WHAT GIVES US IMPETUS

LIKE A TUNING FORK

The blades of modern turbines are made of high-strength steel and are very thin. This is good for the flow behaviour, but unfortunately also for the vibrations. In order to ensure that they do not constantly vibrate like a tuning fork and, in the worst case, destroy the turbine, Jörg Wallaschek is currently carrying out research into friction damping in Hanover. To do this, however, he first had to give up his planned career as a musician.

JÖRG WALLASCHEK

Damping large turbines with friction

A marquee in the Odenwald. The village residents are eating sausages, drinking beer and generally having a good time. One or two people prefer the popular regional cider served in earthenware pitchers. Onstage is ‘Das Trio’, although there are actually four musicians in the band playing one German pop hit after another. Jörg, the young bassist, is still a little uneasy. He actually prefers to play the guitar, but the band needs a bassist right now. Meanwhile, his godfather is sitting on one of the benches in the marquee eyeing him critically. ‘The lad still has his head in the clouds,’ he says to himself. ‘He needs to do something sensible with his life.’ A little while later he finds his charge a work placement at a mechanical engineering company. For the young man who has just left school, it provides the initial spark. He was still considering photography or music as potential careers, but now he wants to head in a completely different direction. Jörg decides to study mechanical engineering at the TU Darmstadt.

It was undoubtedly the right decision. Today Jörg Wallaschek researches and lectures as a professor at the University of Hanover and is head of the Institute of Dynamics and Vibration Research, which employs around 50 people. One of his specialist fields is the vibration behaviour of large turbines. This is by no means trivial. ‘The blades of modern gas and steam turbines used in power stations, for instance, are made of high-strength steel and must be as slim as possible in order to meet the requirements relating to flow mechanics,’ explains Wallaschek. ‘However, this is at the expense of vibration resistance.’ Similar to a tuning fork, even small levels of excitation can cause the turbine steel to vibrate for a long time afterwards. Classic damping is not an option: rubber vibration absorbers would not be able to withstand temperatures of up to 700 degrees Celsius. And even if they could, they would hinder flow within the turbine. ‘Without any kind of damping, however, there would be a resonance-induced catastrophe – the turbine would vibrate itself to death,’ explains Wallaschek.

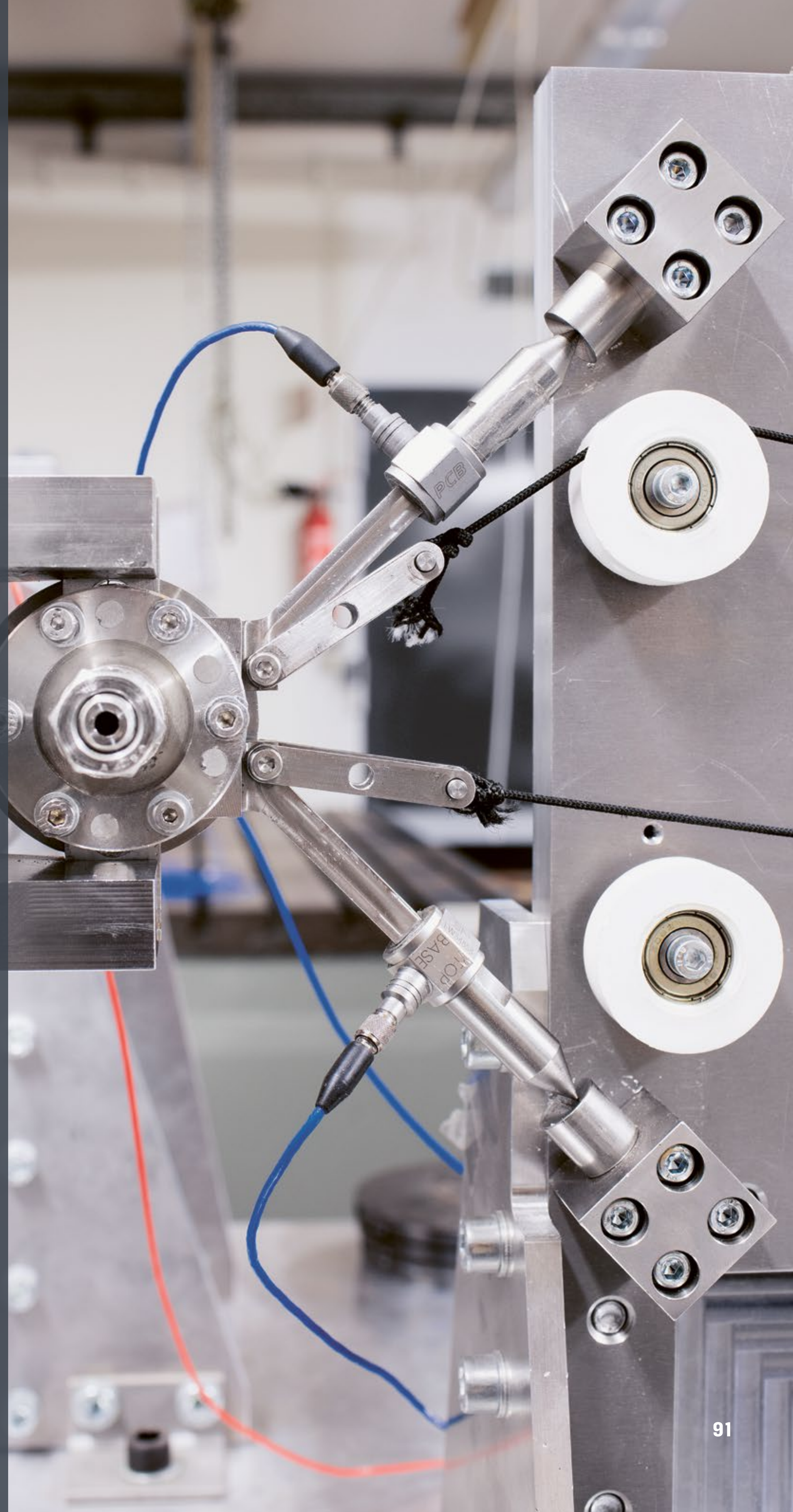
The solution is known as friction damping. This involves incorporating high-precision joints in the turbine blade, thereby creating friction surfaces on which the individual elements slide together. For example, the steel in the shroud at the end of the blade wheel is cut. When a blade vibrates and builds up relative movement to its neighbouring blade, then the shroud elements rub together and dampen the system. Metallic friction elements are also used at the foot of the blades.

