

## Concept of the Aero-Train and its Aerodynamic Stability Nature

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Taking into account the serious greenhouse effect of the earth, drastic proposal which prevents the Carbon Dioxide emission from transportation system must be done. In Japan, over 20% of the Carbon Dioxide is emitted from transportation. Aero-Train is the new zero-emission high speed vehicle which we are proposing. Wing in ground effect is introduced to obtain highest lift to drag ratio and highest payload ratio. In order to compare the performance of the Aero-Train at 500km/h, with several other traffic systems, Eco parameter is newly created as  $E_c = (L/D)(W/W_0)(V/500)^2$  and compared. Eco parameter of the Aero-Train was over 6 and showed the highest value among them. Because of such high energy efficiency, this system can run using only natural energy existing in the guideway area of the Aero-Train system. Namely, Aero-Train is the zero-emission vehicle.

**Key Words:** *Wing in ground effect, Zero-emission vehicle, High-speed train, Greenhouse protection technology*

The future of the human race has become of serious concern year by year owing to our self produced waste. Our most serious environmental problems are the so called greenhouse effect (production of carbon dioxide) and the production of teratogenic constituents which cause human genetic damage. Those problems originated in the huge amount of fossil and atomic energy consumption to sustain our convenient way of life. Keeping such serious environmental conditions in mind, scientists must answer questions practically, and propose possible convincing research and developing projects. How should we diminish the production of carbon dioxide, or how can we stop producing teratogenic constituents from our waste and still keep our present standard of living? The fundamental resolution of such problems is to create new, human-friendly science and technology, and establish pollution-free energy systems. We will call such new science and technology as, "**Adaptive and Refreshing Technology & Science (ARTS)**". First of all, we should practically show how we could stop emitting carbon dioxide from a high speed transportation system, by our *Aero-Train concept*.

The Aero-Train project was proposed to answer the question of how to solve serious environmental problem. The concept of the new high speed ground transportation "Aero-Train" was created to establish a zero-emission vehicle. In order to reduce the total drag of a ground vehicle, one must minimize drags originating from the gravity of the earth, or water. If total drag is

drastically minimized, then natural energy resources, like solar, wind or others, which are considered presently not usable for their low *energy density* and *changeable* nature, will become usable. So drag reduction of the vehicle is essential. The mechanical loss of a vehicle originates with the gravity of the earth. A wheel system had been introduced to reduce this drag. However, it still created quite a large loss. If the vehicle could be suspended somehow, then this loss would be reduced dramatically. Using available technology, the vehicle can only be suspended electro-magnetically or aerodynamically utilizing "wing in ground effect". Magnetically suspended systems have already been under development in Japan and Germany for over thirty years. However, they have a disadvantage in their energy efficiency. On the other hand, an aerodynamically suspended system has not yet been developed anywhere. If the vehicle runs at high speeds, then one can fairly easily utilize aerodynamic forces. The aerodynamic forces (lift, drag, side forces) become very large. Comparing these two suspended systems, it is clear that energy efficiency would be far better in the case of an aerodynamic system if it could become reality.

Under such circumstance, the concept of the "Aero-Train" was created and proposed by our group. **Figure 1** shows a conceptual sketch of the system. First, the vehicle's energy efficiency is minimized as much as possible by introducing the wing in ground effect. Second, low density and unsteady natural energy is cultivated at the place where the vehicle runs. It is necessary to collect several different natural energy

resources, and *store them in the state of Hydrogen*. In such a way, one can store and use natural energy steadily. As shown in the conceptual sketch, this system has solar panels over the guideway and wind mills at the side of the guideway where wind energy is available. **Figure 2** shows the energy flow of the system. The Aero-Train runs at 500km/h where the aerodynamic lifting force(wing in ground effect) becomes very large and the drag force becomes smaller compared to the lifting force. The idea is that the space which we have been considering only as a place to run the vehicles, can also be use to *cultivate* alternative natural energies ( like rice field in the case of food), and use them to run the vehicle. It is certain that the amount of stored energy will be too much to run the system. We can distribute the surplus energy to outer systems from this system. Therefore, it can be also considered as an electric power plant !

If the development of this system succeeds, then Zero-Emission Vehicle will become a reality. If the most difficult system like present proposed system (Ground transportation system with 500km/h) is successfully developed and put into in service, then other less difficult systems can be more easily realized in the society. As a result, all systems can become *human friendly* and eventually, we could create a pollution-free society. Therefore, the development of the "Aero-Train" system is very critical.

At present, we are working on the first stage of this project using the old Linear Motor Car Test Facility located in Hyuga City, Kyushu, Japan. **Figure 3** shows under what conditions the test are being conducted. A running model is pushed steadily by a cart with the universal joint at the connecting position. The cart is driven by a truck. Height of the floating model is controlled either automatically or manually. This model floated successfully last year. The test model is shown in **Figure 4**. Up-to-date conditions of the first stage test are as follows;

Speed of the model: 55 ~ 100 km/h  
 Weight of the model: 80kg ~ 117kg  
 Floating height: 2 ~ 15 cm  
 Lift to drag ratio: 12 ~ 20

From October 2000, we started the second stage of the Aero-Train development. This three year project

if sponsored by Japanese government. Using 2km guide way of Hyuga city, we will realize, unmanned, 150km/h, zero emission Aero-Train system. Conceptual sketch of the second stage model is shown in the **Figure 5**.

