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### AGA Essay Prompt #2

When considering what product the Department of Transportation should specify regarding their roadway's guardrails, there is no better option than hot-dip galvanized steel for several important reasons. These include but are not limited to: the low up-front cost, low life-time cost, exceptional recyclability, and overall superior resilience. With unprotected steel, it has the strength required for a guardrail system, but the primary downfall is its susceptibility to corrosion. Therefore, if this unprotected material were to be used along the highway where it will be exposed to numerous environmental hazards, the steel would ultimately degrade within 5-10 years. This is not appropriate for such an important safety device. In this application, the product is used as a life-saving measure along the road, meaning if anything were to weaken the steel's structural integrity, someone could be seriously injured or possibly lose their life. This is a major consideration to make selecting the proper steel components for the highway guardrails. The galvanizing process also protects the steel from physical damages such as a vehicle veering into the guardrails while driving and physically damaging the steel. This collision would leave less damage structurally to the steel because of the chemically bonded zinc coating which protects the steel's external surface.

This superior strength allows for hot-dipped galvanized steel to be reused after decades of use and this reuse could be for nearly anything depending on its condition and future use. An example would be if the guardrails were to be dismantled and used along a different highway or road in which they could be easily reinstalled without worrying about the integrity of the steel.

This could mean that if in the future, the highway were to be rerouted or expanded, no additional products (guardrails) would be purchased. This money would be saved and spent on another expense to enhance or maintain the DOT property. Another example is if the guardrails were taken out permanently, they could live on elsewhere such as in another city or as possible art. The steel could easily be resold for a profit as well. The money earned could be allocated into funding other civil projects. One more relevant example utilizing the guardrails in the same manner would be donating the components to other state governments for city or state parks in the area. This could allow for said parks to provide a safer experience for visitors and additionally this could positively impact the image of the Department of Transportation painting their image as an entity that cares for the other branches of government and those visiting the parks. The possibilities are quite endless with hot-dipped galvanized steel regarding adaptive reuse.

As mentioned, the cost of installation with hot-dip galvanized steel is rather low due the competitive pricing seen throughout the past 10-15 years giving galvanized steel a consistently low price. The rather long lifespan of the product is another justifiable reason to specify hot-dipped galvanized steel. After installation, along a highway in this case, which is typically a rural environment, galvanized steel with a rather thin coating of zinc (~1mm) can survive up to 30 years of exposure to the elements and its longevity only increasing with a thicker zinc coating. If the guardrails were specified to have a ~2.5mm coating, the steel would be expected to survive nearly 80 years. Regarding an accurate cost estimation for a 50-year lifespan, the 100 miles requiring guardrails would cost ~\$1.76 per sq. ft. Painted then galvanized steel for the same quantity would cost ~\$5.51 per sq. ft. with a 6mm zinc coating. This totals around an 85% of savings in purely material costs. The savings provided by choosing the properly rated galvanized

steel components would lead to a greatly reduced cost of the project compared to a non-galvanized or even painted steel or other metal. Unlike painted metals, the zinc coating does not need to be reapplied or touched up with age. This greatly reduces cost from expected maintenance with labor and possible part replacement. The zinc coating also provides a natural



Figure 1: Natural Patina of Galvanized Steel

patina resulting in a matte finish (Fig. 1) which may increase the visual longevity of the project and keep the product looking as good as it was on the day of installation. If proper maintenance procedures are followed after a painted

steel alternative is selected, then the price would be expected to increase nearly 470%. This increase is considering the recommended repainting on the 19<sup>th</sup>, 25<sup>th</sup>, and 34<sup>th</sup> year after initial installation to provide proper protection for the material along the highway system. The

cumulative cost for this maintenance is estimated to be \$25.88 per sq. ft. If hot-dipped galvanized steel were chosen, the starting cost for material alone is ~\$18,656 where-as painted steel is 313% more expensive, costing ~\$58,374. Figures 2, 3, and 4 shows that even less than 2 years after installation, painted steel does not hold up in regard to quality of finish



Figure 3: Paint Removed from Top of Rail



Figure 2: Paint Removed from Bottom of Rail

as galvanized steel installed at the same time (Fig. 1). By choosing hot-dipped galvanized steel, the Department of Transportation would be saving a considerable amount of taxpayer's money and providing more opportunities to maintain upkeep on the roadways. These possible opportunities include but are not limited to: potholes, eroding shoulders, degrading signage, and greenspace improvements.

Another important factor to consider when installing the properly specified hot-dipped galvanized steel, is that in the event of rain or other weather-related occurrences, workers would still be capable of installing the guardrail or even storing them on-site to



*Figure 4: Paint Removed from Center of Rail*

finish at a later date. The galvanizing process eliminates the concern of possible material corrosion or weakened structural integrity when left outside in the environment in the midst of construction. This means, if the jobsite must be vacated, money is still being saved by eliminating labor costs for covering or moving the material to a safer location.

Regarding the visual superiority of hot-dipped galvanized steel, this product will stand apart from the competition. As mentioned, by choosing hot-dipped galvanized steel, the need for repeated maintenance required to touch up the product is practically non-existent. The need to clean the steel is something that would not be a concern as well due to the zinc coating repelling any chemicals or pollutants from the highway that might come into contact with the guardrails. The inconspicuous matte patina would also reduce the risk to drivers experiencing a possibly dangerous glare from the sun's reflection from the guardrails (Fig. 5 & 6). This matte finish also allows the product to blend into the landscape and provide highway users with a much more

scenic experience. The experience of a scenic route could have other benefits including a better mental and emotional state of drivers which, in turn, creates a safer environment for all of those using the highway as well, including wildlife.

By choosing hot-dipped galvanized steel, not only are the sources possibly more local and allow for lower costs compared to painting, but the Department of Transportation would be helping to provide jobs for the workers operating in a galvanizing plant. This is a possibly dangerous



*Figure 5: Natural Patina of Galvanized Steel Guardrail*



*Figure 6: Natural Patina of Galvanized Steel Guardrail and Components*

profession regarding exposure to extreme temperatures and heavy metals and choosing their work means to allow them to prosper as workers and individuals.

These reasons why the Department of Transportation should highly consider specifying and using hot-dipped galvanized steel for the highway renovation make the superiority of this product clearly evident. With significantly lower pricing, maintenance costs, and the high probability of reuse, this material is the proper way to go in order to reduce the budget for the project as well as to create a lesser impact on the environment through conscious design choices. Ultimately, the Department of Transportation cannot go wrong with selecting a locally manufactured galvanized guardrail product that will stimulate local economy and better the lives of those involved in the manufacturing process and the users of the highway system.