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Use of Solar Panel in Design of Footpath

Ganesh Kore[1], Pooja Shelake[2], Vaibhav Gavade[3], Paresh Katare[4], Ganesh Chavan Patil[5]
[1, 2, 3, 4]B.Tech, [5]Assistant Professor, Civil Engineering Students, Ashokrao Mane Group of Institutions, Vathar, Kolhapur, Maharashtra-416112, India

Abstract: Solar footpath is a series of solar panel interlink to each other The outer layer of solar panel is covered with mild steel(MS). The tempered glass is attached to mild steel fabrication. Glass is tempered is such a way that it can bear up to 1 ton of load, various test are taken on glass like 1) ball drop test, 2) fragmentation test 3) light transmission test. Lithium battery is used to store the energy produce form the solar panel. The plus point of this design is that even if few panels get damage due to natural calamity other panel will still continue producing energy.
Keywords: Photovoltaic cell, Tempered glass, Solar footpath.

I. INTRODUCTION

Solar footpath can pay bonuses for the public budget, making our expenditure on infrastructure more effectual and significantly reducing electricity costs to consumers and businesses. They can make the developing electric vehicle economy far more within your means, and easier to manage. As we have used our own tempered glass which leads in reduction of efficiency of solar panel so our designed panel efficiency reading are different from regular one. At just 15% efficiency, far below what is expected, a 100% Solar footpath enabled driving infrastructure would produce three times total electricity demand. There are additional benefits as well.

II. SIGNIFICANCE

We can lead the world in commanding clean energy technology spreads, proficient of rolling back huge pollution and greenhouse gas emissions. Clean energy technology existence can power the entire countries economy, and more. But the essential is promise to major investment and encouragements in building the infrastructure. If up-gradation is done with this technology, we can create jobs, and a clean energy boom, encouraging private investment on a massive scale, with relatively little extra cost.

III. OBJECTIVES

A. Analyzation of Materials used for Construction of Solar footpath Layers.
B. To carry out the test required for Solar Roadways
C. Design of Road Section.
D. Comparative Study of Solar Panel Roadways.

IV. SCOPE OF PROJECT

Energy is produced by solar road panels to be used by homes and businesses and finally to be able to store excess energy in or alongside the solar roadways. Thus, renewable energy satisfies necessity for generation of electricity, which reduces greenhouse gases and helps in sustainable development. The structural design requirements for a solar road panel is safe and durable as the structure must be corrosion resistant to salts and other potential contaminants.

V. TESTS ON MATERIALS

A. Properties of Tempered Glass

Tempered glass is four to five times stronger than annealed glass of the same size and thickness against impact. Tempered glass has higher thermal strength, and it can withstand high temperature changes up to 250 degree. Tempered glass is considered as a safety glass

1) Density (approximate) – 2.42 – 2.52 g/cm3
2) Tensile Strength – 120 to 200 N/sq.mm
3) Compressive Strength – 1000 N/sq.mm
4) Modulus of Elasticity – 70GPA
5) Coefficient of Linear Expansion – 9*10-6 m/mk

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B. Test Results

1) Ball Drop Test

This test method is intended for use as an in-plant quality control test to evaluate the impact performance of laminated flat glass when a 2.3 kg, 83 mm diameter smooth solid steel ball is dropped from a user selected height.

Result- After dropping of ball, glass does not break it means the glass is strong and passed ball drop test.

Fig.1: Ball Drop Test

2) Fragmentation Test

Tempered glass gives good results for fragmentation test, which are within limits.

Fig.2: Fragmentation of Tempered Glass

3) Light Transmission Test

Following readings are obtained after test.

After the testing laminated toughened glass is more convenient for Solar panel as this glass having visual ray transmission 86.3% so the sun rays can easily pass from the glass.

Table 1: Light transmission test result

Samples -	plane glass 5mm thick	Rough glass 5mm thick	Laminated toughened glass 6 + 5 mm thick pasted with (Polyvinyl butyral)
UV transmission	88.4%	40.5%	1.6%
IR transmission	78.9%	18.1%	66.6%
VL transmission	90%	21.4%	86.3%

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VI. DESIGN OF SOLAR PANEL

The solar roadway panels consist of following parts:-
Solar Panel, LEDs, Induction charging , Electronic Circuit board, Electric Sensor, Tempered glass surface, Battery, Steel Frame

A. *Design of Steel Frame*

L_{eff} = 0.69 m = 690 mm
Assume fy (Yield strength)
tg = 10mm
Size of weld (s) = 10mm
As per IS800: 1989 pg no 87 clause 4.1.1
Permissible axial tensile stress (ɡat) = 0.6fy
ɡat = 0.6 x 250 = 150MPA
For section ISA 8020-3
Ag provided = 1.41 cm^2 = 141mm^2
Let us find net eff area
As per IS800 1984, clause 4.2.1.1 pg no 37

