Portable Electron Beam Applications

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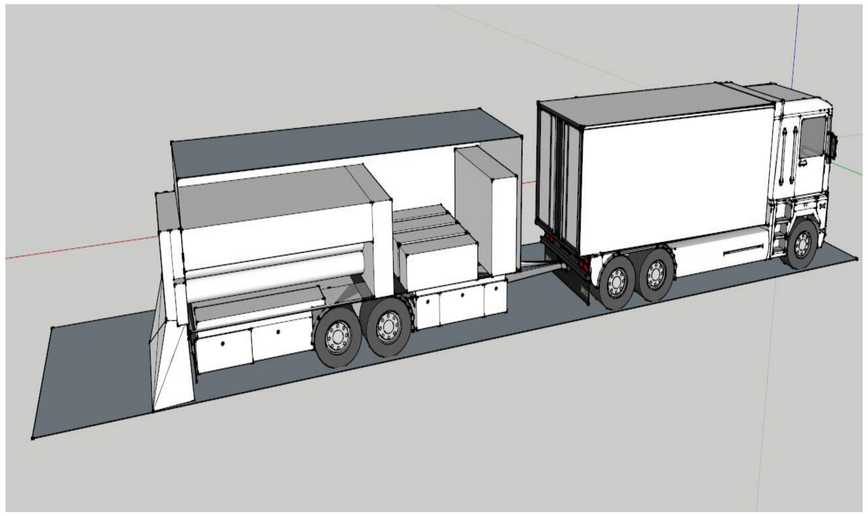
Background Information

Fermilab has developed a concept for truck-mounted electron accelerators that can be used to treat pavement. This treatment turns the pavement into a tougher, longer-lasting material, significantly extending the life of our roads. In addition to the cost savings and improved safety of roads, truck-mounted accelerators can also be used for high-quality pothole repair even on the coldest of winter days. This could lead to a new industry with hundreds of millions, or even billions, per year in sales and service.

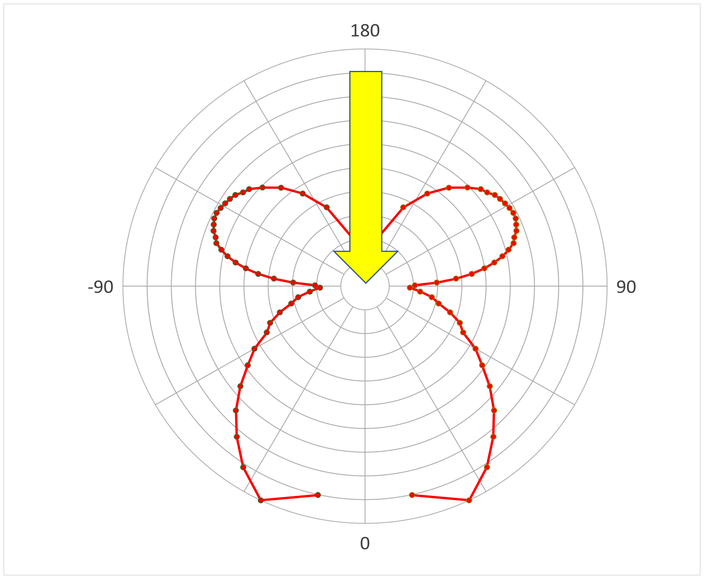


Initial Model taken from Fermi Lab

Radiation Shielding

X-rays will be produced as a byproduct from using the electron beam and proper shielding must be implemented. Gathering data from a simulation conducted by Thomas Kroc, the intensity and direction of the beam can be seen, and proper shielding can be implemented at the specific locations in the system.

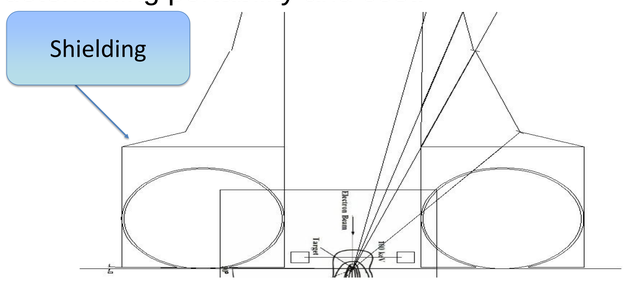
The thickness of the shielding material can be based off the intensity of the beam at the certain location. By observing the figure below, the most intense beams happen to be at a 30-degree angle from the source.



Polar Plot Displaying Intensity & Direction of Beam

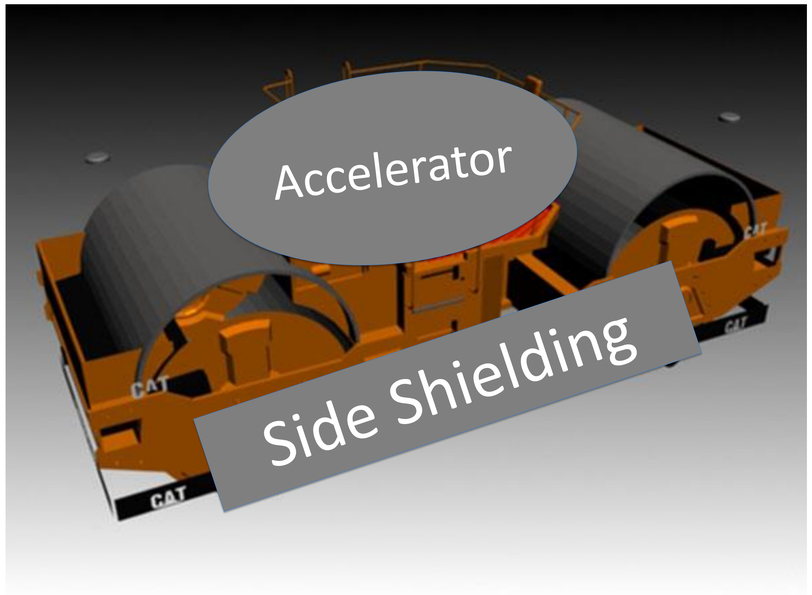
Materials

Steel was found to be the best building material to use for shielding. It has the best combination of cost efficiency and radiation shielding from the x-rays produced by the electron accelerator. It was calculated that in order to achieve a radiation dose of <.25mR/h, approximately 85cm of steel is needed given a person is 10m away from the source. This would make the system extremely heavy which can be a big factor in determining portability and cost.



Design and Possible AI Integrations

The overall design contrary to the image previously shown, will be a modified roller compactor. An already existing roller compactor will be taken and transformed in a way that the electron accelerator will be vertical and pointing downward towards the pavement. A minimum of 12 inches of space is required between the rollers to allow for the beam to pass through without interference. Rollers are expected to be 36-inches in diameter and weigh approximately 12.5 tones each. The overall system is estimated to weigh slightly over 50 tones which will need a special permission from the U.S. Department of Transportation.



New Design

Controlling the system remotely would be a great way to eliminate the immediate problem of having a person exposed to radiation. By programming the system to follow the best possible path, a set perimeter can be set beforehand prohibiting anyone from entering thus reducing the weight and cost of the system.

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