Rollercoaster 03-18-09

Does the thought of whizzing through a loop-the-loop in an open car make your heart beat a little faster? How do you feel about riding that car straight down from 150 feet above the ground? Just gotta try it?

Rollercoaster pic1 03-18-09

Legend Rollercoaster pic1 03-18-09

SheiKra Dive Coaster
Busch Gardens Tampa
Permission of Gustavo V. Abranches,realcoasters.com

To millions of visitors annually, roller coasters are the highlights of theme parks. Many of the most spectacular of those rides such as SheiKra at Busch Gardens Tampa or Dragon Kahn at Port Aventura, Spain began as designs at St. Louis architecture firm PGAV.

As explained by the designers at PGAV, successful coasters use a fiendish knowledge of psychology firmly grounded in the basics of physics. (A bit of human physiology is also incorporated to make the rides very safe.)

Here's how Bill Castle, vice president of PGAV, explains the psychological scripting of a "dive coaster" like SheiKra, recently named the top coaster in central Florida:

"You start out with a little fear. Your trepidation increases as you go up—the clickety click of the lift gets on your nerves. Then you hang at the top looking down 200 feet for about ten seconds, with the suspense constantly building. The adrenaline is in full flower when you go down that drop, and every nerve in your body is tingling. Time seems to slow down, and you are hyperaware. At the bottom of the (200 foot drop you go into a long pullout and begin another climb. It's all energy management—fast and slow, high and low."

The science of the standard roller coaster

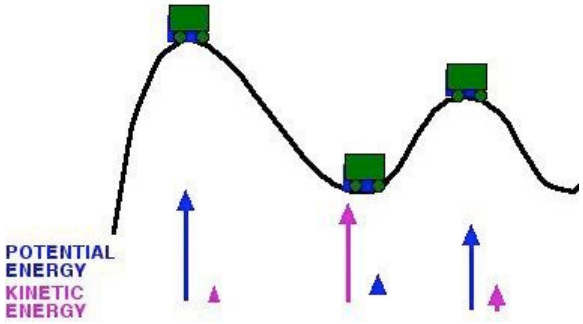
Roller coasters operate on a theoretically simple basic principal: the conversion of potential energy to kinetic energy, and vice versa. Mix with the push-pull psychology of anticipation and release, and you get a unique experience.

Potential energy results from position. Stretching a spring gives it potential energy because a force wants to restore it to its original position. Kinetic energy is the energy of movement. Roller coasters use gravitational potential energy. They usually start as the train is pulled or propelled to a very high point at the crest of a hill. At the crest, the potential energy is at its maximum. As the train begins its descent and picks up speed through momentum, its energy of

motion (kinetic energy) pushes it up the next hill. At the top of the next hill, most of the kinetic energy has been converted to potential energy. Of course, some rides have a second motorized lift or other propulsion to make the thrills last longer.

Forces such as friction will dissipate some of the energy. Nonetheless, according to the PGAV coaster designers, a 150 foot lift gives a steel roller coaster enough energy to easily do seven inverted maneuvers like loops and corkscrews. These maneuvers are named after flight maneuvers —if stunt plane would leave a track in the sky, it would look like a roller coaster track.

Rollercoaster pic2 03-18-09



Rollercoaster pic2 legend 03-15-09

The relative amount of potential energy at a point is shown by the blue arrow. The pink arrow shows relative kinetic energy at the same point

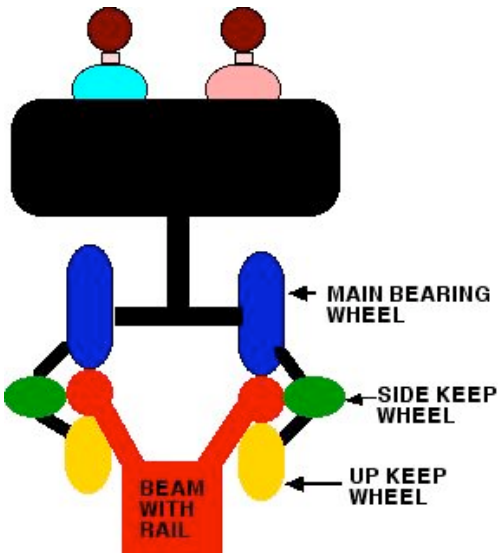
An example is a common element, the Immelman loop, named after a German WWI flying ace. The train goes upward inside the loop, but at the top rotates to an upright position and goes off in the opposite direction. For an animation showing a stunt plane Immelman maneuver go to http://www.scootworks.com/rdrc/aerobatics/immel.html

