Available online www.ejaet.com

European Journal of Advances in Engineering and Technology, 2020, 7(9):41-44

Research Article ISSN: 2394 - 658X

Transmission System of Student Formula-1 SAE Car

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ABSTRACT

This report covers the calculation of transmission system for Student F-1 car participated in Supra-2019. The main purpose of this paper is the calculation of Actual force which includes the calculation of drag force, Speed, Power, Number of links and Length of Chain using knowledge of KTM 390cc engine's data i.e. Over all gear ratio, Torque and RPM to calculate which sprocket is better either sprocket with 45 teeth or 47 teeth.

Key words: transmission system, Actual force, KTM 390cc engine

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INTRODUCTION

This is the part of the vehicle that connects to the back of the engine offering power from the engine to the wheels. The transmission uses the power created in the engine to keep the wheels spinning and keep the engine within a certain revolutions per minute range. Each car is different in the range required, so the transmission needs to be tuned to your vehicle. The arrangement of the transmission and where it sits is dependent on whether the car is all-wheel drive, front-wheel drive, or rear-wheel drive.

TRANSMISSION SYSTEM

Purpose of transmission system in an automobile is to reduce the higher engine speed to the slower wheel speed, increasing torque in the process and vice versa, provides means of connection and disconnection between engine and the rest of the power train without any shock. Components of transmission system are Clutch, Gearbox, Universal joint, Drive shaft of Propeller shaft, Differential, rear & front axle and Wheels.

Fig. 1 Student F1 car

CALCULATION FOR TRANSMISSION

Information from Engine

Gear	Individual gear ratio	Engine RPM	Torque
1	2.6667	4000	26.00
2	1.8571	6000	30.50
3	1.4211	8000	39.02
4	1.1428	10000	26.00
5	0.9565	10000	25.00
6	0.8400	10000	25.00

Overall gear ratio= Individual gear ratio*****Primary gear ratio*****Secondary gear ratio
So according to this formula overall gear ratio for each gear will be as follows:-

Gear	Overall gear ratio
1	21.3338
2	14.8569
3	11.3681
4	9.1425
5	7.6520
6	6.7200

Torque= Engine torque***** Overall gear ratio
So according to this formula calculation for torque will be as follows:-

Gear	Torque
1	554.6788
2	453.1354
3	375.3746
4	237.7050
5	191.3000
6	168.0000

RPM= Gear RPM*****Overall gear ratio (Revolution per minute)
RPS=RPM/60(Revolution per second)

Gear	RPM	RPS
1	187.4958	8.1249
2	403.8527	6.7808
3	703.6740	11.7279
4	1093.7927	18.2298
5	1306.8478	21.7807
6	1488.0952	24.8015

Force=Torque/radius of wheel
Here, radius of wheel was taken as ***r=21*** inches,
From the formula of force ***F=ma***
We deduce acceleration,
a=F/m
in which mass of vehicle is supposed to be m=270kg
now ,
Actual force= F - Drag force
Drag force=0.5∫cd.A.q=196.2267

Force	Acceleration	Actual force
2079.7855	6.9946	1883.5588
1699.0453	5.5659	1502.8186

1655.8209	5.4059	1459.5942
891.2823	2.5743	695.0556
717.2853	1.9298	521.0586
629.9212	1.6062	433.6945

Speed =2πr . RPS m/sec
To convert speed from ***m/sec*** to ***km/hour*** , speed was multiplied to 3.6
For the calculation of time we used equation of motion i.e.
V= u +at
In this equation, we put ***u=0*** as initial velocity and there after we put ***u= v1,v2…***
For calculation of distance we used another equation of motion i.e.
S=ut+1/2at^2

Speed (m/sec)	Km/hr	Time	Distance
5.2338	18.8416	0.7483	1.9583
11.2732	40.5835	1.0850	8.9547
19.6427	70.7137	1.5482	23.9319
30.5326	109.9174	4.2304	106.1316
36.4799	131.3276	3.0818	103.2594
41.5394	149.5418	3.1499	122.8765

Power can be calculated by the following formula:-
Power=2πNT/ 60

Power (in HP)	Power (in kW)
14.8039	10.8852
26.0598	19.1539
37.6146	27.6467
37.0249	27.2133
35.6009	26.1667
35.6009	26.1667

Number of link=K=$(T_1+T_2)/2$ +$(T_1^2-T_2^2)P/ X$ + 2X/P
Where,
P=pitch (for 510,520,540 the pitch is taken as 0.625)
T_1 & T_2=No. of teeth (hereT_1=15 and calculation for T_2 is done below)
X= centre distance
Length of chain=L=no. of link*pitch=k * P

No. of teeth (T_2)	No of links (K)	Centre distance(X)(in inches)	Length of chain (L) (in inches)
45	70	12	43.75
	74	13	46.25
	76	14	47.5
	80	15	50
47	72	12	45
	74	13	46.25
	78	14	48.75
	80	15	50

CONCLUSION

To increase the performance of F1 car, an attempt was made to modify the Transmission System of a Formula SAE car.Comparative study is done on the two types of sprockets by calculating many factors that affect the acceleration of the vehicle.

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