Journal of Energy Research and Environmental Technology (JERET)
Print ISSN: 2394-1561; Online ISSN: 2394-157X; Volume 2, Number 2; January-March, 2015; pp. 102-105
© Krishi Sanskriti Publications
http://www.krishisanskriti.org/jeret.html

Modification in a Bridge to Produce Energy

Manas Pratim Mahanta

Civil Engineering B.E. 8TH SEM Royal Group of Institution Bethkhuchi, GHY-35
E-mail: manasmahantapro@gmail.com

Abstract—*In civil engineering a structure is made for different purposes such as a building provides a suitable environment to work, a bridge gives a passage for easy movement over water bodies etc. But if we boost the technology, all such structure can be modified to a structure that can produce its own energy. Here with an idea of this, the bridge is chosen, which are generally provided over the water bodies and tried to modify it to a structure that will allow smooth movement over the water bodies and even produce energy from its different properties like the sagging, its frequency etc. This will not only be a modification in the structure but if applied it can be bring a boost to energy production in the location and does in turn in the economy of the country without harming the nature and its element.*

Keyword:-*Wind Water And Solar Energy, Efficient, Self-Energised*

1. INTRODUCTION

Energy is something that's need to be fed to very structure, living or non living, to work. In civil engineering the structure are constructed and their energy is being fed by other energy producing structure. But if this structure is constructed such that it could produce its own energy it can reduce the energy consumption and thus be economic in future aspect.

Here with the idea of this a most widely used structure is selected, that is, the bridge and modification is done on it such that it can produce energy which can be used to feed itself or if the amount o energy produce is more it can also be used to feed the nearby areas.

The Saraighat bridge is Assam runs over the mighty Brahmaputra is about 1.5 km long and first of its kind a rail cum road bridge built over the Brahmaputra river. It has 12 spans and 14000 tonnes of steel, 4.2 cubic feet concrete, 40000 tonnes of cement and 100 million cubic feet of earth work. The total cost of construction is about 10.65 crore and every year it take about 10 to 20 lakh for maintenance and other energy required activities like the lighting. It requires a thick amount of money to work efficiently and attractively. This amount can be reduce to a sufficient amount by using some modification in techniques of the bridge which would give a benefit in long term plan of the bridge and thus beneficial for the state.

This modification can be studied under the followingtopics

1. Applied modification:- Modification that are already in use in many places of the world
2. Innovative modification:- modification that aren't common in the world but if applied can make a big difference in energy production.

2. APPLIED MODIFICATION

Modification are already being applied on some bridge that made the bridge energy efficient.

2.1 Use of turbine in bridge

A turbine is always a useful mechanical device to generate energy where there is sufficient wind to produce the energy. The average velocity near the bridge is about 5 km/hour. This velocity is sufficient to produce an energy of 200 watt per sec

Table 1. Velocity Profile of River Brahmaputra

Place	Velocity(km/hour)	Direction
Guwahati	5	S-W
Dibrugarh	6	S-W
Jorhat	6	S-W
Goalpara	4	N-E

Thus the electricity produced can be estimated by the following formula

Power(watts)=0.5 * (swept area) * (density of air) * (velocity of air)

Where the density is constant, velocity can be obtained and thus to obtain required energy turbines can be designed with required swept area.

Let us take swept area of 2000cm^2

Density 0.002gm/cm3

Velocity=200cm/sec

Power = 0.5*2000*0.002*200=200 watt per sec

It is worth mentioning here that the velocity of air can be increased by 20% due to the fast moving cars travelling at a speed of 60 km/hour. Thus this would again add to the velocity and thus to the energy production.

The turbine used in this case should be the vertical turbine that would operate irrespective of the the direction of wind.

Fig. 1: Vertical Turbine

2.2 Use of Energy Efficient Light – LED lighting.

LED lighting is a rapidly evolving technology that produces light in a whole new way. It is already beginning to surpass the quality and efficiency of existing lighting technologies, such as fluorescent and incandescent. LED stand for light emitting diode.

Advantage of LED lightings are

- **Reduces energy costs** — uses at least 75% less energy than incandescent lighting, saving on operating expenses.
- **Reduces maintenance costs** — lasts 35 to 50 times longer than incandescent lighting and about 2 to 5 times longer than fluorescent lighting. No bulb-replacements, no ladders, no ongoing disposal program.
- **Reduces cooling costs** — LEDs produce very little heat.
- **Is guaranteed** — comes with a minimum three-year warranty — far beyond the industry standard.
- **Is durable** — won't break like a bulb

- **Brightness is equal to or greater than existing lighting technologies** (incandescent or fluorescent) and light is well distributed over the area lighted by the fixture.
- **Light output remains constant over time**, only decreasing towards the end of the rated lifetime (at least 35,000 hours or 12 years based on use of 8 hours per day).
- **Excellent color quality**. The shade of white light appears clear and consistent over time.
- **Light comes on instantly** when turned on.
- **No flicker** when dimmed.
- **No off-state power draw**. The fixture does not use power when it is turned off, with the exception of external controls, whose power should not exceed 0.5 watts in the off state

2. 3. Use of Solar Panels.

