

# Electricity Generation by Speed Breakers having Helical Gears using Rack and Pinion Mechanism

Santosh Jadon<sup>1</sup>, Rahul Kumar Singh<sup>2</sup>, Sumeet Kumar Singh<sup>3</sup>

<sup>1</sup>B.E. Student, Mechanical Engineering Department, MITS Gwalior, India

<sup>2</sup>B.E. Student, Mechanical Engineering Department, MITS Gwalior, India

<sup>3</sup>Asst. Professor, Mechanical Engineering Department, MITS Gwalior, India

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**Abstract** -The aim of our project is to use helical gears in place of spur gears for power hump working on rack and pinion mechanism. It is a system in which we utilize the kinetic energy of system and convert it into useful power. By the use of helical gears in place of spur gears, the load carrying capacity of a system has increased due to increases in strength, noise generation due to system is reduced and service life of a system has increased. We can use this power in various places like street lights and parking lights, street signals etc. and in this way we can also reduce the consumption of conventional resources for electricity generation. We can also increase the output by arranging such system in series and this power can be amplified and stored by using some electrical device. With this approach, we can fulfill our demands to some extent.

**Key Words:** Helical gear, Rack and Pinion, dynamo, bearing, high strength, Energy conservation.

## 1. INTRODUCTION

In the current situation, power is main source to fulfil needs of every human being. Power is also required to run machines in our industries so power is considered as an important input for our industries. Day by day increases in population and subsequent reduction in fossil fuels, it has become very important to find renewable sources of energy. Our country is very vast so the requirement of power is also more, as we know that we majorly rely upon conventional resources for power generation which themselves are limited. India is 7<sup>th</sup> largest manufacturer of consumer vehicles which requires power for its operation. Hence we have to look for alternatives sources of energy. Power generation through speed breaker is considered as one such power generation method which is renewable.

When a vehicle passes over the speed breaker, it goes down due the weight of vehicle. This energy can be converted in some usable form like electrical energy and this energy can be stored in batteries which can be used when required.

### 1.1 Literature review

We should study the previous work done on this topic so far for designing any new component or system. Based on study of previous work that are present till now, we can

then think what are the gaps that we could fill in existing methods and thereby develop a unique way of developing power hump.

Noor Fatima, JiyaulMustafa[4] explains the working principle of the power generation through speed breaker, its practical implementation and its advantages.

Akshay Tank, Prof. Chandni Shah, Keyur Shah[5] emphasizes on the idea that the kinetic energy getting wasted can be utilized to generate power by using a special arrangement of spring piston assembly with water tank.

ASWATHAMAN V, PRIYADARSHINI M[6] shows how man have been utilizing energy and t explore prospects of optimizing the same. This paper involves the testing of the system with different loads at different speed. It shows that with increase in speed of vehicles power generation decreases but with increase in weight power generation increases.

Mohamad Ramadan, Mahmoud Khaled, Hicham El Hage[1] mentioned the need of power in current scenario which is on some extent can be fulfilled by speed breaker having rack and pinion arrangement. In this paper they conduct experiment on speed breaker with different masses and find out with increase in mass the power production also increases

AnilaSunny, Bini Bright[2] shows the combination of foot step and road hump method to generate power for street lights.

Akash LiladharGorle, Akash Narendra Patil, Akshay Vilasrao Thawale, Shridhar Vinod Giri, Brinda Daarjee, Leena. H .Patil[3] shows how the power can be generated through the speedbreaker using different mechanism.

## 2. METHODOLOGY

It involves following-

- Present scenario.
- Working principle.
- Comparative study.

### 2.1 PRESENT SCENARIO

The concept of power generation through speed breaker is not new and is being constantly researched for increasing its efficiency, life etc. we have read various works and research papers and hence came to a conclusion that the life, the efficiency, the speed ratio all can be increased if we use double helical gear instead of spur gear .present mechanisms are more prone to fatigue failure due to the application of spur gear

### 2.2 WORKING PRINCIPLE

“The power generation through speed breaker using helical gears” works on the principle of conservation of energy. On roads where these systems are installed if a vehicle crosses the speed breaker then the rack attached to the upper plate of the breaker moves in downward direction [we have also attached springs to the upper plates so that the movement should be smooth otherwise it may cause imbalance to the vehicles]the teeth of the rack is such that its inclined at some angle .the rack is then engaged with a helical gear having same helix angle but in opposite manner. Once the rack moves it will rotate the helical gear and due to the movement of helical gear the shaft will rotate .a large sprocket is attached to the driver shaft which is connected to the smaller sprocket through chain drive .note:-we may use gear train or gear box to transmit motion from driver shaft to driven shaft but it will be a costly operation even if we would be able to increase efficiency to certain accent .Now on the driven shaft a Flywheel is attached to control the fluctuation of energy and to provide constant average torque to the motor .this process is optional but if we want to further increase the speed ratio then we can apply on more gear arrangement as we have seen above in the block diagram

