

Mr. Mike Black
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Dear Mike:

Following the various situations that have occurred during the initial runnings of the Rattler, I have taken time to review the overall process and apply 25 years of coaster operation, maintenance, design, manufacturing and construction experience to develop some overall thoughts on progress to date, and possible directions to go. In addition, I have consulted with my father, who began his career as a coaster designer in 1955, and Steve Okamoto of our staff, who designed a number of very large coaster rides for Arrow over a period of years. Again, these are our opinions, based on experience, and are offered in a constructive attitude.

- 1) The overall design of the ride is excellent and the construction quality is well above average.
- 2) The original schedule to allow 2 months for testing and the inevitable modifications that are virtually always required on a ride of this magnitude was wise and prudent. No matter how skilled the designer is, every time we push the envelope we learn new things about coaster design.
- 3) The decision to attempt to open the coaster in early March, despite the fact that a combination of construction and design co-ordination delays last summer and an extremely wet winter delayed the completion of construction by two months was not a prudent or wise move. The risks being taken by eliminating the testing phase are not worth the potential short term rewards.
- 4) The original design with a maximum of 3 g's pull out and an absence of negative g's was an excellent goal and most likely would have been met if the lift height had not been changed.
- 5) The decision to increase the height of the lift hill last August in an effort to obtain better "statistics" than other recently completed rides has adversely affected the overall quality and ride ability. As I understand it, the increased lift height resulted in a tighter radius at the bottom of the first drop and higher velocities, thus increasing the pull out forces from the original design of 3 g's to 5 g's at a 1:38 running time. These forces are probably much higher at 1:35 and well beyond safe limits for the equipment or the guests when times dip below 1:30.
- 6) We agree with Dr. Brown that people can withstand 5 g's

in most cases: however, it must be recognized that the possibility of injury, particularly to guests with pre-existing conditions is much higher at 5 g's than at 3 g's. It should also be noted that the 5 g readings were obtained after very little running in and are possibly higher at this time.

- 7) The trains were designed and manufactured based on the original design parameters, not the increased forces resulting from the lift height change. The trains were completed last August and shipped to the site in September to be available for the 2 months of testing.
- 8) It is well known that coasters of all types are subject to changes in speed from changes in environmental conditions such as temperature, wind and moisture. A well designed coaster of up to 3,000 feet can normally withstand the changes in velocity without going outside of "safe" limits; however, the changes are great enough on longer rides such as the Rattler that it is virtually impossible to design an exciting coaster that will make it over every hill under cold, high friction conditions and not be too fast under low friction conditions. Rides over 3,000 feet should, in my opinion, be designed with either booster wheels or speed monitoring slowdown brakes, or both, in order to be able to control them within safe limits.

So much for 20 - 20 hind site. The following are our suggestions for the Rattler:

- 1) Monitor speeds at the top of each hill or potential stall spot with a train running the 1:38 to 1:40 range to obtain design data for steps 2, 3, and 4.
- 2) Establish how much energy could be eliminated from the first drop by either lowering the hill or installing brakes.
- 3) Establish a design to re-contour the first pull out to get forces down to 3 g's under "normal" running conditions. This will allow the ride to run safely even if it gets a little faster as the season goes on.
- 4) Establish two locations on the ride capable of accepting four brakes each with a speed sensing system. Minor re-contouring may be required.
- 5) Add two more brakes immediately prior to the station to improve redundancy in a two train operation.
- 6) Consider adding more brakes at the helix exit and controls for a three train operation during this work.

In my opinion, these changes would in no way diminish this rides' world class performance or appeal (remember even the ACE people

thought it was too severe on Saturday night before last). The changes would turn it into a manageable, safe ride that would not damage the trains or the structure, and could be run under most weather conditions while insuring the safety of the guests.

I think it is time for all of us, the owners, the designer, the contractor and the train manufacturer to stop pointing fingers and face the fact that we need to stop and take time to finish what could be the finest roller coaster ever built. It will be expensive, both in dollars and time, and probably hard for each of us, particularly the owner, to accept our financial responsibilities, but the long term benefits of having an exciting and safe roller coaster far outweigh the short term negative effects.

I have copied John Pierce and Alton, but feel free to share my thoughts with the Fiesta Texas people if you think it is appropriate.

Best regards,
D.H. MORGAN MFG. INC.
Dana H. Morgan
President