Important factors affecting how the friction surfaces work include the structure of the surfaces and the geometry of the

PROF DR JÖRG **WALLASCHEK**

Born 1960

Wallaschek spent his childhood and youth in the Odenwald. After leaving school he studied industrial engineering, mechanical engineering and mechanics at the **TU Darmstadt** and the **École Centrale de Lyon,** graduating in 1985. After spending time working as a scientific assistant in Darmstadt at the Institute of Mechanics and completing his doctoral studies, he worked at the university as an assistant professor and was employed at the AEG research centre of **Daimler Benz.** He received his habilitation in 1991. Then he returned to university: initially for 15 years as professor of mechatronics and dynamics at the **University of Paderborn** and since 2007 as the head of the Institute of Dynamics and Vibration Research at the **University of Hanover.** Wallaschek is married and has three grown-up children.



turbine, which influences the preload and centrifugal force. Wallaschek is also researching this interaction in an FVV project. 'We call it experimental validation,' he explains. 'Firstly, we are developing new mathematical methods for calculating the vibration behaviour. Secondly, we are validating the results in the experiment.' The joints are designed on the basis of a predetermined crevice geometry, preload force and temperature. Later on, a so-called interferometer uses a laser beam to measure the blade's vibration amplitude. This allows the scientists to test whether the calculated vibration behaviour also corresponds with the reality.

'Here at the university we mainly conduct basic research; the world of industry is primarily interested in concrete results,' says Wallaschek. 'That is why the FVV projects are very important, because there is a big gap between basic research and applied research; individual partners wouldn't manage it so well on their own.' Wallaschek knows what he is talking about, because he is familiar with both sides. Before his time in Hanover, where he became head of the institute in 2007, he was professor of mechatronics and dynamics at the University of Paderborn for 15 years. His familiarity with the other side comes from his time as divisional head at a Daimler research institute. 'That was a fascinating time for me, but eventually I had to admit to myself that my job was largely determined by others – I wasn't always able to do what I felt was important.' As such, he considers his true vocation to be his work at the university. 'The academic freedom associated with research is something to be valued,' he says. 'I have consciously eschewed financially more attractive options in my career to do this.'

Another thing is even more important to him. 'When I work with young researchers nowadays, I often see the person I was back then,' he says. 'There were always people who would help me to find my way. What those people were to me, I now want to be to other young people.' One such instance is when one of his doctoral students is afraid of not achieving the project aim.

Wallaschek then tries to give his charge self-confidence: everything is alright, you can do it. 'In research especially, the outcome and the success are not predictable. More important than just-in-time delivery is that somebody approaches their scientific work sincerely and takes no unauthorised shortcuts,' he says with conviction. 'Only in this way am I able to establish an environment in which enthusiastic young people grow into themselves.' As far as music is concerned, Wallaschek has now also found his feet. He no longer plays German pop hits and has given up the bass in favour of his own instrument: classical guitar. Unplugged.

An environment in which young researchers can grow

Photo: *Research and teaching; calculation and experimentation – Wallaschek values the academic freedom.*