German Rail Accident Eschede in 1998: Analytical Essay

Abstract—Statistically travelling by train is one of the safest options one can pick, yet there are still some gruesome train crashes throughout the history. On 3 June 1998 the worst train accident in the history of Germany occurred. One of Inter City Express' (ICE) trains derailed under a bridge at Eschede and caused the collapse of this bridge on the train itself. The main reason of this accident was a small wheel breaking because of fatigue. Other factors of this tragic crash were poor maintenance and unreliable track, poor judgement by the conductor of the train. During the crash 101 people died and 88 were heavily injured. Luckily, the number of casualties was limited because the accident occurred in village easily accessible by air during work time.

Keywords—accident; railway; ICE 884; ICE first generation;

I. Introduction

The Deutsche Bahn's (German Railway) Inter City express's (ICE) high-speed train 884 'Wilhelm Conrad Rontgen' was considered to be one of the safest ways to travel. Yet a wheel tire of the first wagon collapsed at a speed of 200 km/h and ultimately lead to the worst train accident in the history of Germany [1], [2]. Soon after the crash an investigation was started to understand the main reasons of this crash and if there were any other factors besides the faulty wheel design, investigations were also made to see if there were any possibilities to prevent this accident from happening in the first place. Legal actions were taken against the engineers of the company and the company itself. Deutsche Bahn had to implement a lot of changes to win the trust of their clients back. This report discusses reasons of the accident and analyses the errors made by the German Railway.

II. Main reasons of the crash

A. New design of wheels

ICE trains were meant to use the standard single cast (mono-block) wheels similar to the one shown in Figure 1. During testing period Deutsche Bahn found out that at high velocity wheels like that created a lot of sound and vibration and lowered the performance. But ICE wanted to be known for both comfort and speed, so they decided to introduce rimmed wheels into their design [3]. The new design as seen in Figure 2 consisted of two metal parts: the body and the rim (also called the tire), a gripping clutch and a rubber damper in order to reduce the sound and vibration [1]. This enhances the performance of the train to make the journey more pleasant for the passengers. This change in the design also introduced a possibility of a fatigue cracking in the wheel that ultimately led to the crash of ICE 884.

- FIGURE 1: An example of a mono-block wheel
- FIGURE 2: Structure of the ICE 884 wheel [4]

B. Mistake of the conductor

The crack reached critical state and the rim of the wheel completely broke about two minutes before the crash [5]. It is known from stories of the survivors that some of them tried to warn the conductor about a strange noise they heard but the conductor wanted to make sure it was an actual problem before stopping the train. The conductor should have trusted the passengers and pulled the emergency brakes to ensure the safety of everyone travelling on the train. By doing so he may have had lowered the number of casualties of even nullified it.

C. The railroad

The Deutsche Bahn used two different types of tracks for their ICE trains. Some of them were designed for high-speed trains but some of them were used for the conventional ones as well. The ones designed for high-speed train ensured more stability. Some other countries, for example France, only used new railroads designed specifically for high-speed trains. An accident similar to the one in Germany happened to a French high-speed train called the TGV (Train à Grande Vitesse). In the year 1993 the TGV 7510 train derailed at a speed of 294 km/h and took 2.3 km to stop, and only two people were injured [1].

The part of the track used near Eschede was designed for older trains, thus lacked the stability provided by modern tracks [6]. Presuming that the Eschede accident happened on a track designed for high-speed trains, the number of casualties may have been lowered or even nullified as we see from the example in France.

III. Sequence of the accident

The ICE 884 was traveling from Munich to Hamburg [7]. A few minutes before reaching the bridge at Eschede the tire of the first passenger wagon cracked as seen in Figure 3. When the damaged wagon was under the bridge it jumped to the opposite track leading to the derailment of the two wagons behind it. When derailed the axle of the third wagon broke and crashed into the piers of the bridge leading it to collapse on top of the fifth and the sixth passenger coaches. The rest of the wagons subsequently crashed into each other, their coupling did not hold so they ended up forming a zig-zag shape as we can see in Figure 4 [6]. The front car (engine) and the first three passenger wagons came to a stop about 300m from the bridge. Most of the casualties were in the crushed wagons.