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Figure 1. Conceptual design of the Aero-Train

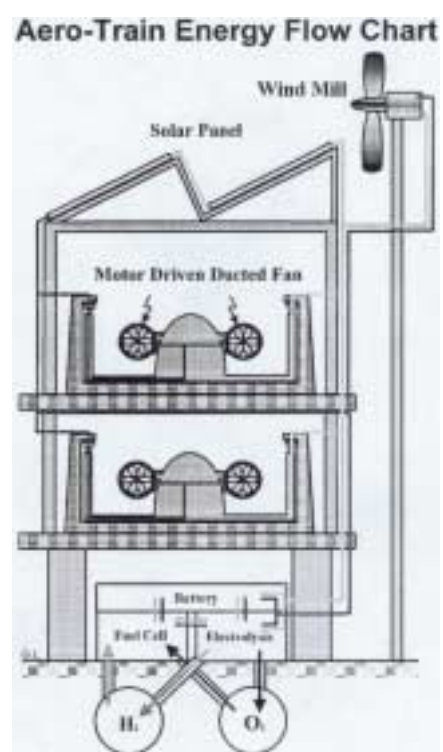


Figure 2. Energy flow chart of the Aero-Train

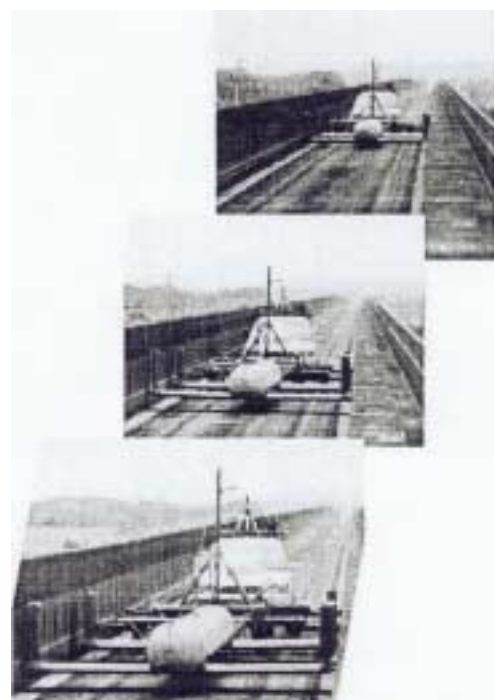


Figure 4. First stage testing model of Aero-Train

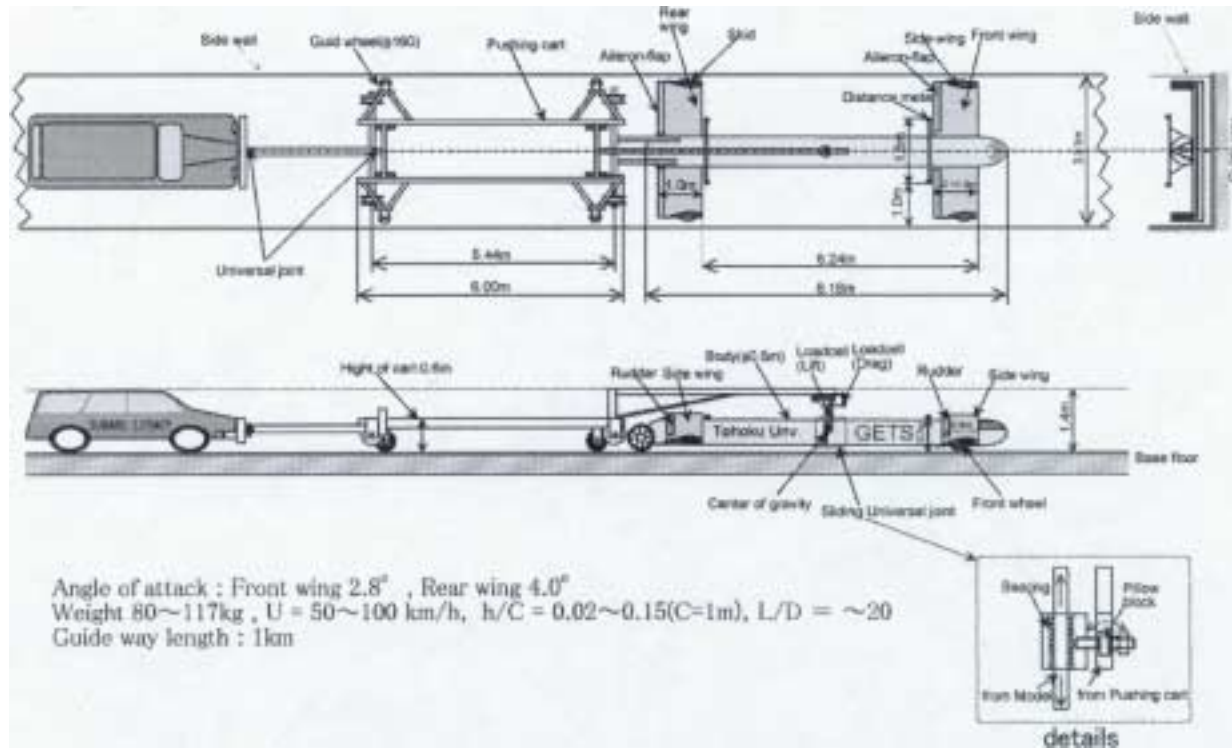


Figure 3. Experimental condition of the first stage of the Aero-Train



Figure 5. Conceptual sketch of the second stage model