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Experimental Analysis of Torque Convertor Using Two Different Masses for Medium Duty Vehicles

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Abstract: ***Mechanism transferring torque from one rotating shaft to another and in particular to a transmission mechanism that will enable an engine or motor to deliver power to a load at optimum torque and speed levels. The relationship between the stress and transmission which is based on the results of two different mass strategies with dynamometer and motor is constructed to test the transmission to speed the results of those tests which shows the efficient at low input torque levels. To understand the descriptions of a new mechanism for design and construct a virtual prototype in the computer environment and finally to propose modifications to improve the original design.***

Keywords: Infinitely Variable Transmission, Novel Cam, Velocity Theorem, Positive Drive

1. Introduction

The linear IVT is solving the problem in modern automobile industry to develop new generation in vehicle to sustain. The input and output ratio in traction the linear IVT parameters to sustain the limited Two masses profile and masses the IVT infinity check the depending upon various load condition in gear, clutch, Two masses and Two masses follower. The superior in automobile cycle, the linear IVT dissolve input speed to the shaft traction to the output shaft to the transmission solver transmission ratio. The different investigators presents the background and theory related to the IVT, considers alternative designs, and presents the final design. It also outlines improvements for the IVT which will be installed in automobiles.

A two masses-based infinitely variable transmission system allows a user to vary the speed between input & output progressively from one positive value to another. Unlike, conventional transmissions the selection of gears is not restricted to a finite number of ratios. The two masses-based infinitely variable transmission systems can be used in automobile drive applications to improve performance, economy & functionality.

2. Objectives

a) To Design & Development of Infinitely variable transmission based on Torque convertor mechanism.
b) Experimental testing and trial to derive the following performance characteristics :
a) Torque Vs Speed
c) Manufacturing experimental setup of torque convertor using IVT system.

3. Research Methodology

a) Review of literature regarding the work done.
b) Analytical design of IVT.
c) Manufacturing and assembly of the Actual testing set-up.
d) Perform experimental testing on IVT with different two masses.
e) Result and Discussion.

4. Analytical Analysis

4.1 Design of Mass-01:

The mass-01 is a link that is subjected to direct tensile load in the form of pull = 48 N material selection

Table 1: Mass no.1 material

Material Designation	*Tensile Strength (N/ mm^2)*	*Yield Strength (N/ mm2)*
EN9	600	380

Check for failure of mass under direct tensile load at the eye end. This is the portion where the lever pin fits, the cross sectional area at this point is 288 mm^2 now,

I. FT = LOAD /AREA

Ft act = 48/288
= 0.166/mm^2

II. AS FT ACT < FT ALL

The link is safe under tensile load.

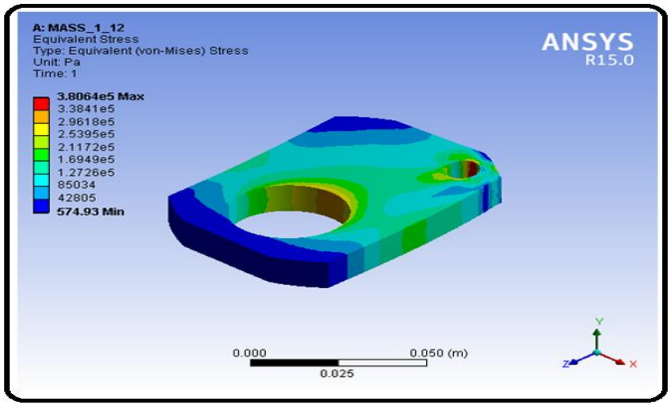


Figure 1: FEA Analysis of Mass No.1

Table 2: Mass no.1 material

Sr. No	*Thickness (mm)*	*Deformation (m)*	*Stress (Max) N/m²*
1	4	3.1398 X 10^{-7}	1.1923
2	6	2.0927 X 10^{-7}	8.246
3	8	1.5693 X 10^{-7}	5.896
4	10	1.2553 X 10^{-7}	4.811
5	12	1.0456 X 10^{-7}	3.8064

4.2 Design of Mass-02:

The mass -02 is a link that is subjected to direct tensile load in the form of pull = 48 N Material Selection:

Table 3: Mass no.2 material

Material Designation	*Tensile Strength (N/ mm²)*	*Yield Strength (N/ mm2)*
EN9	600	380

Check for failure of mass under direct tensile load at the eye end. This is the portion where the lever pin fits, the cross sectional area at this point is 576 mm^2, now

FT = LOAD /AREA FT ACT = 48/576

= 0.0833 N/mm2 AS FT ACT < FT ALL

The Mass No.2 is safe under tensile load.

