Site-Specific Probabalistic Bridge Load Assessment

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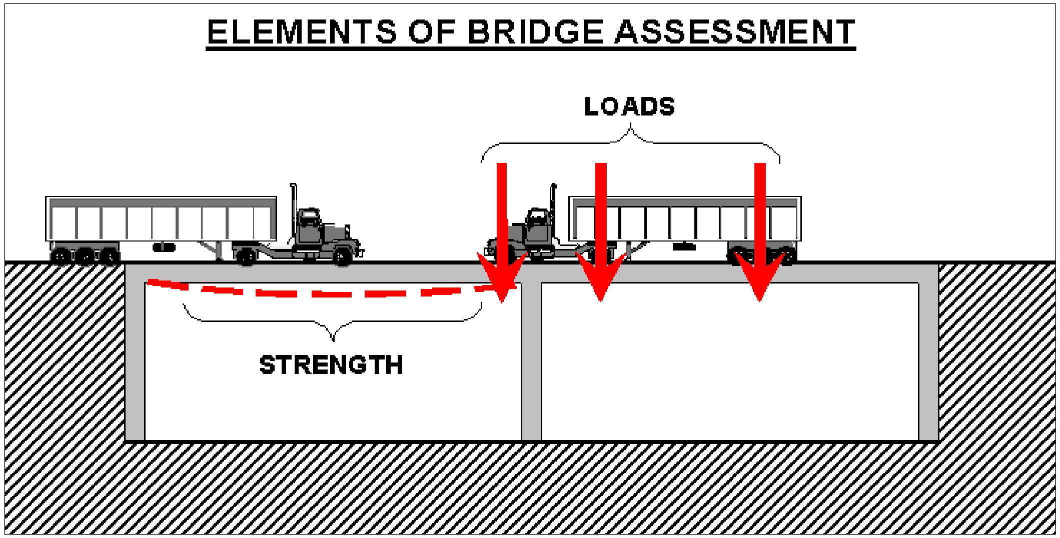
Loading is a great source of uncertainty in bridge assessment



Weigh-In-Motion is used to obtain the statistics of the traffic characteristics of the site.

Simulations based on the statistical data can be performed.

In this paper:

