98-186
Roller Coasters: Background and Design
Spring 2015
Week 7 Notes

Identification and Inversions, Roller Coaster Failures

Identification

Roller coaster identification is an important topic because it allows one to quickly infer information about the coaster. For instance, if one can identify a coaster as an Arrow coaster, then they can infer the trains the ride has, the relative size of the ride, the inversions it might have, and the fact that it was probably constructed during the 70s or 80s.

First, identify if a coaster is wood or steel. If steel, use the following table:

Manufacturer	Spine	Ties	Supports	Trains	Extra
Arrow	Round	Outside	Truss, tubular	2x2 cars, torpedo nose	Usually easy to identify
Schwarzkopf	Round, None	Inside	Intricate tubular	2x2 cars, box	Portable coasters, shuttle coasters, distinctive loops
B&M	Box	Inside	Tubular	1x4 cars	Easy to identify
Intamin	Truss or double round	Inside	Truss, tubular, box	2x2 cars, sleek	Distinctive OTSRs
Vekoma	Round	Outside	Truss, Tubular	2x2 cars	Boomerangs, SLCs, Inverts

Wooden coasters tend to be hard to identify since they are less widespread. Best bet is to look at the trains and supports

- Great Coasters International (GCI) have sloped supports and use Millennium Flyer trains
- Custom Coasters International (CCI) and The Gravity Group (TGG) have supports that slope out but then go vertical. Usually PTC trains. If supports are angle iron, probably CCI or TGG.

Inversions

The main inversions that show up in the coaster world are

- Vertical Loop (two half loops)
- Corkscrew (Wing Over) (two half corkscrews)
- Cobra Roll (half loop into two half corkscrews into a half loop)
- Batwing (half corkscrew into two half loops into a half corkscrew)
- Dive Loop (hill, half barrel roll, half loop)
- Immelmann (dive loop in reverse)
- Heartline/Barrel Roll (two half barrel rolls)
- Zero-G Roll (hill, barrel roll, hill)

There are plenty more inversions that exists (eg flying snake dive, Norwegian loops, inclined loops, etc) which are less common.

Roller Coaster Failures

While there are more 'failures' than the four examples presented here, these are some of the most prominent failures over the past 30 years. It is important to mention that a failure does not mean these rides suffered a deadly accident, but has more to do with the ride design. We discussed accidents on coasters during the coaster design basics week.

The Bat at Kings Island

- The Bat at Kings Island, built by Arrow Dynamics, opened in 1981 to much success
- It was the world's first suspended coaster (the track is above riders, and the cars can swing freely from side to side)
    - Well, that was a lie. The first was Alpenflug in 1975, but it was never permanently installed.
- Arrow decided not to bank the track very much in turns, instead keeping it almost flat in most spots. This caused lots of stress on the hinge supporting the cars as they transitioned into and out of turns.
- Also, Arrow decided to put the brake fins on the bottom of the cars, putting further strain on the joint connecting gondolas to the wheel chassis
- This required constant maintenance of the coaster, causing it to only be open sporadically. In 1984, the park finally decided it wasn't worth it and removed the ride.
- Arrow Dynamics learned from their mistakes on The Bat and their future suspended coasters did not suffer the same issues

Drachen Fire at Busch Gardens Williamsburg

- In the early 1990s, Busch Gardens contracted the new-kids-on-the-block B&M to build two sit down multi-inversion coasters for Busch Gardens Williamsburg and Busch Gardens Tampa. While B&M initially accepted the contract, they were too busy to deliver both coasters and could only deliver one for Busch Gardens Tampa (this was Kumba which opened in 1993)
- Busch then went to Arrow Dynamics for the coaster. Arrow was given preliminary design work that B&M had been working on, which was much different than Arrow's typical design style. They tried to re-design the ride towards their strengths, but Busch wanted something similar to B&M designs
- The result was Drachen Fire (Drachen is German for dragon), which opened in 1992. It appears very similar to a B&M coaster in Arrow Dynamics skin
    - The ride had a cobra roll and interlocking corkscrews, signature features of B&M coasters
    - The ride was supposed to have a loop around the lift hill (like Kumba), but Arrow struggled to engineer something like this; they instead settled on a wraparound corkscrew first drop, which became Drachen Fire's signature feature
- Arrow chose to shy away from their normal design and support techniques in favor of those similar to B&Ms, but this caused the ride experience to deteriorate quickly, which complaints of its roughness surfacing within months of its opening.
- The roughness of the ride made it unbearable. Arrow tried to fix such issues by modifying the ride, even removing one of the corkscrews, but none of the efforts worked.
- While its sister Kumba was a huge success, Drachen Fire closed after only 6 years of operation. Unable to find a buyer, Busch Gardens scrapped the ride in 2002.

