

# Comparative Space Saving Highway Interchange Design

Dr. Lane Ranger<sup>1</sup> and Dr. Mercedes Park<sup>2</sup>

<sup>1</sup> Department of Post-Jungian Road Studies Cranberry-Lemon University, Pittsburgh, PA, USA

<sup>2</sup> Director of the Center for Asphalt Excellence Cranberry-Lemon University, Pittsburgh, PA, USA

## Abstract

The vast majority of American Highways, on/off ramps, and interchanges have been designed for 1950s automobile technology and construction techniques only consisting of concrete and rebar. Due to the advent of cars with some 'Get Up and Go' for cool dads and even cooler stepmom's, the large horizontal-overpass interchanges are now unnecessary, particularly with the raw acceleration power of the electric vehicle. These traditional interchange designs not only take up too much space in an urbanized world, but they create endless traffic. This paper proposes and tests four alternative interchange designs to include a Hot-Wheels style vertical loop, an adaption of an MC Escher Drawing, a Mobius Strip, and an interdimensional portal. The study found that the new interchanges destroyed 99% of the vehicles and the technology will likely require a some maturation process before being integrated into a modern highway.

Keywords: Civil Engineering, Highways, Construction, Interchanges, Topology, Interdimensional Travel, M.C. Escher

## 1. Introduction

Highway interchanges often occur in the heart of a densely packed city. Despite city's land constraints, they are still constructed with 100-year-old technology and topological techniques for the speed of 80-year-old automobiles. Like many infrastructure fields of engineering, highway on-ramp architecture is a stale field whose biggest advance in the last fifty years has been the alternating merge lights and musical rumble strips [1]. By putting the word Smart in front of concrete and thinking outside the box, this paper has devised innovative solutions such as; vertical loops, distributed infinite on-ramps, and other complex shapes using Smart Concrete, a material we believe will solve all structural issues.

Smart Concrete is an ultra-dense material that is infused with nano-magnetic particles and controlled by a system of hyper-intelligent micro-robots called Magitrons [2] who interact with nano-magnetic material in the concrete and rebar. Once the material is set into a phase-lock array and the Magitrons are safe from attack from their sworn enemies the Omegatrons (a race of nano-robots who hate infrastructure) [3], a structure invulnerable to becoming overloaded.

## 2. Designs

Smart concrete is not only a phrase used to sell more concrete and software upgrades [4], but also a material used to ignore physical constraints to avoid drawing a countless number of free body diagrams. By using this material, we were

able to fire a dozen mechanical engineers on our team who told us our new onramps were a stupid idea [5].

### 2.1 Vertical Loop

The first space saving technique is a Hot Wheels style vertical loop. According to our calculations, normal highway speeds of 140mph [6-9] should be sufficient for a car to maintain friction against a 150-300ft vertical loop with the hope that there is no air resistance and the driver knows the Anti-G Straining Maneuver and are adequately hydrated. This interchange design is expected to simultaneously use 80% less space and keep all the slow drivers off the highway.



Figure 1: Vertical Loop Onramp

### 2.2 The Labyrinth: an MC Escher Design

Next, an array of M.C. Escher drawings were adapted into a schematic for even more interchange ramps. This design, nicknamed *The Labyrinth* combines a play on perspective and a general disregard for physics to fit as many ramps into a dense area as humanly possible. Using advanced vehicle navigation, we believe for the first time since the original concept [10], drivers won't get lost in *The Labyrinth* without deciphering the confusing signs and turn-only lanes.



Figure 2: *The Labyrinth*

### 2.3 Mobius Strip Design

Next, the vertical loop was adapted to ask, what if we want the car to be upside down on the other side of the on-ramp, an issue facing highway design and construction every day [11]. By twisting the loop in midair into a Mobius Strip before merging back down onto the highway, this problem is solved. Some concerns for the safety of the Mobius Strip design and a vehicles centripetal force flinging them off the road at highway speeds will likely be solved with probably magnets.



Figure 3: Mobius Strip Design

### 2.4 Inter Dimensional Portal

Finally, by bombarding a few grams of Tritium with enough lasers [12], a fast-acting inter-dimensional portal may be integrated into highway on-ramps to redirect traffic in any possible location or direction. Due to the limited amount of Tritium in the world [13] and the eye safety issues of using powerful lasers in such a public setting, vehicles can only be redirected by hundreds of feet in any direction making it a perfect application for highway on-ramp design. We recommend everyone wear titanium laser eye protection while driving through the portal.



Figure 4: Inter Dimensional Portal

## 3. Results and Discussion

Each design was integrated in a normal every day American town on an unsuspecting intersection at the highway interchange near Cranberry Lemon University shortly before the 2023 graduation ceremony for additional data. In case vehicles could not achieve the required speed for each interchange, speed boosts in the form of arrows of flashing lights were installed in each lane. As long as no one was driving on the shoulder, each speed boost will apply a x2 Speed increase on any unsuspecting traffic. Once the data was cleaned of all the cars who sped into each other following the boost, clearly outliers, the results for the traffic reduction and interchange safety can be seen in table 1.

	Space Used (Football Fields)	Traffic Reduction	Accidents per 10,000
Clover Leaf	2.8	--	1.2
Vertical Loop	0.4	$-\infty$	9,999
The Labyrinth	1.2	$-\infty$	10,000
Mobius Strip	0.3	$-\infty$	9,999
Inter Dimensional Portal	0.8	-12%	3,823

Table 1: Interchange Results

As intended, each design decreased the space used at each interchange significantly with the Mobius Strip using 1.5 less football Fields than the standard Clover! Even more exciting, the Smart Concrete Held! Unfortunately, that's where the positive results ended.

In terms of decreasing the amount of traffic, measured by a proportional change to the clover leaf design, each new interchange could have increased traffic by either positive or negative  $\infty$  as there were zero vehicles that made it through the loop, *The Labyrinth*, and the Mobius Strip so the metric involved some divide by zero issues. We chose negative  $\infty$  after a group discussion and some talk about limits.

While the majority of vehicles were able to make it through the Inter Dimensional portal, nearly all vehicles either got lost in *The Labyrinth* or flew off the edges of the Vertical Loop and Mobius Strip with the exception of a local motorcyclist. We didn't catch the name of the cyclist, but they had a red helmet and wore a Led Zeppelin *House of the Holy* t-shirt who studied the design for days before attempting the feat and motoring through the vertical loop unscathed. They got some serious road rash after taking a tumble off the Mobius strip, but their Yamaha pocket rocket was fine, so it is possible to still use it. The rest of the vehicles tended to fly off on the right in a big pile next to the interstate and refusing to take our survey.

Because the speed boost provided ample velocity for maintaining enough centripetal force, further analysis suggests that lining the loop and mobius strip with loud Rumble strips to alert drivers that they are in danger of driving off the road is expected to correct any safety issue [14]. While the labyrinth kept all vehicles on the road, the double backing prevented any vehicle from making it through the interchange without an accidental head on head collision with another vehicle. Finally, most drivers were able to make it through the Inter Dimensional portal but many shortly crashed afterwards as some passengers did not equip their protective eye wear in time and went blind. A small percentage reported feeling like they were on fire and screamed repentance for all their sins.

#### 4. Conclusion

The technology may need some further maturation before these new interchanges can be safely integrated into the modern highway system. In between the rumble strips, better navigation systems through *The Labyrinth* and subsidized laser eye protection and/or tinted window instillations, we believe this technology is maximum ten years out from an interchange near you!

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