$A_{net\ eff} = A_1 + A_2 k$ **(1)**
$k = 3A_1/3A_1 + A_2$ **(2)**
A_1 = Gross area – Deduction = (30x3) – (3^2 / 2) = 85.5mm^2
A_2 = (20 x 3) – (3^2 /2) = 55.5mm^2
k = 3 x 85.5 / 3x 85.5 + 55.5
k = 0.82
Anet eff = $A_1 + A_2 k$ = 85.5 + 0.82 x 55.5 = 131.01mm^2
L.C.C. = ɡat x $A_{net\ eff}$ = 150 x 131.01 = 19.65 KN = 2003.74 kg

C-Section –
Assume fy = 250 MPA
Size of weld (S) = 10mm
ɡat = 0.6 x 250 = 150MPA
For Section C – 50 x 25 x 5 x 6
Ag provided – 4.94cm^2 = 494mm^2
$A_{net\ eff} = A_1 + kA_2$ --------- **(1)**
$k = 3A_1/3A_1 + A_2$ ---- **(2)**
A_1= (50 x 6) - 6^2 / 2 = 282mm^2
A_2= (25 x 5) - 5^2 / 2 = 112.5mm^2
K = 3 x 282 / 282 x 3 + 112.5 = 0.882
$A_{net\ eff}$ = 282 + 0.882 x 112.5 = 381 mm^2
L.C.C. = ɡat x Anet eff = 150 x 381 = 57.150 KN = 5827.67 kg

$I_{xx} = [I_{yy} + Ah^2] + [I_{yy} + Ah^2] = [0.4 + 1.41 \times 0.49^2] + [16.75 + 4.94 \times 6.7^2] = 24.2\ cm^4$
$I_{yy} = [I_{xx} + Ah^2] + [I_{xx} + Ah^2] = [1.2 + 1.41 \times 0.98^2] + [2.33 + 4.94 \times 1.35^2] = 13.88 cm^4$
I_{min} = 13.88 cm^4
Let us assume member as an eff length of 0.69 m
Leff = 690 mm
$r_{min} = \sqrt{r_{min}} / Ag = \sqrt{13.4 / 4.94 + 1.41}$ = 1.45 cm = 14.5 mm
ƛ = 690 / 14.5
ƛ=47.58 N/mm^2

Let us find axial compressive permissible stress as per IS800: 1984 pg no 39 table 5.1

40	139
47.58	X - ʤac
50	132

(50-40) / (50-47.58) = (132-139) / (132- ʤac)
ʤac = 130.30 N/mm^2

For Compression Member,
L.C.C. = ʤac x A = 130.30 x (141 + 494) = 82.74 KN
L.C.C. = 8437.13 kg

VII. WORKING OF SOLAR PANEL

A. Solar Panel

We have prepared fabrication model, made of mild steel and tempered glass. This tempered glass is different from actual solar panel glass, this glass is ten times stronger than normal glass which is laminated and takes load up to 1000k kg.

1) Type of solar panel - Polycrystalline
2) Size of solar panel - 630mm x 670mm
3) Weight – 5 kg.
4) Maximum Power – 50W
5) Cell Temperature – 25*C
6) Open Circuit Voltage – 21.47V
7) Short Circuit Current – 3.11A
8) Maximum Power Voltage – 17.21V
9) Maximum Power Current – 2.91A
10) Maximum System Voltage – 1000 V DC

B. Battery

1) *Features*

Battery Type – Dry Cell
Nominal Voltage – 12V – 12AM

2) *Check for efficiency of battery design*

Bulb 12w for 6hrs
12x6=72 wh
72 = 9.375Ah
12.8 x 0.8 x 0.8 = 12ah
12.8v X12 ah = 153.6wh
153.6wh =34.13w = 40w

Check of Efficiency
For 40w/hr panel
=20w/hr (minimum efficiency of solar panel)
Day-time = 20 X 6
= 120 Wh > 72Wh

Hence ok

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VIII. PROCEDURE TO INSTALL SOLAR PANEL

A. Fabrication Work

1) Dimension – 69CM X 64CM X 2.6cm
2) Sections – ‘L’ Section , ‘C’ Section

Design of Fabricated Section -

a) As per **IS 800:1984**
b) Size of Weld – 10mm
c) Yield Strength – 250mpa
d) For Section L-ISA :-30 X 20 X 3
e) For Section C-C:- 50 X 25 X 5X 6

B. Placing of Solar Panel

1) *Excavation of Pit* – Excavation of pit or trench for Solar Panel is done.
Size of trench - 630mm X 670mm X 150mm
2) *Set up Frame* – Placing of Steel Frame below the solar panel is essential to avoid the damage of Solar Panel.
3) *Install the Panel* – After the excavation of trench cleaning of trench is done. The Solar Panel having glass on the top is placed with steel frame in the trench
4) *Install the Electrical Wiring* – After placing the solar panel installation of electrical wiring is done.
5) *Install the Inverter* - After that, the **solar inverter** are connected to the system. It is installed near the main panel and it could be both **indoors and outdoors**.
6) *Connection of Solar inverter and Solar Battery* - The **solar inverter** is connected to the **solar battery**. The solar battery storage can save from worrying about the lack of **usable energy during cloudy times**; it can also lower the solar battery storage system costs during installation.
7) *Connect the inverter to the Consumer Unit* – The inverter is then connected to the consumers unit to generate electricity.
8) *Start and test Solar Panel* – The last step was to start the set up and checked the solar panel working.

