

Engineering essay samples

[Environment](#), [Electricity](#)



Design Evaluation

Q.- Add the appropriate headings, highlight, and move paragraphs according to appropriate flow. The final product should look just as it would appear on a proposal.

4. 0 Design Evaluation

After deciding the target performance characteristics of the vehicle, the team selected components that work together to deliver this intended performance. The following text details the rationale for the component selection, simulations that estimate the range per charge for the proposed vehicle and a volume analysis ensuring the components fit within available chassis space.

4. 1 Part Selection Criteria

4. 1. 1 Electric Motor

The team strove to find an electric motor that would meet or exceed the requirements of the client and stakeholders. After researching various electric motors, the team determined that a choice between a hub motor design or mid-mounted motor design must be made.

The hub motor is beneficial to the design because it does not occupy space in the chassis, leaving more room for other necessary electrical components. The hub motor also does not require a transmission or chain drive to transfer the power; the power is transferred to the wheel directly. The hub motor reduces power losses due to friction from mechanical interchange which allows for greater overall efficiency. The weight of a hub motor is less than the weight of a mid-mounted motor and transmission. The vehicle's performance benefits from the higher power to weight ratio. Despite the

benefits of a hub motor design, there are multiple drawbacks.

The hub motor lacks adaptability to different driving conditions because it does not offer an option to change gearing. Using a hub motor also increases unsprung weight over the rear wheel. Unsprung weight refers to the amount of weight on a vehicle that is not supported by the suspension components of the vehicle [#]. Since this weight is not supported by the suspension components, the motor will feel every road discontinuity and transmit this energy directly to the chassis of the motorcycle. This can cause detrimental handling and ride characteristics to the vehicle. To counteract the detrimental handling and ride characteristics, the team intends to alter suspension settings from the factory bike. The team hopes that with suspension adjustment, most of the handling and ride characteristics of the stock bike can be obtained. Figure 5 is an illustration of a hub motor mounted inside of a rim and tire combination.

The mid-mounted motor design offers improved performance compared to a hub motor, and is adaptable to different driving conditions through a transmission [#]. Although having the ability to change gears helps with high load situations, the added weight of a transmission and chain drive assembly decreases performance of the motorcycle by causing a lower power to weight ratio. The motor requires a significant amount of space in the chassis of the motorcycle, taking up crucial room for batteries and other electrical components. Replacing a mid-mounted versus a hub motor is more difficult considering that it is mounted in the chassis instead of on the rear wheel. If the motor prematurely fails, this could cause the owner to bring the bike to a specialized mechanic for replacement, which would reduce the user

serviceability of the motorcycle and increase running costs.

After comparing the benefits and disadvantages of the motor placement options, the choice was made to use a hub motor for the final design. Table 4 shows a comparison of the hub motor and mid-mounted motor designs with respect to important design considerations.

4. 1. 2 Battery

Based on the motor selection for the retrofit kit, 72V was determined as the system voltage for an appropriate power output. The original battery types being considered for this project were Lead Acid, Nickel Cadmium, and Lithium-ion. After brief market research using Alibaba. com, it became obvious that EV batteries are almost exclusively Lithium-ion batteries. Within the category of Lithium batteries, there are numerous types of cathodes available [#]. Lithium Iron Phosphate (LiFePO_4) cathodes are one of the safest in the situation of battery management system failure. Phosphate batteries offer comparatively longer cycle lives with a small tradeoff for energy density. Based on safety, wide availability, and long life cycles, the LiFePO_4 cathode was chosen for the retrofit kit application.

Selecting a battery for the EV retrofit was a logical elimination process. Using the objectives mentioned in Section 2. 2, specifically maximizing range per charge of the vehicle, in addition to task-specific goals of maximizing energy and power density, low maintenance, and maximizing service life, an elimination process is summarized in Figure 6.

The capacity of the battery is designated by most manufacturers using units of Amp-hours. The main criteria dictating capacity selection was the weight of the battery. To maintain a similar curb weight to that of the Kawasaki

Ninja 250R, a 50Ah battery was selected for its weight of 50kg [#]. Assuming that capacity varies 1: 1 with weight, larger capacity batteries were not feasible to maintain a curb weight within the rated range of the hub motor [#].

A volume analysis for the battery is performed in Section 4. 3. 2 based on the manufacturers default dimensions with a low-cost iron casing, proving that the chosen battery can fit in the motorcycle chassis as-is.

4. 1. 3 Controller

When selecting a controller for the electric vehicle, the team strove to find a controller that could deliver voltages and currents commensurate with satisfactory vehicle performance, as well as safety features to protect end users. The primary rationale for choosing the Kelly controller was due to the thorough documentation available for the controller. While there were more inexpensive selections, the Kelly controller is a U. S. designed, Chinese manufactured controller with proven industrial capabilities. Choosing a controller, sight unseen, with limited documentation and no proven industrial capabilities is an unwise decision for a team with limited financial resources. After finding a company that met the standards of quality required for the design, the team selected a controller from their catalog that meets the demands of the electric vehicle design. The team strove to find an item that is compatible with the battery and motor selection. The motor is rated at 6kW, and the battery supplies 72V of potential difference. With these values in mind, the team decided on the KEB72601X brushless e-bike controller (Figure 7) [#].