Planning and Designing of Energy Efficient Parking Shed in Campus

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Abstract **- A car park is an empty area designated for parking a car. The term usually refers to a specific area with a durable or semi-permanent surface. In most places where two-wheeled vehicles are the dominant mode of transportation, parking is a feature of every city and suburban area. Shopping centers, educational institutions, sports stadiums, giant churches and similar places often have huge parking lots. In recent years, the increasing demand for electricity and electric power generation from fossil fuels is increasing day by day which leads to atmospheric environmental impacts from greenhouse gases and the high cost of electric power from these sources makes it unaffordable. The use of renewable energy sources can overcome this problem. Therefore, in this work, we present a solution by implementing solar car parking. Detailed work has been done to determine the location of the solar car parks and the maximum generation of solar electric power.**

Index Terms **- Solar Canopies, Carports, Asphalt pavement, Solar Parking, EV Stations, Parking Lots, Solar and Electric Vehicles, Environment friendly parking lot.**

INTRODUCTION

Renewable energy sources such as geothermal heat. tides, wind, and sunlight can be abundant in nature, and they can easily cope with the increasing demand for electrical power. The sun provides 174.000 TWh of electrical energy in the form of solar radiation to the upper level of the Earth's atmosphere which drops to 121,800 TWh at ground level. This power is roughly equivalent to one year's use of all human activities on Earth. Solar irradiance, which is a measure of solar energy for a given area, is 1.3 kWm above ground level. and 1000 Wm^2 at ground level. We can harness this solar radiation with a solar photovoltaic (PV) system that can replace primary generations of fossil fuels and does not require refueling.

Installing parking blinds on your property protects cars from unexpected weather and damage. Vehicle protection for parking lots should be durable and strong enough to withstand harsh winds, provide protection from UV rays, and be made of materials strong enough to withstand dust and rain. Among the three influences on parking lot design, traffic specifically, truck traffic-is by far the most crucial. A large commercial parking lot might allow for low-cost thinner pavement design if there is little or no truck traffic. However, most commercial operations have dedicated loading areas and roadways that must accommodate heavy, slow-moving loads. A typical parking lot plan will show two or three pavement sections, typically identified as "Heavy Duty-Traffic Class III," "Medium Duty-Traffic Class II" and "Light Duty-Traffic Class I." Investing time predicting vehicle loadings and traffic flow will allow a designer to accommodate actual expected traffic.

The engineer should base the paving design on the local soil types as well as local municipal rules and requirements. Soil testing of the site is an absolute necessity prior to design and Construction of the building and its surrounding car parks. For rehabilitation projects, soil borings are a major asset as they provide the existing pavement cross section and type, strength, and moisture of the underlying subbase. This will provide a historical look at what the pavement section was and how it performed (its service life) and is a great tool in designing the new section. The soil borings will identify structural loading capacity of the in-situ materials, possible groundwater issues, and the variance in soil structures across the site.

Adequate pavement drainage is of great importance to all pavement designs. Both surface and subsurface (groundwater) drainage must be considered. All drainage must be carefully designed and should be

installed in the construction process as early as is practicable.

LITERATURE REVIEW

In Frauenfeld, a city in Switzerland. 48 car parking lots for 4240 cars were analyzed for the installation of photovoltaic (PV) systems. A camera was used for taking pictures of the parking lots, and these pictures were merged into 360° panorama pictures. The number and orientation of these parking spaces were also calculated for the input in the "PV plant design software" by neglecting vertical shading elements, which can generate 5061 MWh annual energy for 15% heavier vehicles and 40% lightweight vehicles of the city. [1]

In a research, a series of experiments were carried out for sizing of car parking lots, solar energy potential of a car parking lot at a proposed site, and detailed shadow analysis from nearby buildings and trees. We performed the modeling of the detailed shadow analysis, losses, and annual generation by the Helioscope software developed by Folsom Labs. The study is performed in the following cases: Case 1. PV carport analysis without the shading effect of buildings and trees, Case 2. PV carport analysis with the shading effect of buildings and trees. After a detailed shadow analysis, the optimization of different car parking canopies is performed at different tilt angles for the maximum utilization of photovoltaic energy and maximum efficiency. [2]