**Table -1: COMPARATIVE STUDY**



TOPIC	HELICAL GEAR	SPUR GEAR
1)ON THE BASIS OF NOISE	THE TEETH OF HELICAL GEARS ARE INCLINED AT CERTAIN ANGLE DUE TO WHICH THE ENGAGEMENT OF TWO GEARS ARE GRADUALL. THE ENGAGEMENT IS SUCH THAT ONLY A POINT OF ONE GEAR IS COMES IN CONTACT TO OTHER THAT'S WHY IT CREATES LESS NOISE	THE TEETH OF SPUR GEARS ARE NOT INCLINED THATS WHY THE CONTACT IS NOT GRADUAL AND A LINE CONTACT IS THERE BETWEEN THE GEARS .THATS WHY IT CREATES MORE NOISE AS COMPARE TO HELICAL GEAR
2)ON THE BASIS OF SPEED RATIO	HELICAL GEARS CAN HAVE A SPEED RATIO RANGING FROM 1:1 TO 1:5 IN THIS ASPECT IT IS HAVING HIGHER SPEED RATIO	SPUR GEAR CAN HAVE SPEED RATIO RANGING FROM 1:1 TO 1:3
3)ON THE BASIS OF STRENGTH	THE BEAM STRENGHT ACCORDING TO LEWIS EQUATION IS $S_b = mb S_{beam} Y$ WHERE Y IS LEWIS FORM FACTOR AND DEPENDS UPON EFFECTIVE NO OF TOOTH  EFF TOOTH OF HELICAL GEAR $= Z / \cos^3[\text{ALFA}]$  FOR SAME PITCH RADIUS, THE EFFECTIVE NO. OF TOOTH OF HELICAL IS MORE THAN SPUR GEAR THAT'S WHY THE BEAM STRENGTH IS ALSO MORE AS FORM FACTOR WILL BE MORE .WE CAN CLEARLY VISUALIZE WITH THE HELP OF FORM FACTOR TABLE BELOW	THE BEAM STRENGTHH FORMULA OF SPUR GEAR IS SAME AS THAT OF HELICAL GEAR BUT THE ONLY DEFFERENCE IS THAT THE EFFECTIVE NO. OF TOOTH FOR SPUR GEAR IS LESSER THAN HELICAL GEAR

z	Y	z	Y	z	Y
15	0.289	27	0.348	55	0.415
16	0.295	28	0.352	60	0.421
17	0.302	29	0.355	65	0.425
18	0.308	30	0.358	70	0.429
19	0.314	32	0.364	75	0.433
20	0.320	33	0.367	80	0.436
21	0.326	35	0.373	90	0.442
22	0.330	37	0.380	100	0.446
23	0.333	39	0.386	150	0.458
24	0.337	40	0.389	200	0.463
25	0.340	45	0.399	300	0.471
26	0.344	50	0.408	Rack	0.484

HEIGHT OF HUMP = 12CM

Acc to work obtained formula,

Work=FS (F= FORCE , S= DISPLACEMENT)

FORCE = GRAVITATIONAL WEIGHT OF THE MASS=400\*9.81=3924N

DISPACEMENT = HT OF BUMP =12CM= 0.12M

WORK OBTAINED =3924\*0.12=588J

\*LET US ASSUME THAT ON AN AVERAGE ROAD 30 VEHICLES PASSES EACH MINUTE [THIS DATA MIGHT BE VERY LARGE FOR A VERY BUSY ROAD]

IN ONE MIN IF 30 VEHICLES CROSSES THEN IN 1 DAY TOTAL VEHICLES CROSSES WILL BE EQAUL TO 30\*60\*24=43200 VEHICLES

NOW TOTAL AMOUNT OF ENERGY PRODUCED BY A SPEED BUMP WHOSE EFFICIENCY IS [90% SAY]

=0.90\*43200\*588=22861KJ

\*NOW A TYPICAL SODIUM VAPOR LAMP CONSUMES 150W OF POWER

Let us assume that street light is on for 9 hours then the amount of electricity consumed by it in 9 hours will be =150\*60\*60\*9=4860KJ OF ENERGY

NOW THE POWER OUTPUT OF THE SPEED HUMP IS **22861KJ** AND THE POWER CONSUMED BY A TYPICAL STREET LIGHT IN NIGHT TIME IS **4860KJ** OF ENERGY

NO OF STREET LIGHT WHICH CAN CONSUME POWER FROM THE HUMO = 22861KJ/4860KJ=4.7

HENCE WE CAME TO A CONCLUSION THAT ON AVG WE CAN LIGHT 5 STREET LIGHTS WHICH IS SUFFICIENTLY GUD

#### 4. Description of various important elements used-

**4.1 Dyanmo-** It is device used to convert the mechanical energy received through shaft into electrical energy which is thus restored to a battery. It operates on the postulates/theory of electromagnetic induction.

