SITE REDESIGN OF CROZET ELEMENTARY

HARMFUL EMISSIONS: HOW DIESEL FUELED SCHOOL BUSES ARE HARMING STUDENTS

A Thesis Prospectus
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On my honor as a University student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments.

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Introduction

Dramatic change has been occurring in the transportation sector throughout the world. The introduction of the electric vehicle has allowed for individuals to traverse long distances in an environmentally safe manner with specifications for these vehicles being similar, if not better, than the traditional gas-powered vehicles. In recent years, the spotlight has been on larger vehicles to follow the same transition and school buses are no exception. Debates have risen whether these diesel-powered school buses do more harm than good (Skibell, 2021). On one hand, they're economically cheaper and allow school districts to employ more school buses which allow the opportunity for more students to ride the bus. However, many parents have been concerned with pollution levels both outside and inside of these buses. Since site design and transportation policy are huge components of the issue at hand, both arguments will be investigated in the context of emission controversies. This will allow further analysis in how to achieve an economically and safe implementation of mass transportation regarding the educational sector. The structure of this prospectus begins with the technical research problem, flows into the overarching STS topic, and finishes with the key texts that will be utilized to articulate the research.

Technical Research Problem

Crozet Elementary School is constructing an additional academic wing in order to increase their capacity for an anticipated rise in student population. With this, there is an anticipated increase in vehicular presence on both the main road and on school premises. The main road, Crozet Ave. is also a VDOT road that many individuals use to get to and from work on a daily basis. Therefore, it is critical to redesign the site in a manner that will allow traffic to flow smoothly while also considering student safety. The presence of not just standard cars in this area, but also school buses and pedestrians will have to be considered in a way that mitigates the number of clash points on site as well as on Crozet Ave. Ideally, Crozet Elementary would be redesigned in a manner that is economically feasible and safe while accommodating pedestrians, school buses, and vehicles in a manner that will mitigate any impact created on the main road.

The focus of this project is to redesign the site in order to improve traffic flow on site. Due to the complexity of this problem, direct changes to the main road will not be done by our team but will be assumed to be done by a traffic engineer working in hand with us. However, Crozet Ave. is still to be considered when redesigning the site and any changes (i.e., proposing another entrance or exit) will have to adhere to VDOT standards. The design team will analyze best practices from other schools throughout the United States focusing on how vehicular and school bus traffic are separated to inspire design ideas for Crozet Elementary.

Proposed designs will have to adhere to a number of constraints laid out by the county board members of Albemarle County. For starters, the bus and car circulation on site are to be separated. This is to ensure safety of students while also allowing for less clash points. The site must also incorporate any stormwater requirements into a play area to ensure that students can play around the BMPs and so that teachers can use them to teach students about stormwater management techniques. The site must also include 12 bus spaces and a total of 136 parking spaces. From these 135 parking spots, a minimum of 5 handicap parking spots will have to be created such that compliance with Albemarle County codes is met. Consequently, the site must also be reconfigured in a manner that will allow capacity for the flow of all these vehicles the site will hold. Finally, any design created by the design team should maintain the footprint of the existing soccer field. Reconstructing the soccer field and potentially moving is economically unfeasible and thus, it is expected to not be touched at all.

A full set of construction documents that will allow a contractor to enact site changes are to be created in order to communicate design solution alternatives and ensure feasibility of the proposed design. These include, but are not limited to, site grading plans, stormwater management plans, erosion & sediment control plans, and utility plans. These set of plans will help communicate the physical characteristics of the proposed design and allow for construction to take place. Cut and Fill reports will also be generated to give the contractor an idea of how the site will be altered. The software used to generate these plans will be Civil 3D, though a number of the calculations done will be generated by hand.

STS Research Problem

Research Question:

School buses are an essential mode of transportation for students within the United States and currently, more than half of the pre-high school student population rides the bus to and from school (Keenan, 2021). While these diesel-powered school buses are a staple to society, their diesel fuels are composed of very fine particles of carbon and a mixture of toxic gases that when released, expose harmful emissions to both the environment and student health. These harmful emissions include particulate matter, which can be devastating to the pulmonary and cardiovascular systems (Jacobson, 2002). Upon dismissal of most schools, many students do not report immediately onto the buses; most hang around near buses as they talk with friends before the final call to get onto the buses. As these younger students have a faster breathing rate than an average adult and whose lungs are not fully developed, they are especially susceptible to these negative impacts on health especially when exposed for prolonged periods.

Electric School buses are what many of the community has been pushing for. These low emission buses significantly reduce greenhouse gas emissions compared to diesel school buses and provide lower maintenance cost (Casale, 2022). However, the main barrier to the immediate implementation of these buses is cost. A standard electric school bus costs roughly three times more than those with internal combustion engines in front costs and while the savings help make it manageable, many counties have been hesitant in pursuing this alternative. The high upfront costs and the spread-out savings have made this option unappealing to most counties.

The following research revolves around the overarching question of how engineers and/or planners can improve the safety and quality of air in local communities. Rather than strictly focusing on the technical side of the issue at hand, this research will mainly focus on how engineers and planners can push for certain policies within projects to ensure that negative effects are mitigated. The following research explores different perspectives on how to best improve the safety of students and quality of air in communities while taking local perspectives into consideration.