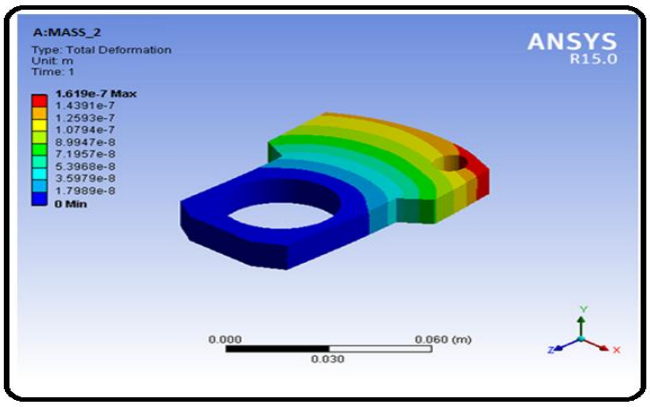


Figure 2: FEA Analysis of Mass No.2

Table 4: Mass no.2 material

Sr. No	*Thickness (mm)*	*Deformation (m)*	*Stress (Max) N/m²*
1	4	4.8732 X 10-7	1.4766
2	6	3.248 X 10-7	0.5983
3	8	2.429 X 10-7	0.72404
4	10	1.944 X 10-7	0.57489
5	12	1.619 X 10-7	0.48529

5. Analytical Calculations

Observation data:

For the Analytical analysis observation data are given below:

1] Load (kg) = 0.33

2] Acceleration (m/s^2) = 9.81

3] Mass (kg) = 0.033

4] Radius of mass (R_{cc}) in meter = 0.056

5] Radius of lobe (R_l) in meter = 0.032

The maximum torque is given by the formula:

$T = m^* \omega^2 * RCG * D$ (lobe offset)…….. (1)

Where,

T : Maximum torque (N-m)

m : Masse (kg)

ω^2 : Angular acceleration (m/s^2)

RCG : Radius of offset mass

D (lobe offset) : Radius of lobe

Sample Calculations for maximum torque are given below:

Consider,

N_2 = 520 r.p.m.

$w = \frac{2 \Pi N}{60}$

$w = \frac{(2) \times (\Pi) \times (520)}{60}$

= 54.45

But,

w^2 = 2965.09 rad /sec

Also,

Rcc = 0.056

$D_{(lobe)}$ = 0.032

$T = m \times w^2 \times Rcc \times D_{(lobe)}$

= 0.033639 X 2965.09 X 0.056 X 0.032

= 0.18 N-m

Consider,

N_4 = 650 r.p.m.

$w = \frac{2 \Pi N}{60}$

$w = \frac{(2) \times (\Pi) \times (650)}{60}$

= 68.07

But,

w^2 = 4632.96 rad /sec

Also,

Rcc = 0.056

$D_{(lobe)}$ = 0.032

T = $m \times w^2 \times Rcc \times D_{(lobe)}$
= 0.033639 X 4632.96 X 0.056 X 0.032
= 0.28 N-m

6. Analytical Results

The following analytical results will be derived from calculations for maximum torque is given below:

Table 5: Analytical Results

Sr. No	*Speed (rpm)*	*Angular Speed*		*Torque (N-m)*
		(w)	*(w^2)*	
1	380	39.79	1583.4	0.10
2	520	54.45	2965	0.18
3	535	56.02	3138.6	0.19
4	650	68.07	4632.9	0.28
5	850	89.01	7922.6	0.48
6	1050	109.9	12089.5	0.73

7. Experimental Setup

Experiment Setup of torque converter in of IVT system:

The IVT test rig consists of the following assembly give below:

1. Motor
2. Speed Regulator
3. Reduction Pulley
4. Bearing Housing-1
5. Bearing Housing-2
6. Mass-Inertia IVT
7. Brake Dynamometer pulley
8. Base frame

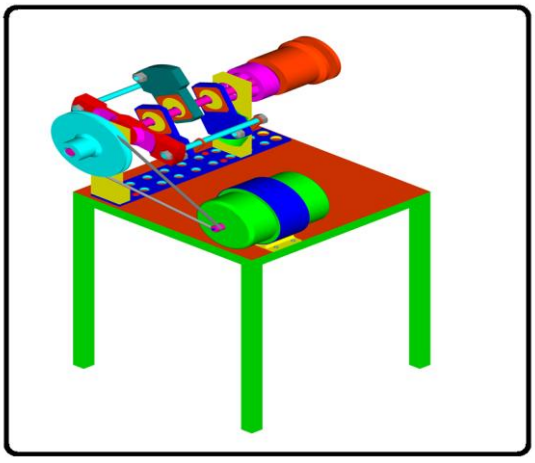


Figure 3: Experimental Setup of mechanical torque convertor by using IVT

1. Experimental Testing Procedure:

a) Start motor by turning electronic speed variator knob.
b) Let mechanism run & stabilize at certain speed (say 2100 rpm)
c) Place the pulley cord on dynobrake pulley and add 100 gm weight into, the pan, note down the output speed for this load by means of tachometer.
d) Add another 100 gm cut & take reading.
e) Tabulate the readings in the observation table
f) Plot Torque Vs speed characteristic