Safety Precautions both physical and physiological

Unlike a stunt plane, however, the roller coaster is attached to a fixed track. Modern steel coasters are built of modular units about 10 meters long, welded to each other for a smooth ride. The train of cars is tightly attached to the rails by sets of three wheels, and the rider is snugly harnessed into the seat. Elements like loops are designed with a teardrop shape to maintain the centrifugal force at 1 g (normal gravity), so that even if a rider was holding a drink, not a drop would spill. Design concepts are translated into precision engineered structures by the companies that actually build the coasters.

In addition to safety, the roller coaster adventure is engineered with physiological comfort in mind. In the ups and downs, for example, the rider experiences constant changes in the force of gravity. But by industry standard the g-force doesn't exceed 4.5, where the body essentially weighs four and a half times its on-ground weight, and it only will experience that for a fraction of a second at the bottom of a curve. More than that would be too stressful and decrease the fun.

Rollercoaster pic3 03-18-09



Rollercoaster pic3 03-18-09
Cross section of a top-rider rollercoaster

The 'strongback' beam supports the rails that the trains ride on. Three sets of wheels lock the train car in place--the main bearing wheels or 'truck', the side wheels to prevent lateral motion and slide, and the up keep wheels to keep the train securely on the track.

And basically, fun is what it is all about. A roller coaster ride is an extraordinary experience, like nothing in daily life. And the best ones, like the ones designed at PGAV offer not only thrills, but a sense of being immersed in an exotic environment. Hence names like Kumba, Manta, and Steel Eel.

How PGAV came to design SheiKra

The theme park design section of PGAV was born in 1969, when Anheuser-Busch decided to change its beer garden in Florida to a theme park. A-B liked their new entry area design so much that they had PGAV design a train to take visitors through their wild animal park. The idea was to cage the people, not the 4000 or so exotic animals.

Rollercoaster pic4 03-18-09

Legend Rollercoaster pic4 03-18-09

Loch Ness Monster
Permission Busch Gardens Europe

The train is still in use today, periodically updated. And that first train led to designs of whole theme parks. Busch Gardens Europe in Williamsburg VA was the first, and and has been voted the most beautiful theme park in American for years running by industry poll. The Loch Ness Monster coaster, with its interlocking loops, just marked its 30th year in operation.

Today PGAV's roller coasters highlight not only the Busch Gardens parks, but Sea World in Orlando, San Diego, and *San Antonio*, as well as Port Aventura and Isla Magica in Spain. The newest, Manta, opening in May at Sea World Orlando, has cars shaped like sting rays. After gliding aerial maneuvers, Manta literally splashes down , using the fins on its cars to create a wall of water behind it.

Today, designers use computer programs to devise bigger and scarier coasters. But the reasons people ride them remains the same—the huge personal accomplishment of overcoming fear. It's a memorable peak moment. The rider has given up control, hurtled around in space at high speed in an open car, and made a safe return to the station. And it's a shared experience. In two minutes or so, the riders have had an adventure good for hours of reminiscence.

Why rollercoasters are loved (by some)

As Bill Castle puts it, " It was exciting and you now feel alive. It's called "the tingle." People try to get the tingle in many ways—sky diving, downhill skiing, off-road racing. This tingle defines their sense of self. But tingle hunting can get expensive, is inherently dangerous, and requires learning skills. The commitment to riding a roller coaster is small in comparison to sky diving and racing, but the result is not. It is the same. You feel great.

Maybe we really do need more coasters in the world!"

Rollercoaster pic 5 03-18-09

Legend Rollercoaster pic 5
Kumba, Busch Gardens Africa
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End note: PGAV has not designed any roller coasters in the St. Louis areas, but their experiential designs can be seen at the Penguin-Puffin Coast and Big Cat Country at the Zoo, and at the Exploradome at the Science Center.