As the bridge are located over water bodies thus we can say that it is well expose to the open environment and thus to the sun light. So using a solar panel it can generate a large amount of solar energy during the day time.

The solar energy i.e. energy form the sun is the most abundant in this nature. The sun emits $3.7*10^{20}$ MW of energy in the form of electromagnetic radiation out of which the earth receives about $1.8*10^{11}$ MW. The energy obtain form PV solar panel depends on the duration of time exposed to the sunlight, efficiency of solar panel and total area of solar panel. It can be calculated by using the following equation

P=A*r*H*PR, where

A=total solar panel area (m^2) =500m^2(assumed)

r=yield of solar panel (%) = 0.2

H=annual average solar radiatiation=5kWh/m^2/day

PR=performance ratio (constant=0.75)

Therefore power=500*5*0.2*0.75/3600=0.1kW/s

Thus by using this modification in a normal building we can make it use free energy form the nature to generate its own energy.

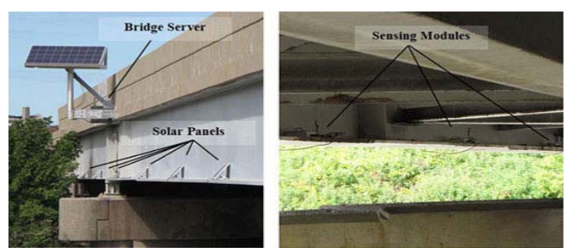

Fig. 2: Solar Panel Used in Bridge

3. INNOVATIVE IDEA

3.1 Oscillation suppression

A new Energy Efficient Bridge Crane with Micro/Macro dual-bridges was presented. A planar model of the energy efficient bridge crane (EEBC) was developed. The dynamic performance of the EEBC was discussed based on simulations. The simulation results showed that input shaping is capable of limiting the oscillation of the macro bridge, trolley, and payload. Furthermore, the shaper can improve the positioning accuracy. These results indicate that the EEBC is a prospective potential product with advantages of saving energy and improving positioning precision.

3.2 Use of Nano Scale Binders

Nanoscale binders can give concrete, as the conventional construction material, new properties with regard to workability, strength and durability. Adding silicon dioxide nanoparticles fills the pores in the concrete, making it denser and harder. Ultra high performance/ high-strength concrete also contains steel fibers, which improve tensile strength. These types of concrete attain a steel-like compressive strength of over 200 N/mm^2. Polymer additives (for example artificial resins) help liquefy and stabilize the cement suspension, which is used to develop self-compacting concretes. The high strength and density of UHCP enables especially lightweight and delicate constructions such as bridges. The Gartnerplatzbrucke, a bridge inaugurated in 2007 over the Fulda River in Kassel (Germany), was the first larger bridge in Germany to use ultra high performance concrete for the prefabricated elements. In addition, the concrete elements were joined with a novel bonding technique.

3.4 Multimodel Energy Harvesting

The multimodal approach consists in a multi-vibration harvester, designed to be excited when the natural driving frequency approaches one natural frequency of the harvester. In this case useful power can be harvested over multiple frequency spectra, increasing the bandwidth that can be covered for efficient energy harvesting.

One way to design a multimodal VEH consists in the combination of more transduction mechanisms together. A hybrid scenario was presented by Tadesse et al. a. The harvester consists of a cantilever beam with piezoelectric crystal plates bonded on it at a fixed distance each other; a permanent magnet is attached at the cantilever tip oscillating within a coil fixed to the housing structure. It this configuration the electromagnetic transducer generates high output power at the cantilever first mode (at 20 Hz), while the piezoelectric transducer generates higher power at the cantilever second mode (at 300 Hz). The combination of the two schemes in one device is able to improve significantly the harvester response covering two frequency ranges. The drawback of this solution is the difficulty in combining the output power from two different mechanisms, thus requiring two separate converting circuits.

A different approach rather than exploiting the energy present at different modes of a single oscillator is to design a cantilever array integrated in one single device. If the geometric parameters of the harvester are appropriately selected, a wide vibration bandwidth can be exploited.

It has been demonstrated by that the improved bandwidth and performance were worth the modest increase in size of the proposed array device. A cantilever array configuration in respect to the hybrid solution, doesn't present the difficulty in combining the output power from the different mechanisms, but requires one rectifier for each cantilever to avoid output cancellation due to the phase difference between the cantilevers.