Son of Beast at Kings Island

- Of all the coaster failures ever, Son of Beast has to be the most well-known, and possibly the worst.
- Kings Island had always had close connections with wooden coasters. They built the Beast by themselves, and featured an in-house carpentry and maintenance team for maintaining their wooden coasters (most other park contract major maintenance to companies like GCI).
- In the late 1990s, Kings Island decided they wanted to shock the world by building the world's largest wooden coaster which would be, if they could, over 200ft tall.
    - Remember that Kings Island is at this time under the ownership of Paramount Parks, who had a reputation for going with half-baked ideas
- Kings Island approached the two big wooden coaster manufacturers of the time, GCI and CCI, asking if they would build the coaster. GCI, a fairly new company, wasn't interested in such a large project. CCI basically told Kings Island they were nuts
    - This may have been because CCI had seen how Mean Streak and Texas Giant, two large wooden coasters built by Dinn Corp, had deteriorated over time and knew bigger wouldn't work
- The only company who would take the contract was the Roller Coaster Corporation of America (RCCA), a company now famous for their poor building standards and hit-or-miss quality
- The park announced the coaster in 1999. The ride would break seven world records, most notably tallest (218ft) and only wooden coaster with a vertical loop
- Constructing shortly began, and halfway through construction Kings Island became very upset with RCCA's poor quality standards. It got so bad that Kings Island fired the RCCA and vowed to finish the rides themselves. In response, the RCCA allegedly stole some of the ride's blueprints
- The ride opened in 2000 and was quite popular at the time (I personally remember being at the park around this time and seeing lines 3 hours long). However, the ride began to get rougher and rougher as time went on, becoming unbearable within 5 years (it hurt like hell).
- In 2006, there was a structural failure in the Rose Bowl section of the ride, causing the train full of riders to be injured (only 2 were admitted to hospitals, but no injuries were severe). In response, the park repaired the section of track, removed the loop, put different trains on the coaster, and reopened the ride in 2007.
- In 2009, a woman claimed she suffered head injuries riding the ride, but the story was shady at best. However, the ride closed and never reopened. In late 2012, the coaster was torn down.
- One can cite many reasons for the Son of Beast failure
    - The use of RCCA led to a low quality structure (there are reports that the RCCA cut corners to save money)
    - The firing of the RCCA and completion by Kings Island was risky. While their staff was good, Kings Island wasn't as good as full fledge wooden coaster builders.
    - The ride was designed by Werner Stengel, the roller coaster legend. However, he designed it like a steel coaster. He also relied on large helixes rather than hills, leading to a ride with basically no airtime.
    - The ride used trains built by Premier Rides, which had to be heavy to make it through the loop in the middle of the ride. The weight of the trains, combined with the high forces put on the track at the bottom of the first drop and Rose Bowl (up to 4.5 Gs) was too much for the track structure to handle.
    - The trains also had very uncomfortable lap bars that went up to one's chest, which was one of the main factors causing injuries during the 2006 incident.

    - The investigation by the Ohio Dept. of Agriculture found that Kings Island's repairs to Son of Beast had been focused on patching up holes rather than looking at the ride as a whole. This led to some areas going unattended.
- Since Son of Beast, no other coaster manufacturer has made a woodie over 200ft (the closest is Intamin who has made a couple around 180ft). Also, no other coaster manufacturer has tried a vertical loop, with the almost unanimous consensus of the wooden coaster community being that it is a really bad idea.