2. Experimental Result:

The following test results will be derived from the test and trial on IVT Drive.

Table 6: Experimental Results

Sr. No	***Weight***	***Radius of Pulley***	***Speed***	***Angular speed***	***Torque***
	(kg)	(m)	(rpm)	(w)	(N-m)
1	0.1	0.0375	2100	219.905	0.037
2	0.15	0.0375	1960	205.245	0.055
3	0.2	0.0375	1750	183.254	0.074
4	0.25	0.0375	1600	167.547	0.092
5	0.3	0.0375	1250	130.896	0.110
6	0.35	0.0375	1050	109.953	0.129
7	0.5	0.0375	810	84.8205	0.184
8	0.6	0.0375	650	68.0658	0.221
9	0.7	0.0375	535	56.0234	0.258
10	0.8	0.0375	520	54.4527	0.294
11	1	0.0375	380	39.7923	0.368

8. Result and Discussion

The results obtained experimentally are compared theoretically. The results are given in the form of tables. Also the results are compared in the form of graphs. Hence the verification of proposed method is done by theoretically and experimentally.

9. Summary of Results

The result correlation summarized as show in table 7

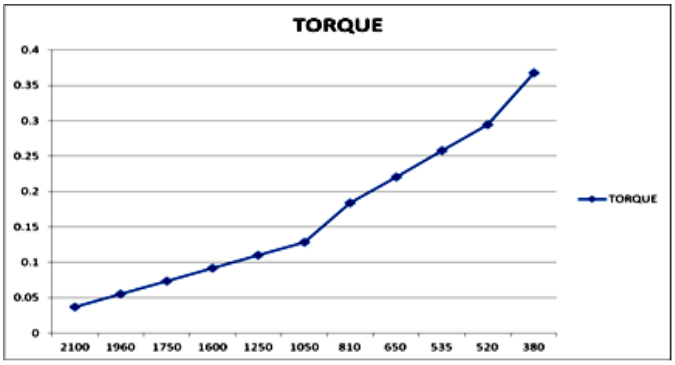
Table 7: Summary of Results correlation between theoretical and experimental

Sr. No	***Speed***	***Analytical Results Torque (N-m)***	***Experimental results Torque (N-m)***	***% error***
1	650	0.2793	0.2207	5
2	535	0.1892	0.2575	6
3	520	0.1787	0.2800	10

The error in prediction of IVT by theoretical analysis is the range of 3 to 4% and experimental analysis 5 to 20%. The propose method is confirmed by the comparing it with result of Analytical and Experimental result. This is in well agreement the acceptable limit ±10%.

10. Torque Vs Speed Characteristics

The following test results will be derived from the test and trial on IVT Drive:



Graph No. 1: Summary of Results correlation between theoretical and experimental

11. Conclusion

The IVT is infinity variable transmission of input speed to the output speed in torque convert ratio will be change. In two masses like Rectangular shape, irregular shape, the input shaft given the specific speed motor to the output result is varying different masses to determine torque converter by the Infinitely Variable Transmission (IVT). The speed difference ratios are design criteria of IVT and development in torque in the mass moment and convert different masses in linear speed.

The error in prediction of torque converter by theoretical analysis is in the range of 3 % to 15% and experimental analysis it is the range of 5 % to 20 %. The proposed method is confirmed by comparing it with results of FEA results and experimental results. The proposed method is found to be simple and accurate. The IVT is newly concept in Light and Medium vehicle on automobile industries is development research they are torque convertor in various masses with different input speed to very output speed to give the more efficient in output power.

12. Future Scope

In this transmission system to develop the maximum torque and minimum output speed. The IVT dissolve the speed variation in medium duty vehicle are used. But IVT is the more powerful as compared to CVT. The two masses profile further development of masses with mechanism, experimental analysis, FEA analysis. The linear repeated of the transmission ratio. In any technology with inherent benefits eventually reach the IVT has only just begun to blossom.

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