

Putting an end to flying ballast on speeding trains

March 5 2014, by Anne-Muriel Brouet



Credit: Photos.com

Results of an EPFL study on ballast projections in exceptional winter conditions have enabled SBB to set-up measures to improve safety around the tracks.

SBB transports close to one million passengers per day, by any weather even in tough winter conditions. In 2012, striving to better safety, SBB mandated the EPFL Transportation Center to study the phenomenon of [ballast](#) projection by very cold weather.

The results from this study have enabled SBB to undertake measures of improvement.

Why does ballast fly up? Analysing this rare phenomenon, that is also an issue in foreign countries, confirms that two related factors are involved: the high speed of trains and tough winter conditions. Snow, wind and frost favour the formation of blocks of ice on the undersides of the wagons. These blocks detach from time to time, falling abruptly onto the track. The shock of the ice block on the gravel can induce the ballast to move, like a billiard ball hitting another. The gravel is flung into the air, where it ricochets off the wagon, or even further afield if it hits the wheel.

The researchers have discovered that some stretches of track were more affected than others. Typically, Western and Central Switzerland, and particularly the Geneva-Lausanne, Lausanne-Brig and Olten-Lucern axes had the highest number of incidents. They observed that in each case the maximum authorized speed on the stretch was between 140-160 km/h, there was significant winter snowfall along the stretch and often the train ran alongside a lake or river. One possible explanation is that snow-covered trains descending the Bern-Fribourg route warmed up in Lausanne, resulting in ballast spray along the Geneva-Lausanne stretch. It's also worth noting that many cases of flying ballast occur inside tunnels, particularly on the Olten-Basel stretch. There too, the warming of snow and ice blocks as the train passes through the tunnel could be the cause.

Recommendations implemented

Scientists have tried to identify all possible causes, looking, for example at wagons themselves. Finally they also investigated at track level, to determine if the passage of the wheels on "glued joints" (between to rail pieces) as well as the jonction could cause this flight of ballast phenomenon.

According to researchers, there are many possibilities, starting with

better incident reporting, to help better understand the evolution of the phenomenon. The SBB has already put into place a systematic reporting mechanism. They have also instituted regulations that slow the trains down in heavy snow conditions.

EPFL scientists have recommended SBB to eliminate weak points – To replace jointed rails with long continuously welded rails in heavily populated areas; To use recent ICN type trains on sensitive stretches and consider erecting noise-buffering walls, which would also serve to stop possible flying ballast.

"All the EPFL scientists' suggestions, as well as others, have been taken into consideration and evaluated in terms of feasibility, efficiency and cost. The best measures have been selected for implementation" says SBB. In December 2012, SBB put into place local weather-dependent speed limits for a few hours, conducted additional wintertime car inspections, lowered the ballast level to reduce the effects of falling ice blocks, and treated the undercarriages with a lacquer to prevent ice from accumulating. This caused delay for passengers, but it guaranteed maximum security. As winter 2013-2014 has been rather pleasant, not such speed limiting measures have been necessary.

Provided by Ecole Polytechnique Federale de Lausanne

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