Most pavement designs rely on traffic using the road when construction is complete. However, with the construction of car parks, the most congested traffic is with the majority of car parks being used during the construction phase. Once the parking lot is completed, the cars will be in the parking areas and the trucks or buses will be on designated driving lanes or ring roads. Therefore, the paving structure should be selected based on the construction movement and construction sequence. These berths are generally built-in phases. The first stage is the laying of sub-base and asphalt sub-layers on the prepared substrate or direct asphalt substrate application on the prepared substrate. Because of heavy trucks. pavement malfunctions are not unexpected. However, once construction is completed, these areas are repaired, and the final pavement surface laid. [3]

Vehicle entrances should be visible and easily identifiable. The minimum distance of entry/exits from corner intersections is at least 75 to 100 feet (preferably 150 feet), Entrances and exits should have clear lines of sight. It is preferable to enter a facility from a one-way street or by turning right from a two-way street and to exit a facility by turning right on a low-volume street. High traffic volumes and left turns can slow exiting and cause internal traffic backups. Consideration should be given to acceleration/deceleration lanes on busy streets. Gates should be located far enough away from the street to allow at least one vehicle behind the vehicle in the service position (at a ticket dispenser, card reader or cashier booth) without blocking the sidewalk. Entry/exit areas that have parking. control equipment should have a maximum 3% slope. It is very important to provide the appropriate number of entry/exit lanes to meet projected peak traffic volumes. The number of lanes is a function of user groups served, peak- hour traffic volumes, and service rates of the parking control equipment. It is recommended to have a parking professional prepare a lane and queuing analysis to guarantee sufficient. entry and exit capacities. [4]

A project is split into two parts, part I and part II. Part 1 describes the objective to design a low-cost, efficient. And economical solar powered canopy that also has electric vehicle charging capabilities with minimum interruption to traffic. Part I also breaks down those objectives into individual goals for the system. lists the challenges we faced. designing this system, and finally our solution for the objective. Part Il entails the hands-on section of the project. For the hands-on part we constructed a solar circuit composed of three 130-watt panels in series to charge two Nissan LEAF battery modules as a prototype for the proposed system. [5]

To achieve a low-cost structure, researcher must use the most cost-effective equipment available, such as solar panels and other equipment required. In order to reduce any maintenance costs, equipment that can increase return on investment (ROI) due to its durability must be utilized in system operation. Durability of the system also includes selecting the appropriate materials for supporting the solar canopies in all weather conditions. Using equipment readily available in the USA is another way cuts maintenance costs because there will be a better chance it is readily available and supported locally in case, we need product support. Readily available equipment and

supplies in the USA will better guarantee on-time or even shorter delivery times and allows us closer access to product support and maintenance if any problems shall occur. [6]

In a research paper it was recommended that the in-situ soil permeability infiltration rate is 12,5 mm per hour. However, 2,5 mm per hour is acceptable by suitably increasing the thickness of the stone reservoir course. In Jaipur, the infiltration rate of the local soil is significantly higher than 12.5 mm per hour. Soil investigations should be carried out by boring and/or test pit to test for permeability. determining the depth of high-water table and determining depth to bedrock. Porous asphalt pavement is not suitable if (a) local soil is clayey: (b) bedrock is close to pavement; and (c) location has high water table. Also, porous asphalt pavement should not be constructed at a location subjected to blowing sand. That is, the adjacent ground should either be paved or covered with grass. Compacted stone reservoir layer should be placed directly on natural soil subgrade (bed) because fill is not recommended. Although a flat soil bed is preferred. slope of natural soil bed should be limited to 5 percent. This would ensure that water at the. bottom of stone reservoir layer does not flow; rather it percolates downwards. If the slope is steeper, a terraced king lot can be considered. [7]

Electrical vehicle charging That is about charging by, on, or of humans. We are not talking of such charging here. We are unfortunately talking of charging up of inanimate battery driven electric objects, and primarily, vehicles. With the advent of technology, more and more of such devices are either carrying us or being carried by us. These devices range from aircraft to electric vehicles (EVS), to laptops to handy mobile phones. This situation demands pay-charging stations should be available by the roadside and in other public places. [8]

Electric Vehicle Supply Equipment (EVSE) Charging stations normally derive their power from the grid. But increasingly, renewable source charging stations including solar charging station are becoming popular. The reasons include their low carbon footprint. and of course, fast reducing cost. Standardization Just as the same gas nozzle fits all vehicles. similarly, the same power outlet should be able to supply all vehicles. [9]

METHODOLOGY

At first, large and rectangular shaped sites are ideal for parking structures. Although flat sites are generally more economical to develop, sloped sites can provide design opportunities such as access on different levels and/or no ramping between levels.

