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MODELING AND ANALYSIS OF DIFFERENTIAL GEAR MECHANISM

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Abstract:

A degree of distinction could be a exacting variety of straightforward gear wheel train that has the products that the angular speed of its mover is that the average of the angular gears.

The differential mechanism permits the outer drive wheel to rotate quicker than the inner drive wheel throughout a flip. this is often necessary once the vehicle turns, creating the wheel that's traveling round the outside of the turning curve roll farther and quicker than the opposite.

The main objective of this paper is to developed constant model of differential mechanism by victimization solid works underneath numerous style stages

Keywords— Differential gears, Planetary gears, Design, Stress, Strain, Displacement, Simulation

I INTRODUCTION

A differential could be a specific sort of easy gear train that has the property that the angular rate of its carrier is that the average of the angular velocities of its sun and circinate gears. this is often accomplished by packaging the gear train thus it\'s a hard and fast carrier train quantitative relation R = -1, which suggests the gears adore the sun and circinate gears ar identical size. this will be done by participating the earth gears of 2 identical and homocentric planetary gear trains to make a spur wheel differential. Another approach is to use pinion and ring gears for the sun and circinate gears and a bevel gear because the planet, that is thought as a pinion and ring gear differential.

In cars and alternative wheeled vehicles, the differential permits the outer drive wheel to rotate quicker than the inner drive wheel throughout a flip. this is often necessary once the vehicle turns, creating the wheel that\'s traveling round the outside of the turning curve roll farther and quicker than the opposite. the typical of the move speed of the 2 driving wheels equals the input move speed of the drive shaft. a rise within the speed of 1 wheel is balanced by a decrease within the speed of the opposite

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Locking pinion and crown wheel mechanism:

A lockup differential, differential lock, diff lock or locker may be a variation on the quality automotive differential. A lockup differential could give inflated traction compared to a customary or \"open\" differential by proscribing every of the 2 wheels on Associate in Nursing shaft to identical movement speed while not relevance obtainable traction or variations in resistance seen at every wheel.

A lockup differential is meant to beat the chief limitation of a customary open differential by basically \"locking\" each wheels on Associate in Nursing shaft along as if on a typical shaft. This forces each wheels to show in unison, in spite of the traction (or lack thereof) obtainable to either wheel one by one.

When the differential is unbarred (open differential), it permits every wheel to rotate at totally different speeds (such as once negotiating a turn), so avoiding tire scuffing. Associate in Nursing open (or unlocked) differential invariably provides identical force (rotational force) to every of the 2 wheels, on it shaft. thus though the wheels will rotate at totally different speeds, they apply identical movement force, although one is entirely stationary, and also the alternative spinning. (Equal force, unequal movement speed).

By distinction, a latched differential forces each left and right wheels on identical shaft to rotate at identical speed underneath nearly all circumstances, while not relevance half variations seen at either wheel. Therefore, every wheel will apply the maximum amount movement force because the traction thereunder can permit, and also the torques on every side-shaft are unequal. (Unequal force, equal movement speeds). Exceptions apply to automatic lockers, mentioned below.

A latched differential will give a major traction advantage over Associate in Nursing open differential, however only if the traction underneath every wheel differs considerably.

All the higher than comments apply to central differentials additionally on those in every axle: regular four-wheel-drive (more accurately as \"All Wheel Drive\") vehicles have 3 differentials, one in every shaft, and a central one between the front and rear axles (transfer case).

Disadvantages:

Because they are doing not operate as swimmingly as commonplace differentials, automatic lockup differentials are typically chargeable for inflated tire wear. Some older automatic lockup differentials ar best-known for creating a clicking or banging noise once lockup and unlocking because the vehicle negotiates turns. this is often annoying to several drivers. Also, automatic lockup differentials can have an effect on the flexibility of a vehicle to steer, notably if a locker is found within the front shaft. except for tire scuffing whereas turning any degree on high friction (low slip) surfaces, latched axles provoke underneath steer and, if used on the front shaft, can increase steering forces needed to show the vehicle. moreover, mechanically lockup differentials will cause a loss of management on ice wherever Associate in Nursing open differential would permit one wheel to spin and also the alternative to carry, whereas not transferring power. Associate in Nursing example of this could be a vehicle position sideways on a slippery grade. once each wheels spin the vehicle can break traction and slump the grade.

