

Taxi 2000, Inc.

Urban Transportation Systems

United States




ANSYS Structural™

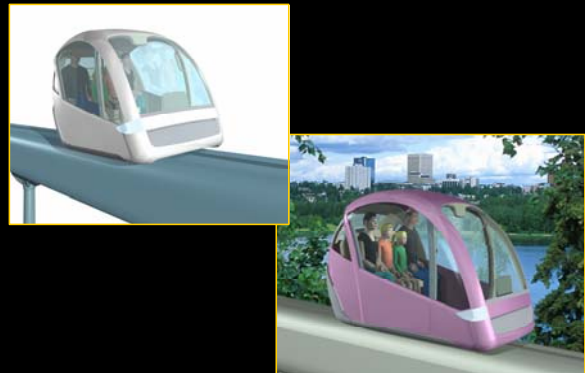
Overview

Taxi 2000, Inc. was formed to develop and commercialize the concept of a personal rapid transit (PRT) system emerging from work done at the University of Minnesota. In contrast to mass transit systems that move many people in large vehicles traveling successively from station to station along an established route, SkyWeb Express saves considerable time with smaller vehicles that travel directly to a destination with no intermediate stops. Each electrically driven vehicle carries up to 650 pounds (typically three or four people) and travels on a raised network of single-rail guideways connecting conveniently located stations. The rider swipes a prepaid card through a stanchion in front of an empty waiting vehicle, punches in a destination number, and takes a seat. A computer system chooses the fastest route to the destination and proceeds there nonstop. Since stations are off the main line, riders go directly from origin to destination, bypassing all the other stations along the way. There are no stop signs, red lights, or interferences along the route.

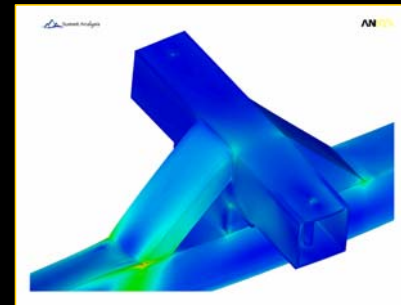
Testimonial

"ANSYS® Structural™ was valuable in studying stress levels for this project, especially the convenience and flexibility of the surface-to-surface bonded contact feature. This functionality greatly facilitated modeling the structure and provided a convenient mechanism for extracting load values on each adhesive joint to verify that forces were within acceptable limits. The speed of this approach enabled Taxi 2000 to confirm the performance expectations of the design so a working prototype of the SkyWeb Express could be completed within the time constraints of the development program."

Mitchell Voehl
 CEO and Engineering Consultant
 Summit Analysis Inc.



Traveling on a network of raised single-rail guideways, computer-controlled SkyWeb Express personal rapid transit (PRT) vehicles take people directly to their destination with no intermediate stops.



ANSYS Structural was used to determine if stresses were within acceptable limits for the adhesive-bonded tubular aluminum T-joint connecting the cabin to the narrow vehicle chassis.

Challenge

The company needed to get a working prototype system built as quickly as possible to demonstrate the operation and feasibility of SkyWeb Express. Vehicle weight was a key economic issue, so the cabin and chassis were designed to be constructed of tubular aluminum members bonded together with structural adhesive much the same as aircraft are fabricated. Safety and reliability were primary concerns, so components were required to be strong enough to safely withstand operational loads. Of particular concern was the bonded aluminum T-joint connecting the cabin to the narrow chassis. This part had to provide adequate support for turning and wind-load forces as the vehicle rides along the guideway as well as repeated unbalanced load cycles as passengers enter and exit the cabin.

Solution

To determine if the bonded aluminum T-joint and cabin structure were strong enough to withstand these operational loads, the company turned to the consulting firm Summit Analysis Inc. to study component stresses. Working on a Dell Pentium 3 desktop PC, Summit Analysis used ANSYS meshing capabilities to construct a parametric finite element model of the tubular vehicle chassis and overlapping gusset sheets. ANSYS surface-to-surface contact elements were used to represent the adhesive joining the structural members. The bonded contact feature of these elements allows both tangential and normal forces to be transferred between adjacent surfaces. Using these software features, the study enabled engineers to develop a satisfactory design and quickly verified that joint forces were within acceptable limits for the shear and peel strengths for the adhesive.

Benefits

Summit Analysis used ANSYS contact elements to quickly and accurately model the T-joint structures. For such analyses, ANSYS contact technology has useful capabilities including automatic assembly contact detection, robust default settings, and a range of contact behavior and solution options. Other FEA packages may require extensive manual intervention in setting up these contact conditions. ANSYS software also can easily generate customized reports with critical information summed, listed or plotted for each joint. Verification of the safety of the SkyWeb Express structure enabled the company to construct a working prototype of the SkyWeb Express on schedule. Since then, more than 5,000 people have ridden the prototype PRT vehicle, with cities in North America, Europe, the Middle East, and Asia investigating the feasibility of implementing the transit system.