.Main frame Assembly.
3.Hub Assembly.
4.Top and Bottom platens with respective Tire molds.
5.Center Mechanism Cylinder Assembly.
6.Water Hydraulic Cylinder Assembly.

1.Hydraulic cylinders:

Hydraulic cylinders of 2Ton capacity with a Hydraulic force of 120 kg/cm2 at the temperature range of 40° C. And stroke length is 800 mm. weight of cylinder is 450 kg.

2.Main Frame Assembly:

It is important sub assembly of the press, which holds and transfers the other components and their loads respectively to the Base Area, Where the proper grouting had been done to absorb the loads and their vibrations by proper holding of machine. Since it plays a major role in the machine, Maximum loads from the cylinders can be first applied on the main frame itself. So, it is mandatory to make an analysis over main frame to avoid practical failures and damages after and during production of tires. Fig 02 shows the structure of main frame model which is done with the help of solid works software.



3.Hub assembly:

This assembly contains Circular plates with proper fabrication of gussets to distribute the load from Hydraulic cylinder ram to all over the platen area on the main frame.i.e., from narrow to face load distribution.

4. Top and Bottom Platens:

Top and Bottom platens are circular plates made of mild steel and having provision for steam passages inside the body. And closing these provisions with help of sockets. By providing Hex nipples over the

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Threaded sockets we can feed the platen with the steam with 10 kg/cm2 pressure and 75 ° C temperature. Maintaining the steam with this pressure and temperature rating gives vulcanization process optimized success. With variations on these pressure and temperature ratings gives improper curing to the tire which gives quality error on the product. Fig 4.0 shows the model of platen.

5. Center Mechanism Cylinder and Water Hydraulic Cylinders:

C.M.C Cylinders are used for only lifting of Bladder which contains Green tire. Water hydraulic cylinders are used for lifting of these C.M.C Cylinders. Water hydraulic cylinders and C.M.C Cinders are maintained at 15 kg/cm2 pressure.

Green tire:

Green tire is a readymade rubber ring which is also called uncured tire. After placing in Tire press with the help of vulcanization process, tire attains proper physical properties to with stand the radial and pressure loads of vehicles.

Bladder:

Bladder is made of rubber with high elastic levels. This component is fixed to C.M.C Cylinder with the help of steam it pushes the green tire at semisolid condition towards the walls of mold to attain the grooves on the surface of tire. Which practically calls as air passages of tire.

Vulcanization process:

It is a process of heating the uncured tire up to semisolid sate and with the help of bladder component and molds by the application of steam it gains the physical properties. Approx. 75° C temperature maintains to make Green tire to tire.

Advantages

Curing with nitrogen offers significant advantages:

- Improved pressure stability and independent pressure level
- Maximum availability and reliability
- Cycle time reduction of up to 18%
- Up to 100 % longer bladder life time
- Possible reduction of more than 80 % of the steam costs compared to a steam-water-system
- Higher process flexibility and quality due to individually controllable pressure and curing temperature
- Reduction of production and maintenance costs
- Improved quality leads to minor tyre scrap
- Higher availability of the presses
- Reduced pipeline corrosion
- High purity guaranteed

Trial capabilities

Trials are normally necessary in order to define specific parameters and to achieve optimal production safety.With testing devices and know-how, we are able to support in-house trials. Our application engineers will assist you with efficiency evaluations and process specific requirements.

Safety

Safety is paramount to BOC and our engineers will ensure that a safe working system is put in place.

With decades of experience in gas supply and related process technologies, we facilitate an efficient and Service and know-how individual project development. Our extensive know-how in these application areas ensures a safe and reliablesystem operation as well as the economical application of the technical gases.