Applications:

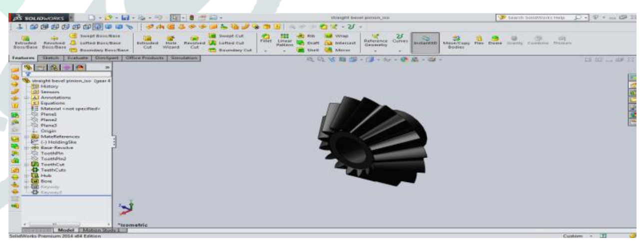
- Race cars typically use protection differentials so as to keep up traction throughout high speed maneuvers or once fast at extreme rates. to boot, vehicle dynamics square measure created a lot of certain once there\'s a loss of traction, because the driver is aware of that neither wheel can suddenly sap power if it encounters a low-friction surface.

- Some utility vehicles like tow trucks, forklifts, tractors, and serious instrumentation use protection differentials to keep up traction, particularly once driving on soft, muddy, or uneven surfaces. Lockers square measure common in agricultural instrumentation and military trucks. On some farm tractors, there\'s a pedal that may be stepped on with the operator\'s heel to lock the differential as required.

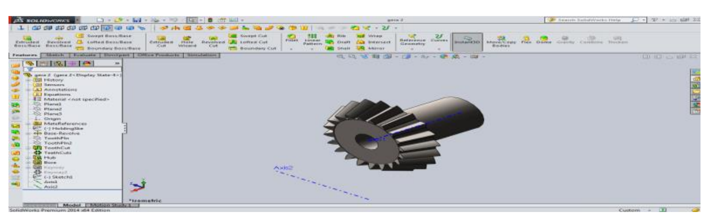
- Differential protection also can be employed in the game of drifting as an alternate to a restricted slip differential.

MODELLING OF DIFFERENTIAL GEAR MECHANISM IN SOLID WORKS:

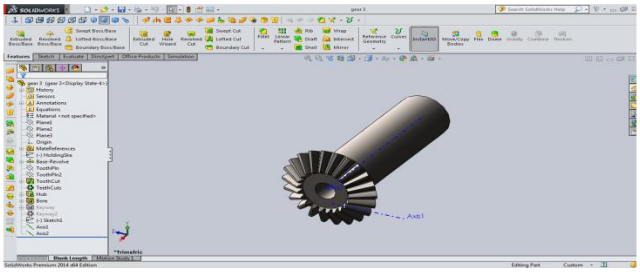
BEVEL GEAR PINION:



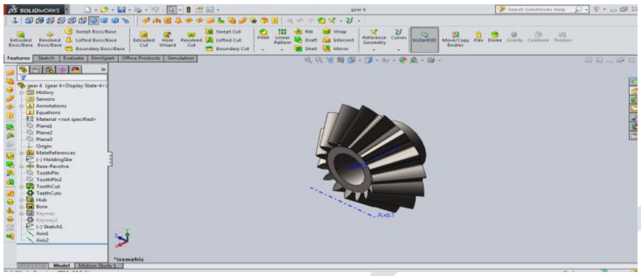
SMALLER GEAR:



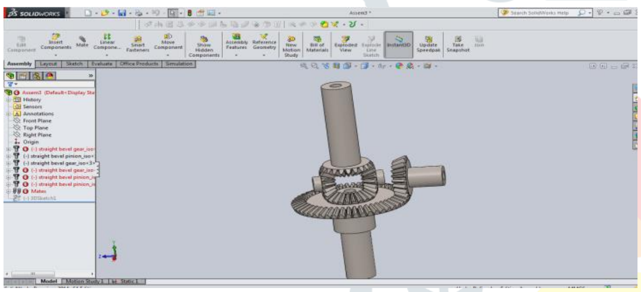
STRIGHT BEVEL GEAR:



PINION GEAR:



ASSEMBLY OF DIFFERENTIAL GEAR MECHANISM:

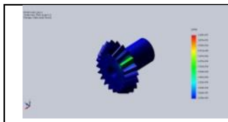


Analysis of bevel gear:

Material: 2014 alloy steel:

Model Reference	Properties		Components
	Name:	2014 Alloy	SolidBody 1(Bore)(gera 2)
	Model type:	Linear Elastic Isotropic	
	Default failure criterion:	Max von Mises Stress	
	Yield strength:	9.65098e+007 N/m^2	
	Tensile strength:	1.65445e+008 N/m^2	
	Elastic modulus:	7.3e+010 N/m^2	
	Poisson's ratio:	0.33	
	Mass density:	2800 kg/m^3	
	Shear modulus:	2.8e+010 N/m^2	
	Thermal expansion coefficient:	2.3e-005 /Kelvin	
Curve Data:N/A			

Minimum and maximum values of stress, displacement and strain

	290.786 N/m^2	1.13384e+008 N/m^2
	0 mm	0.0112309 mm
	8.69013e-009	0.00119619

Material: alloy steel:

Model Reference	Properties		Components
	Name:	Alloy Steel	SolidBody 1(Bore)(gera 2)
	Model type:	Linear Elastic Isotropic	
	Default failure criterion:	Max von Mises Stress	
	Yield strength:	6.20422e+008 N/m^2	
	Tensile strength:	7.23826e+008 N/m^2	
	Elastic modulus:	2.1e+011 N/m^2	
	Poisson's ratio:	0.28	
	Mass density:	7700 kg/m^3	
	Shear modulus:	7.9e+010 N/m^2	
	Thermal expansion coefficient:	1.3e-005 /Kelvin	
Curve Data:N/A			

Minimum and maximum values of stress, displacement and strain

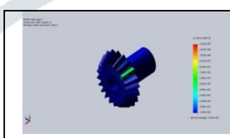
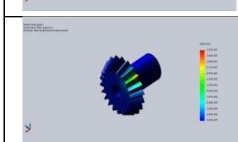
	100.64 N/m^2	1.14727e+008 N/m^2
	0 mm	0.00381284 mm
	2.22489e-009	0.000403033

Material: Beryllium S-65C, Vacuum Hot Pressed (copper)

Load: 2000N

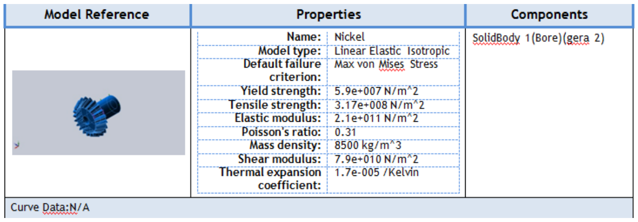
Model Reference	Properties		Components
	Name:	Beryllium S-65C, Vacuum Hot Pressed	SolidBody 1(Bore)(gera 2)
	Model type:	Linear Elastic Isotropic	
	Default failure criterion:	Max von Mises Stress	
	Yield strength:	2.07e+008 N/m^2	
	Tensile strength:	2.9e+008 N/m^2	
	Elastic modulus:	3.03e+011 N/m^2	
	Poisson's ratio:	0.07	
	Mass density:	1844 kg/m^3	
	Shear modulus:	1.35e+011 N/m^2	
	Thermal expansion coefficient:	1.15e-005 /Kelvin	
Curve Data:N/A			