As a matter of fact, the multimodal approach increases the bandwidth increasing the volume or the weight of the harvester, thus reducing the energy density. Specifically for the cantilever array, only one cantilever or a subset of them are active at the same time generating a certain amount of power while the others are at off-resonance. Hence, knowing the dominant spectrum of the ambient vibrations, the harvester has to be carefully designed to prevent a dramatic efficiency loss.

3.5 Motion of the Bridge

A bridge has a various forms of motion such as sagging or to and fro due to the live loads and the natural frequency. This movement can be harvested to produce energy. One of the innovative idea would be the use Lenz's law.

Table 2 : Magnetic Shielding Materials

Or strong filed over 1 gauss (high saturation and low permeability allot)	Or weak and moderate fields milligauss level	For high frequency table
Giron(best performance, large format) MagnetShield (good performance) PaperShield (low performance	Magnetic Shielding Foil Mag-Stop Plates(large format) JointShield (adhesive on one side)	Finemat for KHz range cobal tex for MHz range

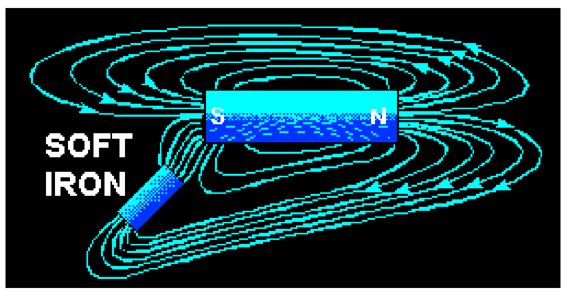

Fig. 2: Magnetic shielding by Soft Iron

Lenz's law state that if the magnetic field changes it induces an emf to the coil. This emf produces the current. If magnetic particles can be fixed in a bridge along the direction of motion of the bridge and coils wrapped around it it could use the motion of the bridge to change the magnetic field and thus to induce the emf. But the problem arise here is that the magnetic field can affect the motion of the vehicle. Thus to reduce this effect an magnetic insulator can be use. But there isn't actually any magnetic insulator. So an effect called the magnetic shielding effect is used where the magnetic field is changed by repelling the magnetic field and for this many materials can be used which are economic in nature

4. ECONOMY

Economy o such modification is hard to estimate as the environmental condition isn't same in all places. And even the economy isn't instantaneous, its a long term process. Moreover all the modification may not be applied all together. But as it reduces the energy consumption it turns out to be economic in a long term process.

5. ADVANTAGE OF THE MODIFICATION

The modification have the following advantages.

- No harm to the nature:- The modification that are applied doesn't harm the nature in any way and is thus eco-friendly.
- No pollution caused:- The modification has no polluting effect and thus doesn't add up to the green house effect .
- Produces energy for nearby sites:- The energy produce may be sufficient enough to fed it to the nearby sites.
- Miscellaneous advantages:- This add up to the world o technology and thus open scopes to the various branch of science and job opportunities which in turn will add upto to the prosperity of the country.

6. FUTURE SCOPE AND DEVELOPMENT

There are many other forms of energy induce in the bridge that could be harvested to form energy. This forms of energy should be studied carefully and use it to the benefit of the people without harming the nature. Further the modification discussed here have some exception. Those exception can be analysed thoroughly and use it for better results.

7. CONCLUSION

The various modification discuss can be used to produce energy form a bridge structure. As taken into account, the Brahmaputra Bridge in Assam, applied with the modification, the energy consumed by it will reduce significantly. As it lies on the entrance on the main City Guwahati, it is crowded with different modes of vehicle and thus using this crowd we can transform it to form enegy which can be either fed by The Brahmaputra bridge itself and if efficient enough it can give those energy to the nearby areas and thus is economic in long term process.

REFERENCES

[1] Anke Fröbel "Cable Shielding to Minimize Electromagnetic Interference"

[2] Goyal Ajay "Provisions Regarding Deflection/Camber in Various National and International Codes for Rail and Road Bridges"

[3] Geoffrey Jones Loubna Bouamane "Power from Sunshine": A Business History of Solar Energy May 25, 2012

[4] Kishinami, K. "Theoretical and experimental study on the aerodynamic characteristics of a horizontal axis wind turbine Energy" 2005

[5] Tarujyoti Buragohain "Impact of Solar Energy in Rural Development in India" August 2012

[6] V.Prasad Kodali, "Engineering electromagnetic compatibility: principles, measurements, and technologies", vol. I. New York: Institute of Electrical and Electronics Engineers, 1996, pp. 199-227

[7] Youmin Hu, Bo Wu "Oscillation Suppressing for an Energy Efficient Bridge Crane Using Input Shaping"