Speed-Zug – Tomorrow’s Transit System

Einheit, Germany (population 90,179) is the focal point of the Eurozone’s financial sector which provides economic and social connectivity with the rest of Europe and western Asia. Surrounded by mountains, rivers, and forests, this progressive city lies only 317 kilometers east of the European Union’s Headquarters. The Einheit/Frankfurt metropolitan areas are interconnected by Speed-Zug, a hyperloop subway system developed by the Viefalt Transportation Firm. Mechanical engineers’ designs were crucial to the development and design of this innovative transit system.

With an aging rail and air infrastructure, Einheit’s and the Eurozone’s economies were no longer competitive with the rest of the world and on the verge of collapsing. Personal transportation, along with the delivery of goods and services, had nearly ceased. Adverse weather conditions in Europe were also negatively impacting transportation. Upgrading the existing rail system and land acquisition for new airport construction would prove economically impractical and cause displacement of people under imminent domain. Innovative enhancements to Speed-Zug became the perfect solution for replacing the deteriorating Eurorail and air-transport networks.

European Speed-Zug Network

![Speed-Zug Network Map]

**Speed-Zug Network Key**
- **Main Routes**
  - (Speeds up to 965 km/h)
- **Auxiliary Routes**
  - (Speeds up to 320 km/h)
Compared to the alternative of refurbishing the existing air and rail infrastructure, this intelligent transport system provides cost-effective solutions for replacing the antiquated networks. Speed-Zug meets the following criteria:

- Cost-effective infrastructure such as tunnel/bridges and right-of-ways already exist
- Fast travels up to speeds of 965 km/h
- Safe incorporates redundant and backup systems
- Resistant to seismic activity- lateral and vertical dampers within support pylons
- Secure elevated steel tube construction
- Immune to weather pods enclosed in steel tubes
- Non-polluting powered by batteries and alternating current; travels silently
- Sustainable power waste heat turned into electricity; southern routes solar powered

Speed-Zug propels pods through steel tubes maintained at a partial vacuum. The pods float on a 1 millimeter cushion of air generated by on-board compressors, creating an air-bearing suspension which allows speeds that wheels cannot achieve. Positioned at various locations along the route, linear induction-motor accelerators propel the pods. Within the tubes, these accelerators increase and decrease the pod’s speed as it passes through each tube’s section. To negate the risk caused by high-speed aerodynamic pressure forces created in the tubes, aerospace and mechanical engineers designed an electrically-driven inlet fan and air compressor system which directs air from the front to the rear of the pod. These innovations eliminate rolling resistance and significantly reduce air resistance, allowing Speed-Zug to glide the majority of the route.

In the designing of Speed-Zug, Vielfalt Transportation Firm decreased risks by making safety paramount. Immune to extreme weather conditions, pods travel in a maintained and carefully controlled tube environment. Computer engineers designed seismic detection sensors which identify platonic shifts along the route. In response to the sensors, the support pylons’ dampers immediately rebalance or, in a worst case scenario, shut the hyperloop down. In addition, main/backup computer and sensor systems, with total redundant systems, are in place to signal any failures that could occur within the network. If the main and redundant systems disagree, the pod will discontinue travel. Mechanical engineers produced retractable wheels driven by small motors that deliver the pod at a reduced speed to the nearest safety stop. In case of a full system failure, robotic pushers are deployed to propel the passenger pod to the stop. Civil engineers located these stops approximately every 48 kilometers. They are equipped with the basic essentials for passengers’ comfort.

Mechanical and electrical engineers understood the key to sustainability was to make Speed-Zug economically feasible as a mass transportation system. Encapsulated within a controlled environment, the hyperloop requires less maintenance which significantly adds to the
system’s reliability and longevity. It is immune to weather’s adverse effects along the route’s thousands of kilometers. Further enhancing sustainability, biochemical and mechanical engineers developed a process to utilize soy oil in the place of petroleum based textiles and materials. Mechanical engineers utilized these bio-plastics in the manufacturing of soft items such as seats and hard materials such as trims.

Mechanical engineers created a relaxing environment: ergonomically correct seats, natural weather scenes viewed on electro-chromic glass display windows, soothing audio, and a noise-free, yet speedy trip.

Speed-Zug’s primary energy source is electrical power. In collaboration with mechanical engineers, electrical and chemical engineers developed a sustainable method to charge the pod’s onboard batteries by capturing waste heat. This heat is generated by the pod’s passage through the tubes and by the air compressors. By utilizing strategically placed silicon membranes on or within the capsule, electricity is produced. The waste heat excites the silicon membranes’ atoms, releasing electrons, thus creating electricity. In southern areas of the Eurozone, significant amounts of sunlight allow the use of solar panels.

In deciding certain elements of Speed-Zug’s design, project managers considered numerous trade-offs.
TRADEOFFS/DESIGN CONSIDERATIONS

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<th>High-Speed Rail</th>
<th>Speed-Zug</th>
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| **Cost**           | • New construction approximately $8B per airport  
                    • Most major cities need new airports               | • High-speed rail construction approximately $117M/km               | • Speed-Zug construction approximately $5.1M/km and $1.35M per pod |
| **Flexibility**    | • Adaptable routes                            | • Fixed routes                                                  | • Fixed routes                                             |
| **Environmental Effects** | • Major noise and air pollution  
                    • Hazardous chemicals (jet fuel, lubricants, and deicer)  
                    • Major encroachment upon wildlife habitats around airports | • Minor noise pollution  
                    • High levels of electromagnetic fields  
                    • Minor encroachment upon wildlife habitats along routes | • No noise pollution  
                    • Minimal encroachment upon wildlife habitats-tubes raised on support pylons |
| **Energy Consumption per passenger per 500 km** | • Consumes approximately 890MJ of energy per passenger | • Consumes approximately 775MJ of energy per passenger     | • Consumes approximately 45MJ of energy per passenger       |
| **Revenue**        | • Cancelled flights due to weather result in loss of revenue | • Cancelled trips due to weather result in loss of revenue     | • Incoming revenue continues despite weather conditions    |

After considering these tradeoffs/design considerations, Speed-Zug was easily determined the most economically practical solution for replacing the deteriorating air and rail network. The economies of Einheit and the Eurozone were re-energized by this innovative transit system.

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