Minimum and maximum values of stress, displacement and strain

	133.792 N/m^2	1.2165e+008 N/m^2
	0 mm	0.00236321 mm
	5.23407e-010	0.000242591

Material: nickel

Load: 2000N



Model Reference	Properties		Components
	Name:	Nickel	SolidBody 1(Bore)(gera 2)
	Model type:	Linear Elastic Isotropic	
	Default failure criterion:	Max von Mises Stress	
	Yield strength:	5.9e+007 N/m^2	
	Tensile strength:	3.17e+008 N/m^2	
	Elastic modulus:	2.1e+011 N/m^2	
	Poisson's ratio:	0.31	
	Mass density:	8500 kg/m^3	
	Shear modulus:	7.9e+010 N/m^2	
	Thermal expansion coefficient:	1.7e-005 /Kelvin	

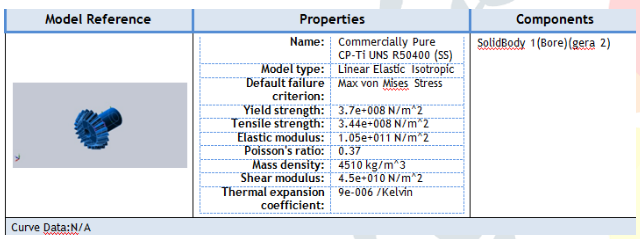
Curve Data:N/A

Minimum and maximum values of stress, displacement and strain

	197.373 N/m^2	1.13912e+008 N/m^2
	0 mm	0.00386804 mm
	2.66231e-009	0.000410742

Material: Commercially Pure CP-Ti UNS R50400 (SS)(titanium)

Load: 2000N



Model Reference	Properties		Components
	Name:	Commercially Pure CP-Ti UNS R50400 (SS)	SolidBody 1(Bore)(gera 2)
	Model type:	Linear Elastic Isotropic	
	Default failure criterion:	Max von Mises Stress	
	Yield strength:	3.7e+008 N/m^2	
	Tensile strength:	3.44e+008 N/m^2	
	Elastic modulus:	1.05e+011 N/m^2	
	Poisson's ratio:	0.37	
	Mass density:	4510 kg/m^3	
	Shear modulus:	4.5e+010 N/m^2	
	Thermal expansion coefficient:	9e-006 /Kelvin	

Curve Data:N/A

Minimum and maximum values of stress, displacement and strain

	473.439 N/m^2	1.12337e+008 N/m^2
	0 mm	0.00794725 mm
	7.67787e-009	0.000851109

Conclusion: bevel gear

Material: 2014 alloy steel; load: 2000N

Stress	290.786 N/mm^2	1.13384*10^8 N/mm^2
Displacement	0 mm	0.0112309 mm
strain	8.69013*10^{-9}	0.0011961

Material: alloy steel; load: 2000N

Stress	100.64 N/mm^2	1.1472*10^8 N/mm^2
Displacement	0 mm	0.00381284 mm
strain	2.22489*10^{-9}	0.000403033

Material: copper; load: 2000N

Stress	153.792 N/mm^2	1.2165*10^8 N/mm^2
Displacement	0 mm	0.00236321mm
strain	5.23407*10^{-10}	0.000242591

Material: nickel; load: 2000N

Stress	193.373 N/mm^2	1.13912*10^8 N/mm^2
Displacement	0 mm	0.00386804mm
strain	2.66231*10^{-9}	0.000410742

Material: titanium; load: 2000N

Stress	473.439 N/mm^2	1.12337*10^8 N/mm^2
Displacement	0 mm	0.007947525mm
strain	7.67787*10^{-9}	0.000851109

By the comparison of above result at 2000 N load titanium has less stress values compare to other material stress values.

Conclusion:

- **As by comparing above results titanium and alloy steel has less stress values.**
- **Titanium has less stress values compared to alloy steel and 2014 alloy metal.**
- **but titanium is costly than remaining two materials.**
- **the alloy steel has less stress values and less deformation values**
- **its weights more than titanium**
- **Alloy steel is the suitable material for the basic design of differential mechanism.**

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