- Data was collected for a bridge in Vienna

- Monte-Carlo simulations of the site were performed

- The results are compared to the direct strain measurements

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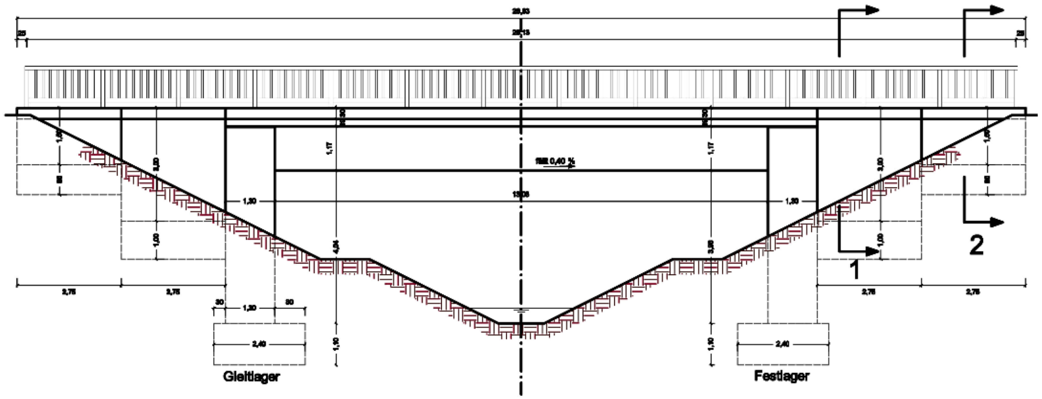
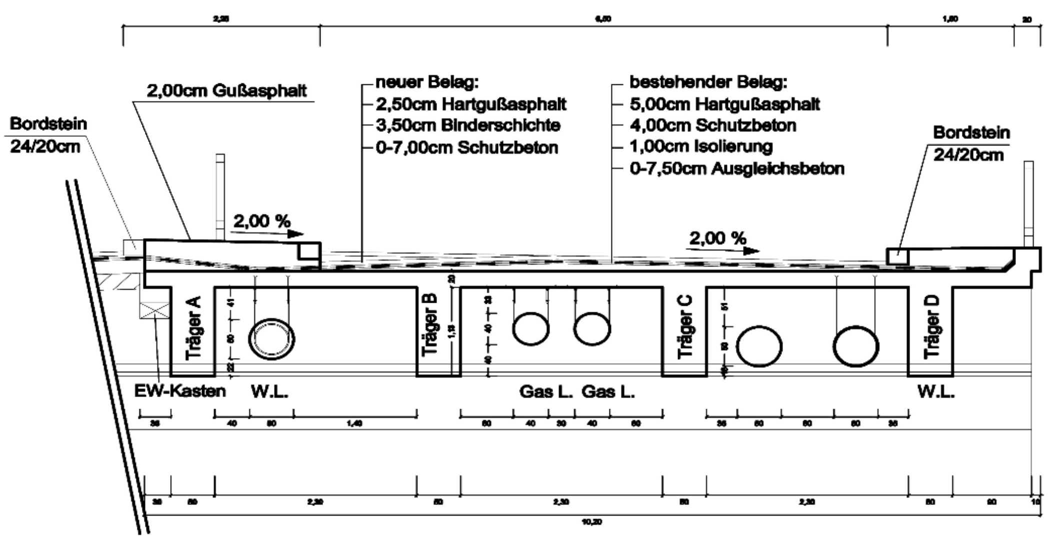
Field Measurements





The SiWIM weigh-in-motion systems was installed on the B224 road bridge in Vienna.

Data was collected for 4 days after calibration runs were performed.

Over 16,000 trucks were identified.

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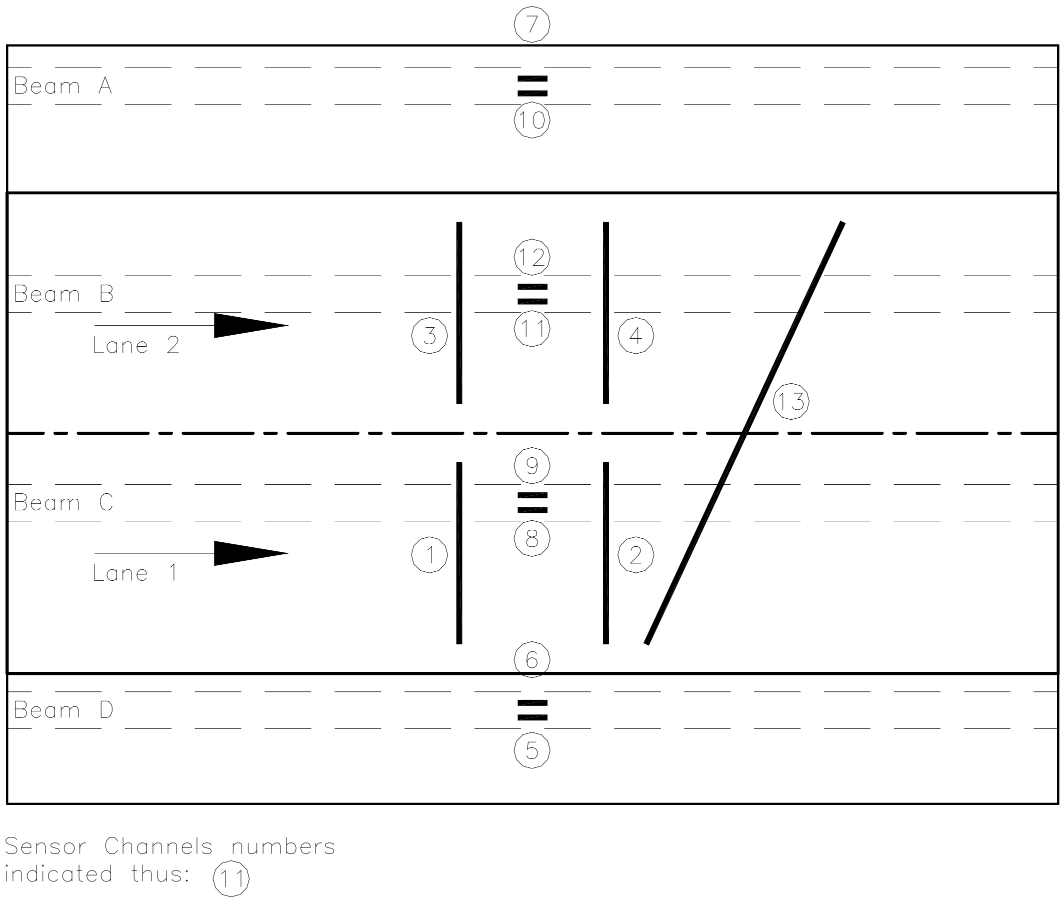
Traffic Simulation