The Bidirectional Act was recently approved and has helped boost the transition to electric school bus deployment (Johnson, 2022). However, this recent infrastructure package

proposed by the Senate and the White house offers less funding than many had hoped for. There is fear that because there is little federal cash incentive that the transition may stall and even disproportionally be distributed leaving low-income areas behind. Further research will be done on similar case studies where counties or countries were given grants to help with pollution problems and were not addressed effectively. As there is minimal pressure from the government to enforce this transition, counties are given the option to either pursue an electric or low emission form of school bus transportation. One specific case would be Anne Arundel County where the federal government granted the Maryland Transit Administration $1,890,000 to in helping transition to low or no emission school buses. As the grant is vague in what the money can be used for and low, the county pursued a hybrid electric & diesel bus. These hybrid buses emit roughly 1.06 grams of NO_X per mile (Ranganathan, 2005). Albeit they are lower, this still poses a threat to student health and wellbeing of the community overall. While this is a step in the right direction, the issue has not been erased but rather reduced.

Relevant Social Groups

As engineers and planners, the safety of the overlying community where a technological artifact is placed is a core principle. However, unlike cost, this is very subjective and varies from place to place. Safety measures cost money and most planners and/or clients go through loopholes to get by and save themselves money. Two of the biggest contributors to harmful emissions on school sites are site design and neglecting community feedback. Considering feedback from the community can help alleviate a lot of the issues with the usages of the proposed technological artifact and can help reconfigure the design in a manner that encompasses the values in either legislation or policies to enforce it. In regard to harmful emissions from school buses, a common key factor to the issue is the arrangement of buses during drop off and pickups. To save space, most buses are stacked in rows with buses behind one another. This arrangement exposes students traversing in between buses to harmful emissions that can impact their health long term. In the case of school bus emissions, engineers can help push or advise the client of measures to help mitigate the issues with these harmful emissions.

The issue at hand involves much more than those that are on school premises. A multitude of individuals are affected by the decisions engineers and/or planners make regarding

the designs and policies they pursue for the reconfiguration of school layouts. For starters, the most impacted groups are the students and faculty. As mentioned earlier, prolonged impacts to these toxic gases from the school buses can hinder the long-term health of these adolescents. In regard to faculty, more individuals have to be put on dismissal duties especially when buses are stacked in rows due to lack of visibility. Finally, the surrounding community is also impacted by the design configurations and specifications of engineers and planners. These toxic gases are not restricted to only on school premises, but travel with the buses as they traverse to drop off students. This impairs air quality and subsequently hinders the greater community health.

Methods & Data Collection:

Infrastructure changes and site redesigns are a significant part of the improvement process of air quality and student health. As schools are redesigned to accommodate more cars and buses, sites are redesigned to mitigate clashes and hold the increased capacity. Therefore, further research on case studies of the configuration of buses in impacting student health will be conducted to evaluate conflicting interests in the expansion of infrastructure. These case studies will be utilized to analyze the framework of the school board members, faculty, engineers, planners, and community members. From this, I will be able to identify repeated conflicts of interest and provide a deeper understanding of how site design can harm student health and wellbeing. In order to analyze both sides of the argument, I will also look at case studies where a firm had a limited budget or limited terrain as well as case studies where students were negatively impacted because of the toxic emissions they breathed.

Key Texts

In order to adequately assess the issue at hand, a multitude of texts will be analyzed to articulate both side of the argument. These texts examined will range from law cases to news reports.

For starters, I will be thoroughly analyzing the court case Dean v. Utica Community Schools regarding the overarching issue that diesel buses pose on student health. In this court case, a federal judge rejected censorship of a Michigan high school's student newspaper in which they analyzed a lawsuit against the school that claimed that the diesel-powered school buses

proved to be a nuisance to their living (Dean v. Utica, 2004). This case will help analyze how individuals in higher positions can influence public perception in regard to limiting awareness of issues at hand.

The next case I will be analyzing will be the court case Reynolds v. Board of Education of Prince George's City. In this court case, the appellant, who was a bus driver for the county, applied for accidental disability retirement benefits as a result of prolonged exposure to diesel fuel and fumes (Reynolds v. Board of Education of Prince George's Cty, 1999). However, the medical board established by the board of trustees denied him and instead granted ordinary disability retirement benefits as a result of the appellant having a pre-existing health condition, but the appellant applied for judicial review. This court case will be analyzed to see how prolonged effects to these harmful gases can impact the overall health even if inside the school buses.

An article I will be analyzing will be a cost benefit analysis of Vehicle to Grid electric school buses in regard to traditional diesel school buses. The analysis argues that vehicle to grid electric school buses may seem expensive because of their high upfront costs but ultimately end up saving counties a lot of money throughout their life cycle that makes them a smart investment. It also analyzes the harmful consequences of diesel school buses in regard to noise pollution and health effects on an individual which will further help argue against diesel school buses.

Overall Conclusion

Upon assessing case studies of school bus emission controversies regarding conflicting interests between engineers, planners, and the surrounding community, there will be a better understanding of how to improve safety and protect the wellbeing of the students. In addition, the research seeks to develop a way for planners and engineers to push for a greener method of infrastructure through faculty perspectives and thus, mitigating the issues with school reconfigurations. It is important to note that this research does not serve as a means to create a solution to the air pollution occurring in society, but rather as a means to explore how influential engineers and/or planners can be through their designs & policies pursued.

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