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Analysis of Vertical Stiffness Non-Pneumatic Tires for a Tractor

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Abstract: *Thepurposeofthisarticleistodesignnon-pneumatictireswithalargediameterforitsapplicationinatractorandcarryout an escalated relative assessment of different talked structuresbased upon various limits. The three critical kinds of tireswhich are focused on in this article are Michelin Tweel, HoneycombstructurebyResilientTechnologyandAirlessTireconceptintroducedbyBridgestone.ThedesigningwascarriedoutinSolidWorksandthestaticanalysiswasconductedinAnsysWorkbench.Thecorrespondinggraphswereplottedfromtheobtained values from reenactments where full scale evasion, contactpressure, and most prominent not totally settled by contrasting designparameters.Thiswillhelpindefiningtherelationshipbetweenthethree huge limits for instance talked thickness, support layerthicknessandtotaldeformationundersimilarloadingconditions.*

Index Terms: *Ansys, Michelin, Non-Pneumatic Tires, StaticAnalysis,Tractor, Tweel.*

I.INTRODUCTION

The concept to fairless tires was introduced by Michelin,a French tire delivering association. In this article, we willbeconsideringthreespecifictypesofnon-pneumatictiresi.e.Michelin Tweel [1], Airless tires thought by Bridgestone [2]andthehoneycombstructuredairlesstiresdevelopedbyResilientTechnology[3].TheTweelbyMichelinisbasedonthe thought of joining the inside and the outside part ofthe wheel with the help of radially situated versatile spokes. InBridgestoneconcept,therearetworowsofspokesinopposite course segregated by an opening in thewheel.TheconceptintroducedbyResilientTechnologymakesuse ofhoneycomb structure

II.PROBLEMSTATEMENT

Thepneumatictireswhicharecurrentlyusedintractorsareunabletogivebetterperformanceduetotheirdeflationphenomenon and heavyweight. The cultivating fields havecoarse surfaces which contain various little peculiarities suchasstones whichcontributetothewearand tearoftiresand thus reducing their life. This burden of getting puncturecanbecompletelyeliminatedwiththehelpofnon-pneumatictires withbetterhandlingandincreased surfacetraction.

III.PROPOSEDSOLUTION

Arranging a non-pneumatic tire for the foreordained model oftractor.Conductingcomparativeanalysisonthethreedesignsbased upon talked thickness and the help layer [4].Thus closing which talked development will be more beneficialunder decided conditions. The assessment is done in staticstructural under varying weight to mirror certified conditions ofstanding weight and shock load. There are various advantages ofusingnon-pneumatictiressuchastheeliminationofblowout,involves less help and has low moving resistance.Also, the materials used for the collecting of shear andspokesarerecyclableandhaveaservicelife3-4times[5]thatofconventional tires.

IV.MAINBODY

A.Vehicle Specifications

The reference model taken here is Mahindra Yuvo 275 DI[6]. It is the most typically elaborate homestead hauler for agriculturalworksinIndiaandhasawidevarietyofequipmentattachments open and in this manner it was picked as a referencemodel.The conclusions of the vehicle are given .

The Tweel by Michelin fundamentally contains three areas. Itconsists of a flexible tire which is blended in with track, a shearlayer just under the track and subsequently there are series of energyabsorbingspokeswhicharemadeofPolyresinbasedonPolyurethanewhichisconnectedtothehubatthecentertotheshaft. There are transcendently two kinds of materials used in thesewheels.Theyare:
1)Elastic, orthotropic materials which are fundamental for the shearbeamandreinforcement layer,whichprovidestructuralsupporttothecollapsiblespokesandthus

Table1. Material Composition of the wheel by weight percentage.

RawMaterial	Spokes(Wt%)	Hub(Wt%)	Tread(Wt%)	ShearLayer (Wt%)
Steel	0	100	0	0
Polyurethane	100	0	0	70
CoatedWires	0	0	0	30
SyntheticRubber	0	0	42	0
NaturalRubber	0	0	3	0
Sulfur	0	0	1	0
Oil	0	0	10	0
Silica	0	0	27	0
CarbonBlack	0	0	12	0
StearicAcid	0	0	2	0

Fig.1 Tweelbaseddesignfortherearwheelofatractor.