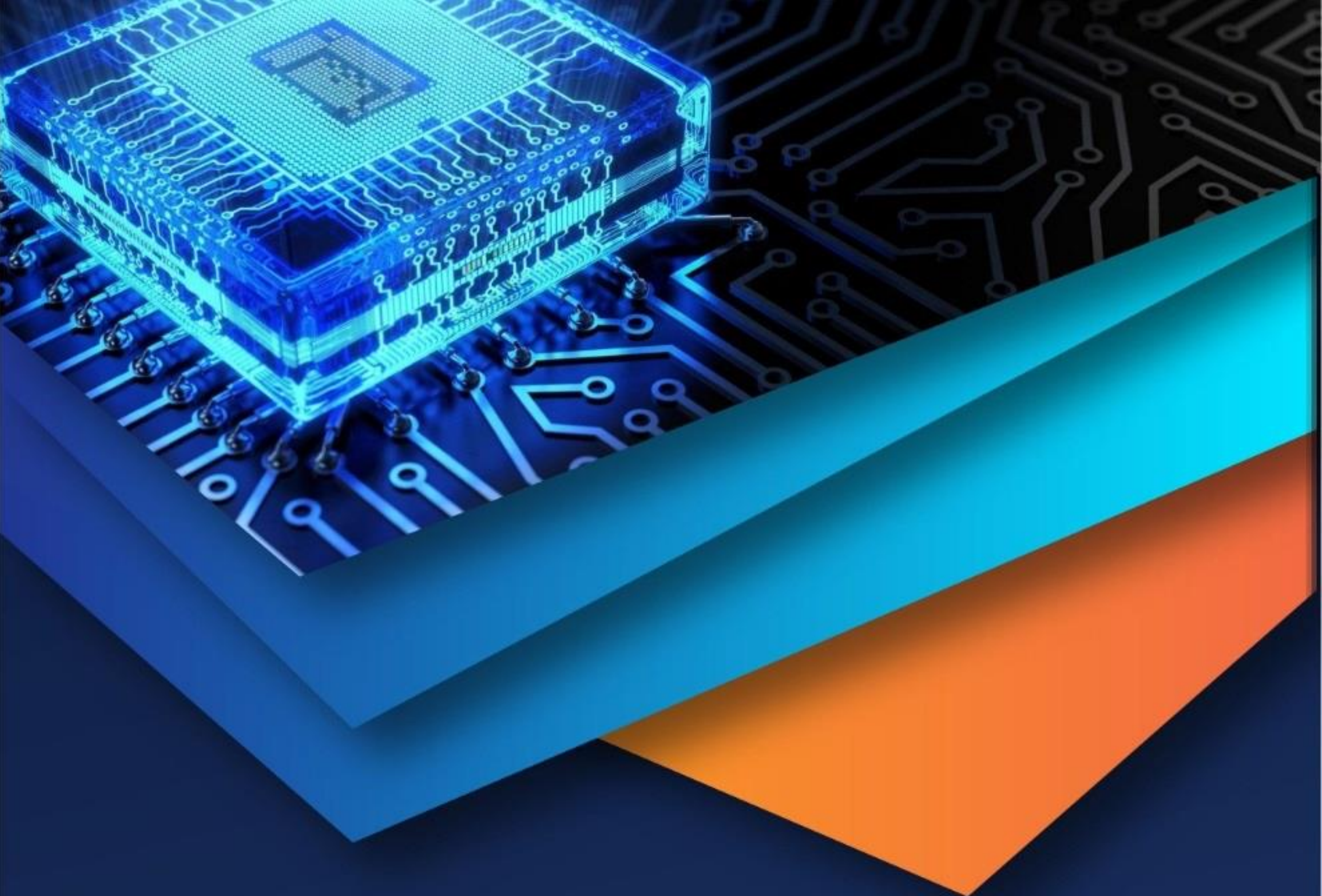
Fig.3: Installation of Solar Panel and light bulb

IX. CONCLUSION

A. It is complied solar panels which to replace ordinary asphalt street as it has better features.
B. It is also to produce electricity and heating elements.
C. It is designed with LED lights and sensor which able to act as traffic lines, road indicators, construction detours and streetlight for roadways.

REFERENCES

[1] Joseph Mages, "Examining the opportunities associated with solar roadways: Case study of interstate 95 in Baltimore".
[2] Andrew Northmore , "Innovative Pavement Design: Are solar Roads Feasible?"
[3] Ayushi Mehta, Neha Aggrawal, Anjali Tiwari, "Solar Roadways – The Future of Roadways".
[4] Alark A. Kulkarni, "Solar Roadways – Rebuilding our Infrastructure And Economy".
[5] Monalisa Hati, "Solar Roadways: An effort to make safe and smart highways".
[6] Scott Brusaw, "Solar roadway at TEDx – Ideas worth spreading".
[7] Andriopoulou Symeoni, MSc, Environmental Engineering and Sustainable Infrastructure, "A review on Energy harvesting from Roads".



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