Main Features Include:

- Fully automatic operation
- Platens or domes for heating moulds
- Single acting or double acting centre mechanisms, which ensure accurate centering, shaping and curing of bias/radial tyres
- Unloader systems

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- Centralised automatic lubrication systems
- Provision for mounting segmented mould operators
- Improved design of tyre curing presses with reduced stress levels, longer life and higher accuracy

The hydraulic press range includes presses for passenger / LCV and truck radial tyres with advanced features such as:

- Individual cavity control
- Electronic pumps for energy optimization
- Standing Post and Rolling-in-bladder options
- Suitable for both two piece and segmented moulds
- Pick and place or stripper unloader

Curing Controls

Tyre curing presses are furnished with controls to suit the technology and requirements of the various tyre manufacturers. The complete instrumentation and controls are custom built to suit the tyre curing process. Ergonomically designed instrumentation and control panels are offered with the state-of-the-art Programmable Logic Controllers (PLCs) of reputed manufacturers for press motion as well as cure control.

Simple and effective Dedicated Programmable Logic Controller (DPLC) has been developed in our in-house R&D facility to provide highly reliable and cost effective solution for replacement of electronic timers used for cure time control.

ANSYS Project

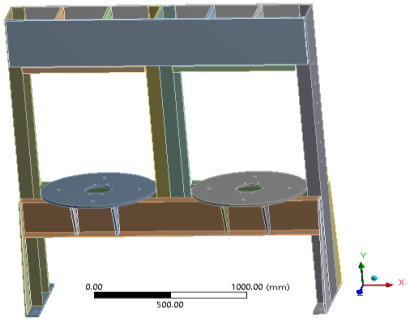

TABLE 28

Model (B4) > Modal (B5) > Solution (B6) > Total Deformation 2

Mode	Frequency [Hz]
1.	19.276
2.	27.216
3.	53.871
4.	55.861
5.	99.098
6.	137.26
7.	201.42