**4.2 Led bulb-** It is used to indicate when kinetic energy of vehicles is converted into electrical energy through dynamo/generator.

**4.3 Battery-** It is used to store the electrical energy generated by dynamo

4]ON THE BASIS OF LIFE OF GEAR	SINCE THE ENGAGEMENT OF THE GEARS ARE GRADUAL THAT'S WHY THERE IS A NILL CHANCE OF IMPACT STRESS WHICH MIGHT CAUSE SUDDEN FAILURE AS IMPACT STRESS IS MORE THAN NORMAL STRESS	IN SPUR GEAR SINCE THE ENGAGEMENT IS SUDDEN THIS LEADS TO AN IMPACT STRESS WHICH MIGHT NOT ONLY CAUSE VIBRATION OR SUDDEN FAILURE BUT DUE TO THIS THE FATIGUE STRESS DEVELOPED WILL ME MORE WHICH MIGHT LIMIT THE VEHICLES CROSSING IT
5]ON THE BASIS OF NOISE AND VIBRATION	HERE THE ENGAGEMENT IS GRADUAL THAT MIGHT CAUSE NO NOISE POLLUTION AS WELL AS VIBRATION	HERE THE ENGAGEMENT IS NOT GRADUAL AND HENCE THE IMPACT STRESS MIGHT CAUSE LARGER NOISE POLLUTION AS WELL AS VIBRATION IN THE SYSTEM

### 3. RESULTS OBTAINED

#### 3.1:- CALCULATING POWER OBTAINED AT SPEED BUMP-

LET'S ASSUME,

MASS OF VEHICLE =400[APPROX]

**4.4 Rack and pinion-** When vehicle passes over the speed breaker due to its weight speed breaker goes down which in turn causes the linear movement of rack which rotates the pinion attached to it. In this project, teeth cut on rack and pinion are not straight but at an angle for smooth engagement.

**4.5 Helical gear drive-** it is used to transmit power to the generator after receiving it from the small sprocket through shaft.

**4.6 Chains-**It is used to transfer power from large sprocket to small sprocket.

**4.7 Shaft-** it is used to transfer from pinion to large sprocket and from small sprocket to helical gear drive.

**4.8 Bearing no.628-** It allows all elements to work smoothly.

And rest components are-nut and bolt, wood, diode 160 mega ohm, resistance, board, iron plate, capacitor 100 mfd, crankshaft.

## 5. CONCLUSIONS

The only objective of this project is to develop a speed breaker system with high load carrying capacity, low noise generation and higher service life.

With the application of helical gears in place of spur it offers following advantages-

- Higher load carrying capacity as a result of higher value of bending strength.
- Lesser noise and vibration generation.
- Improved service life.
- Higher speed ratio.

## REFERENCES

[1] "Using speed bump for power generation-Experimental study" Mohamad Ramadan, Mahmoud Khaled, Hicham El Hage, ICAE2015.

[2] "Effective Power Generation Using Foot Step and Road Hump For Intelligent Street Light" Anila Sunny, Bini Bright, Vol. 4, Issue IV, April 2016, ISSN:2321-9653.

[3] "Literature Review on Electricity Generation using Speed Breaker" Akash LiladharGorle, Akash Narendra Patil, Akshay Vilasrao Thawale, Shridhar Vinod Giri, Brinda Darjee Leena. H .Patil, Vol. 7, Issue 10, October 2018 ISSN:2278-1021.

[4] "Production of electricity by the method of road power generation", Noor Fatima, Jiyaul Mustafa, Vol. 1, Number 1, IJAEEE 2010.

[5] "Eco-friendly Energy Generation through Speed Breaker", Akshay Tank, Prof. Chnadni V. Shah< Keyur Shah, Vol. 2, Issue 1, IJEDR2014.

[6] "Every Speed Breaker is Now A Source of Power", ASWATHAMAN V, PRIYADARSHINI M, Vol. 1, IPCBEE 2011

[7] "Role of renewable energy sources in environmental protection" Panwar N.I., Kaushik S.C., Kothari S. Renewable sustainable Energy Rev 2011; 15:1753-1766.

[8] "A review on sustainable design of renewable energy system" Shri. L.S, Yit Lin Chew M. Renew Sust Energy Rev 2012; 16:192-207.