ThebasicdesignoftheTweelbasedwheelisshowninFig.
1.DesigningisdoneusingSolidWorks[14].Thewheelconsistsof5partshub,rim, spokes,areinforcementlayer, and flexible tracks. Allpartsareseparatebodiesfor thepurposeofanalysiswithsolidmergefeatureturnedoff.

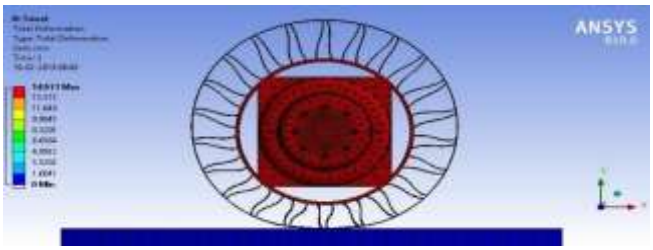
a) DesignsusedforAnalysis

Three plans were used for static examination reason theseareTweelbyMichelin(Fig.1),AirlessconceptbyBridgestone (Fig. 2) and a honeycomb coordinated spoke byResilientTechnology(Fig.3).

Fig.2WheelbasedonBridgestoneAirlessconcept.

A. AnalysisSettingsandMeshing.

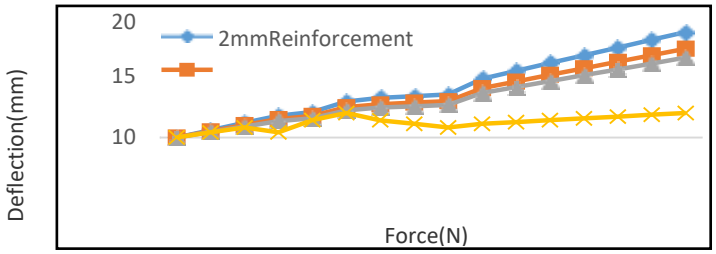
Foranalysispurpose,arigidsupportmadeofconcretewasintroducedandallthesimulations[17,18]werecarriedoutontop of it. Movement in even and longitudinal directionsweresetconstantthusdisplacementonlyintheradialdirectionwasallowed.Agraduallyincreasingloadof5000Nwasappliedradiallydownwardstoresemblestandingloadofa ranch hauler and a pile of 15000 N was applied to reflect theshock load tending to a biggest power that a vehicle hasto face under totally stacked conditions. Contact surfaces weremade between spokes, support layer, and focus point. A meshdependent study was in like manner got done and a most outrageous deviation of7.4% was seen for general examination. Fitting (Fig. 4)was done using tetragonal and quadrilateral cross section methodwith importance set to 10, network capacity was set as constant,relevancecenterwassetasfineandrefinementwasappliedatcontactsurfaces.



MeshinginAirlessConceptbyBridgestone,Reinforcementlayerindirectcontactwithrigidsupport.

V.RESULTS

The examination was done by changing two sections fromdesigni.e.spokethicknessandreinforcementlayerthickness.Spoke thickness is varied from 4-10 mm and reinforcementlayer is moved from 2-7.5 mm. All multiplications were doneunderthesameinitialconditionwiththesameload.Variationindeflectionandstresswereobserved



VI.CONCLUSION

Thearticlepresentedherehasthreeofthetopnon-pneumatic tire thoughts with mathematical calculationandsimulationsusingAnsysworkbench.Itisthusconcludedthat each tire thought, due to its unquestionable numerical structure,possessesdifferentworkingcharacteristicsforthesamedesign limits under unambiguous essentials. HoneycombstructurebyResilientTechnologyperformedsuperiorwith shear pressure improvement and lower contact pressure. Airlessconcept by Bridgestone showed the most important redirection withloadandthuscouldbethebestoptionforbetterridecomfort.Ithastobestatedthat,presentedconclusionsarebasedonthematerial limits expected by us, as material properties ofpolyurethane based polyresin are at this point one of the most mind blowing keptcompanysecrets.Thoroughexperimentationwithbothsimulations and models are supposed to get to a concreteresult.

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