FIGURE 4

Model (B4) > Modal (B5) > Solution (B6) > Total Deformation 3 > Figure

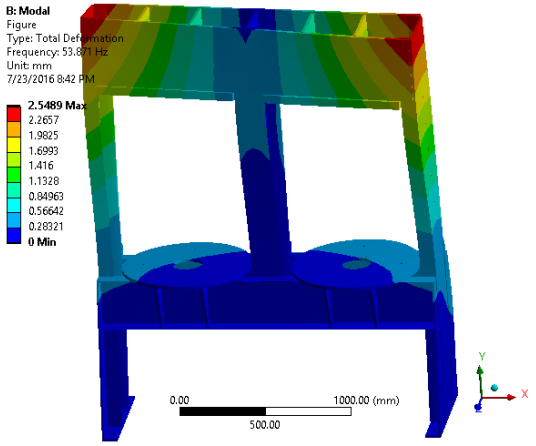

FIGURE 5

Model (B4) > Modal (B5) > Solution (B6) > Total Deformation 4 > Figure

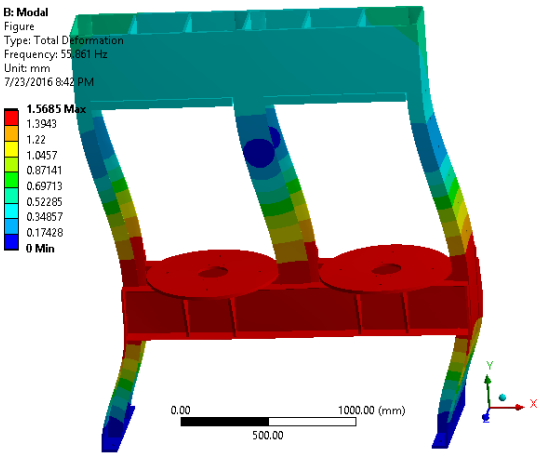

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FIGURE 6

Model (B4) > Modal (B5) > Solution (B6) > Total Deformation 5 > Figure

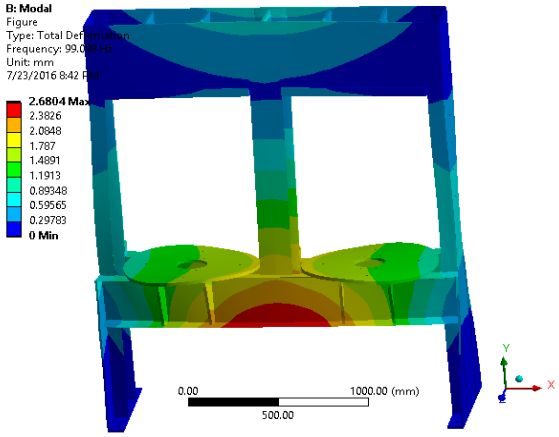
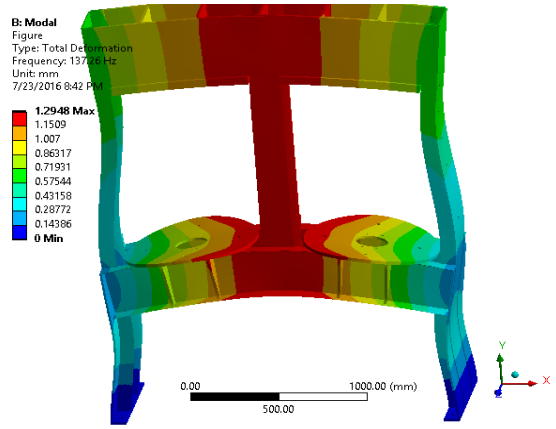


FIGURE 7

Model (B4) > Modal (B5) > Solution (B6) > Total Deformation 6 > Figure



Material Data

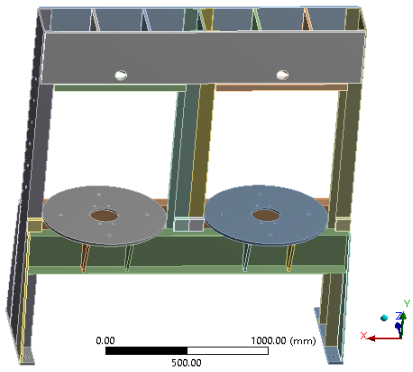
Structural Steel

TABLE 33

Structural Steel > Constants

Density	7.85e-006 kg mm^-3
Coefficient of Thermal Expansion	1.2e-005 C^-1
Specific Heat	4.34e+005 mJ kg^-1 C^-1
Thermal Conductivity	6.05e-002 W mm^-1 C^-1
Resistivity	1.7e-004 ohm mm