Then next. Site Survey - a topographic survey of the site is a very important precursor to develop a conceptual plan. The site survey should delineate property lines, easements, and utility lines. Site Slope - The topographic information will define the slope of the site. Sometimes the slope of a site can utilized to reduce internal ramping in a parking structure. resulting in significantly lower costs (however, this should be weighed against operational concerns created by the inability to circulate within the structure).

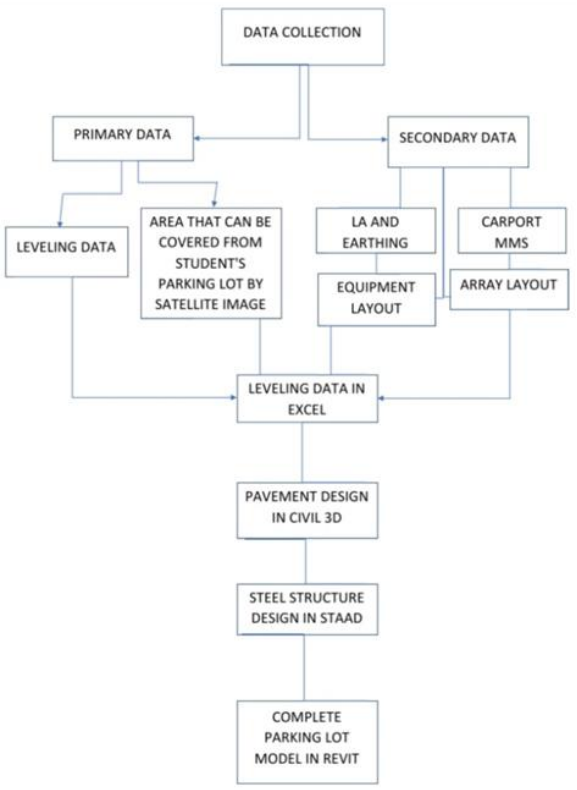
When the subgrade is extremely poor (clayey, highly plastic, or incompatible), it may be necessary to remove the upper portion of the subgrade and replace it with select material when the subgrade is weak due to excess moisture, consider or more these techniques: Stabilize subgrade with a binding agent. Install underdrains to remove excess water. Remove the subgrade. dry it through reworking, return it to place, and recompact it and remove and replace the subgrade with a stronger material. The remediated layer can be further stabilized with a fabric prior to placing the next pavement layer, or the next pavement layers can be made thicker. Proper drainage is best addressed in advance. detailed in the section Drainage Provisions below. Verify the success of the reworked areas with a second proof roll.

A parking structure that is built into a hillside can also reduce the visual mass of the facility. Geotechnical & Soils - Obtaining a soils report with sample borings and geotechnical analysis early in the design process is prudent. If soils with poor bearing capacity are present on the site, the added cost for structural foundations can be significant.

The solar canopy system not only needs to be efficient, but it also needs to have the ability to withstand any toughest weather conditions. The design of the canopy is a is a mixture of a couple of different factors: safety, efficiency, and style. Safety is the first priority. Without safety at the core, the project would have very little real-world applicability if civilian lives are at an increased risk using our system. We started our analysis of the solar canopy structure with a top-down approach. We had to calculate out first how much wind

load the solar canopy would have to withstand. The next step was to figure out the materials we would need for the solar canopy structure. We utilized the Steel Construction Manuel to find the types of steel beams we should use to support the solar panels. We had three factors to think about when we are doing these cases. The dead load. live load, and wind load are all things we considered.

Methodology Flow Chart:



CONCLUSION

This study indicated that the combination of hydro acoustics, GPS, and GIS are capable of producing bed 6. elevations maps comparable in accuracy and quality to traditional surveying method. A key difference between the traditional and GIS analysis approaches is that the GIS approach calculates sediment volumes over the entire reservoir area by comparing digital surfaces, whereas the traditional approach applies an average area method to calculate volumes based on a 7. limited number of cross sections. A future benefit of the GIS analysis approach will be the ability to view time perspective of sediment change and support automated sedimentation analysis. However, certain issues and problems were recognized during this study

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