- FIGURE 3: The broken wheel rim [1]
- FIGURE 4: A view of the crash from a helicopter [5]

IV. Maintenance problems

The technology used for the maintenance of the train was outdated. Deutsche Bahn knew that their wheel design was more fragile than the previous one they used and that small cracks in the rim of the wheel can occur after some time of usage. The maintenance technology of the year 1998 was already advanced and used ultrasonic equipment to look for fractures or cracks in the wheels. Deutsche Bahn were aware that if they used this new maintenance method on the ICE 884 it would reveal those small cracks and a lot of the wheels would fail the check. German Railway thought those small cracks to be harmless, thus they stuck with the old-fashioned manual inspection of the wheel, which consisted of banging a hammer on the wheel and listening to the sound and later using torch lights to check for cracks. This method of

inspection was sufficiently accurate for the old models, but the new wheel design had a rubber damper, that changed the sound during hammering, and had some hidden parts, that were impossible to check with the naked eye [6].

V. Legal actions after the accident

- Deutsche Bahn paid out around £13600 each to the families of the 101 casualties [1]. They also paid out compensations for the injured people (amounts varied).
- Some families were unhappy with the compensated amount and sued Deutsche Bahn, but the court rejected the case.
- Three engineers had criminal cases filed against them in the year 2002. These three engineers were accused of 101 cases of manslaughter and causing 105 injuries because of their poor design of the wheels. The Lawyers of the accused did not agree with any of those accusations. 'Our expert witnesses have come to the clear conclusion that Deutsche Bahn and its engineers were fully correct in all aspects with regard to the technology of the time,' said Hanns Feigen, lawyer for the rail operator [8]. In the end no heavy blame was proven during the investigation so after 53 days the accused were fined £8868 each but not sent to jail [5].
- The conductor who did not pull the emergency brakes was sued by a couple of victims' families, but the case was dropped because according to the regulations the conductor must first know the problem before trying to take any actions.

VI. Discussion

A. Ethical problems

- Higher up engineers should have taken some responsibility for their subordinates and not have allow them to take the full blame when being prosecuted.
- The conductor of the ICE 844 should have stopped the train when the passengers were concerned about the noise because a professional engineer must 'hold paramount the health and safety of others draw attention to hazard' (Engineering council and Royal academy of engineering, 2017) [9].
- Deutsche Bahn should have not used the old methods of maintenance on the train to mask the small cracks in the wheel rim because any engineering company is supposed to avoid any deception and use the best technology possible to ensure safety [9].
- Deutsche Bahm clearly wanted to compete in speed with the French TGV but did not invest enough in the tracks before staring to use the first generation of ICE. So personal ambition and the corporate body came before the safety of the passengers.

B. Consequences of the accident

- German Railroad began to always use the ultrasonic equipment to check the for cracks in wheels. Before it was only used for new wheels before the first journey of the train.
- All the other ICE trains were inspected before any of them were allowed to continue carrying passengers [10].
- The wheel design used for the first generation of ICE trains was never used in Germany again. The second generation of ICE trains went back to use the standard mono-block wheel design.

- The accident happened near a railroad switch after this tragedy regulations of speed near them were made stricter.
- No other German train was ever given the name of Wilhelm Conrad Rontgen or the number 884.

C. Other factors worth discussing

- Prior to the accident Deutsche Bahm became a private corporation (before that it was owned by the country). Thus, greed and personal agenda could have been behind the reason of poor maintenance methods and the use of tracks made for conventional trains.
- ICE 884 was an advanced train and had sensors to detect issues but no sensor was installed to detect the failure of the wheels, though it was suggested by one of the employees before.
- The accident happened in an area easily accessible by air and by roads during a working day [3]. It only took the rescue teams a couple of hours to start taking care of every injured passenger. If not for these factors the number of casualties could have been much higher.

VII. Conclusion

Eschede (1998) is still the worst train accident in the history of Germany. The main reasons of the crash are: poor job by the engineers when designing the wheel, some of the tracks were not suitable for high-speed trains and methods of maintenance were inaccurate.

Although, this was a gruesome crash it taught Deutsche Bahm a serious lesson. Wheels of ICE trains never used rubber dampers in their design again. The old-fashioned maintenance method was replaced with the more accurate one. Every victims’ family and every injured person were paid compensations by German railroads