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Autor: Edwards, Thomas
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Blow Over on the Appenzellerbahn

Thomas Edwards



The high winds in Europe earlier this year did some unusual damage and left the Appenzellerbahn with a curious accident to clear up. Just how a train came to be derailed in apparently sheltered conditions is explained here.

The accident looks surprising and looking at the steep valley sides a sense of incredulity is understandable. However, when strong winds pass over the tops of high mountains the resulting turbulence can reach the valley floor. Trains can be susceptible to blowing off tracks in very strong winds and the possibility of side-wind roll-over has had to be considered in design of a number of trains including the Swedish X2000, which had to have 8 tonnes of ballast added to the driving trailer to compensate for the phenomenon described below. Operational arrangements are in place to prevent strong westerly winds in the English Channel possibly blowing Eurotunnel shuttle trains over at the French terminal.

Of note at the particular location of this accident is that the railway is elevated. As the flow passes over the embankment the venturi effect accelerates it locally just where the train must pass. This is the same effect that enables an aircraft to fly. As the air passes over the top of the wing the air pressure is reduced and the aircraft is lifted upwards against the force of gravity pulling it downwards. The embankment is behaving like the top surface of an aircraft's wing. Being metre-gauge the train's body tends to be bigger in relation to the gauge than for standard gauge vehicles. The aerodynamic forces will thus be large in relation to the restoring forces from gravity, vehicle mass and rail-centre-

to-rail-centre width (slightly greater than gauge). The flow round the vehicle will create a significant lift force on the train (highest at the front in the direction of travel oddly enough), a significant side force and large turning forces acting to make it swing from side to side and to roll. This means that the front vehicle experiences an upwards turning force tending to make it pitch as well. Intermediate vehicles will experience a lift force, a side force and a rolling force. It is most likely that the leading car's front end was lifted off and slewed round by a cross wind. The trailing bogie and intermediate car will have obediently followed off the rails until the whole lot came to a halt. It looks like the driver had already reduced the speed significantly, presumably due to the discomfort in the turbulence. The lack of marks on the road in front of the train supports this conclusion.

It is also quite possible that the train was at a stand and had been evacuated. The Steuerwagen (driving trailer) is lighter than the Triebwagen (powercar) and therefore I would expect the Steuerwagen to blow off first if the train were stationary. As well as being lighter, it has the flow round the vehicle end unlike the intermediate car (which could be the lightest of them all but only looks as though it was dragged off).

Fortunately, it is very rare for passenger trains to blow off the tracks!

Editor's note: Thomas is a glider pilot and an Accident Investigator at the RAIB. We thank him for his contribution and Paul Russenberger for arranging it.