ANSYS Project



Material Data

Structural Steel

FIGURE 1

Model (A4) > Static Structural (A5) > Fixed Support > Figure

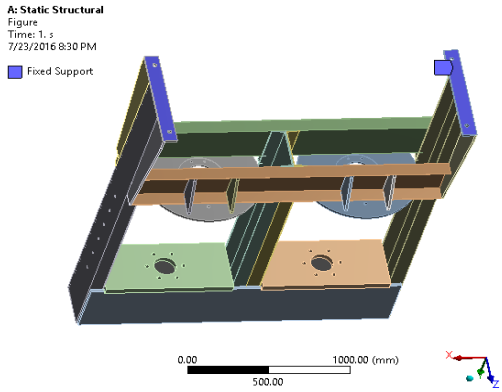


FIGURE 2

Model (A4) > Static Structural (A5) > Force

Model (A4) > Static Structural (A5) > Force > Figure

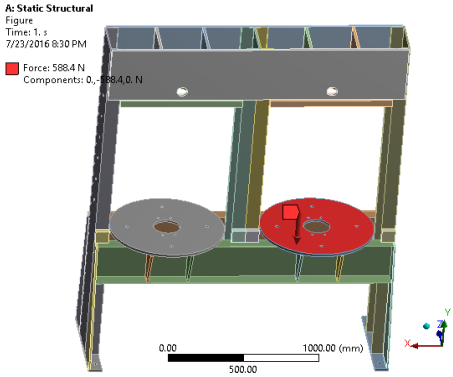


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FIGURE 4

Model (A4) > Static Structural (A5) > Force 2

Model (A4) > Static Structural (A5) > Force 2 > Figure

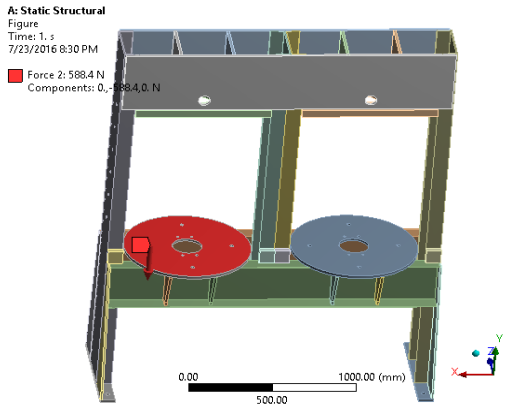


FIGURE 7

Model (A4) > Static Structural (A5) > Solution (A6) > Total Deformation > Figure

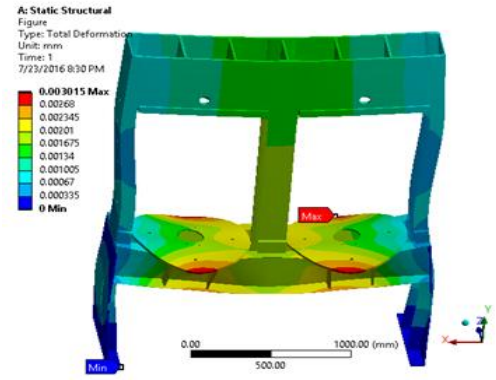


FIGURE 9

Model (A4) > Static Structural (A5) > Solution (A6) > Equivalent Elastic Strain > Figure

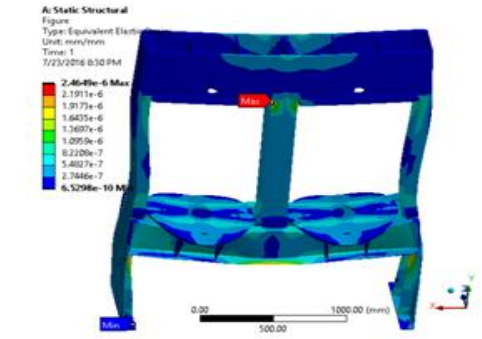
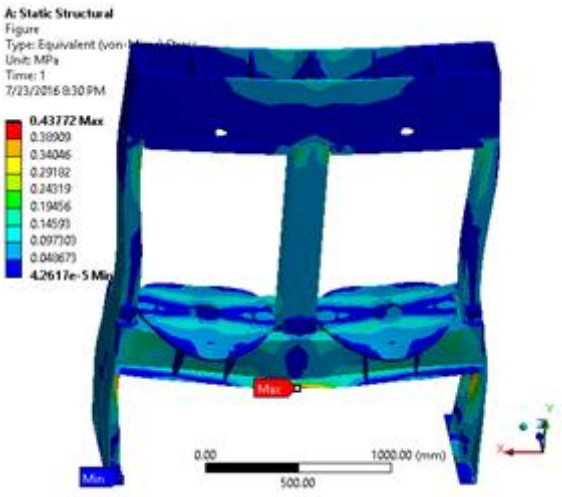


FIGURE 11

Model (A4) > Static Structural (A5) > Solution (A6) > Equivalent Stress > Figure



Material Data

Structural Steel

TABLE 28

Structural Steel > Constants

Density	7.85e-006 kg mm^-3
Coefficient of Thermal Expansion	1.2e-005 C^-1
Specific Heat	4.34e+005 mJ kg^-1 C^-1
Thermal Conductivity	6.05e-002 W mm^-1 C^-1
Resistivity	1.7e-004 ohm mm

Conclusion:

Hydraulic Tire Curing Press

- Main frame consists of steel plate and U type steel welding with high temperature treatment. After maching, release stress to improve machine life cycle.
- Return oil with filter and cooler to maintain stable hydraulic system.
- Excellent solid frame mechanism design with FEA approval to enhance body strength.

In this project with reference to the analysis reports on main frame of tire curing press ,total deformation max

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is 0.003015 mm and equivalent elastic strain with reference to stress is of maximum 2.4649 e-6 mm.

From the above analysis reports we can conclude that main frame can with stand up to maximum ultimate stress of 0.43772 Mpa.

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