Pedestrians enjoy more comfort on their way to the Auto City of Wolfsburg

Maurer Söhne installs dampers in the bridge and thus reduces vibrations to almost 1%.

Munich, Wolfsburg. **The pedestrian bridge leading to the Auto City of Wolfsburg can now, 10 years after its inauguration be crossed much more comfortably. Vibrations at critical locations were considerably reduced, partially to almost one hundredth of its original magnitude. Maurer Söhne achieved this with 43 tons of damper mass, distributed over 8 tuned mass dampers, which could be integrated invisibly into the bridge structure.**

The 245 m long pedestrian bridge enjoys considerable pedestrian traffic. The bridge leads from the railway station to the Auto City of Wolfsburg and on to the VW-Arena, crossing among others railway lines and the Mittelland canal. At its Southern end it is accessible via an escalator, at its centre and in the North via stairs. The bridge is an aesthetically demanding structure, also its stability was perfect, but the crossing comfort was reduced. The bridge "wobbled" so strongly that for some pedestrians the crossing of the bridge lead to physical discomfort.

Maurer Söhne with its competence not only in steel or bridge construction, but also in the damping of structural vibrations, was entrusted to retrofit the bridge with tuned mass dampers. The particular challenge was to neither disturb the slender appearance of the bridge, nor to overload the structure.

Integration into the main girders

The steel bridge is being supported at six locations by vertical and inclined columns. This results in five fields, of which the two biggest fields with span widths of 79.5 m respectively 77 m make the biggest impact onto the vibrational behaviour. Two roofed automatic moving sidewalks lead through these two fields. The roof structure is fixed to the bridge deck.

Originally it was planned to simply hang the dampers underneath the bridge. However this would have required to work directly above the railway tracks, which would as a consequence had meant their closure. For security reasons and a lengthy approval procedure this situation had to be avoided. Therefore, Maurer Söhne integrated the eight tuned mass dampers into the voids of the main girders. This had an additional advantage in that the dampers were installed further to the edge of the structure, leading to a more effective mass concentration. Or the other way round, damping mass could be saved.

To be installed were four horizontally and four vertically acting MTMD (Maurer tuned mass damper). Their damping effect particularly aims at the horizontal vibrations (0.84 Hz) and at the torsional vibrations (1.9 Hz). Their 43 tons of damper mass are relatively small and make only 1.5% of the modal mass – 5% would be normal. 26 tons of mass damp the vertical vibrations, 17 tons damp the horizontal vibrations.

For aesthetic reasons, the installation of the dampers had to be carried out underneath a tent.
Photo: Maurer Söhne

The flame zinced tuned mass damper with a weight of 6,500 kg/unit and a vibration frequency of 1.87 Hz prior to installation at the pedestrian bridge leading to the Auto City of Wolfsburg.
Photo: Maurer Söhne

Contact for the press

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Difficult installation to measure

Under several aspects the installation posed a challenge:

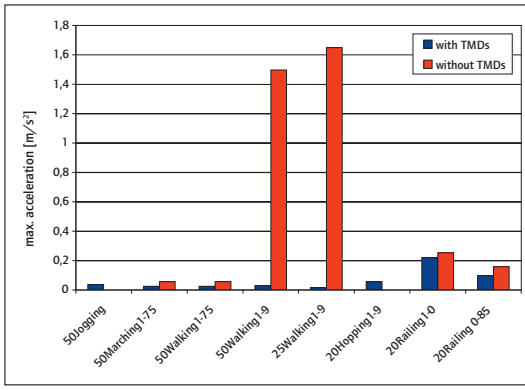
- **Technical aspect**
  For the installation, the bridge boxes had to be opened from above, which compromised the statics and the stress distribution in the structure. The openings therefore had to be made as small as possible, and being strengthened with steel. Cables had to be installed, and the insertion of the up to 6.5 ton heavy dampers was a precision job. Then, the damper chambers had to be closed with optically suitable lids, because accessibility hat to be ensured at all times.
- **Optical aspect**
  During the day, this bridge is lively frequented and poses as the gate to the Auto City. Correspondingly, Volkswagen set high demands to the aesthetic even of the job site: it was covered under a tent. The white tent canvas was selected in accordance to the colour concept of Volkswagen, and had to be regularly cleaned.
- **Nigh shift under time pressure**
  To be added was a high time pressure, combined with the condition to work only in the night from 23 hrs to 6 hrs, because a major event on 28./29. November required a completely freely accessible bridge. In addition, the bridge had to be kept open at all times at least at one lane.

Job done: Vibrations comprehensively reduced

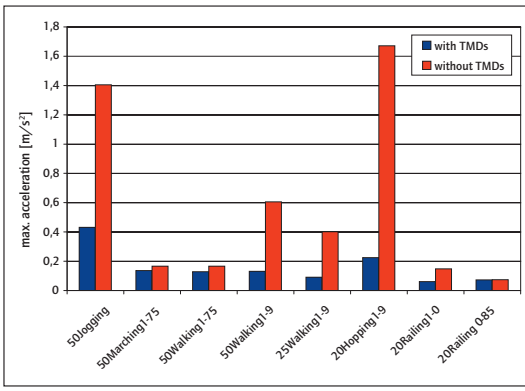
On November 26, 2009, Maurer Söhne conducted measurements with up to 46 test persons, who also arbitrarily caused vibrations, thus simulating vandalism, for example in shaking the bridge rails or keep time with hopping. All measurements resulted in acceleration peaks far below the comfort limit of 0.7 m/s², and anyway far below those values that had been measured before the dampers were installed. The most remarkable damping effects were achieved in the section "walking group of pedestrians". For example, the horizontal acceleration peaks for a group of 25 persons could be reduced to 1/97, and for a group of 50 persons to 1/50. That is, 1% or 2% of the initial vibrations remain.

The dampers did not have to be adjusted in their tuning, because by way of careful planning and additional measurements of the vibrations the required damping characteristics could be exactly calculated. In particular the so called lock-in-effect could be eliminated, which is created when pedestrians react to vibrations of the bridge structure in a way that these vibrations are amplified.

Axis 55 East, horizontal acceleration



Axis 55 East, vertical acceleration



The graphics illustrate the acceleration peaks before (red) and after (blue) the installation of the dampers. Of particular relevance are the columns "50walking1-9", and "25 walking1-9", these are groups of pedestrians. As desired, for these groups the biggest damping effect was achieved: to 1% respectively 2% of the horizontal vibration (above), and to less than 25% of the vertical vibration (below).

Graphics: Maurer Söhne

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