Monte-Carlo traffic simulations were performed based upon the WIM data obtained.



Actual influence lines for the strains at the mid-span of Beams A, B & C were obtained for each lane (1 & 2) from the calibration runs.

These influence lines were used to obtain the strains from the simulated traffic.

No dynamic amplification was allowed for.

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Prediction of Extreme Load Effects

Extreme value statistics is used to exptrapolate from the simulation period to the 1000 year values of the load effects…

The Gumbel type distribution is assumed:

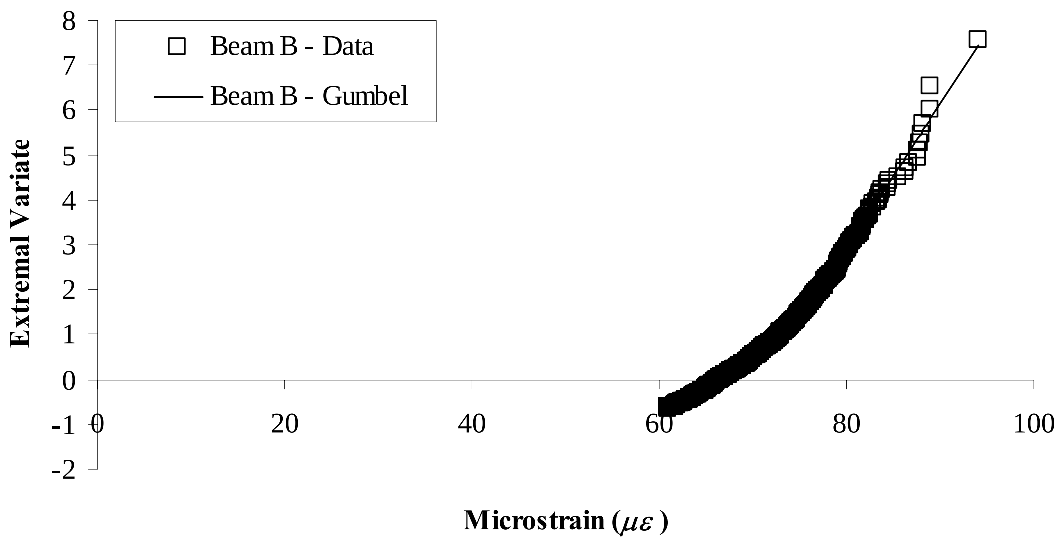
- Simulations: Hourly maximum effect is used as the Gumbel population

- Measurements: the 20 critical cases were used as the Gumbel population

Lines are fitted to the data on probability paper: y = mx + c characterises the distribution

Only $k = 2\sqrt{n}$ tail data is used in the fit…

15.6 on the y-axis corresponds with a 1000-year return period; thus, knowing the line equation we establish the x-axis value.



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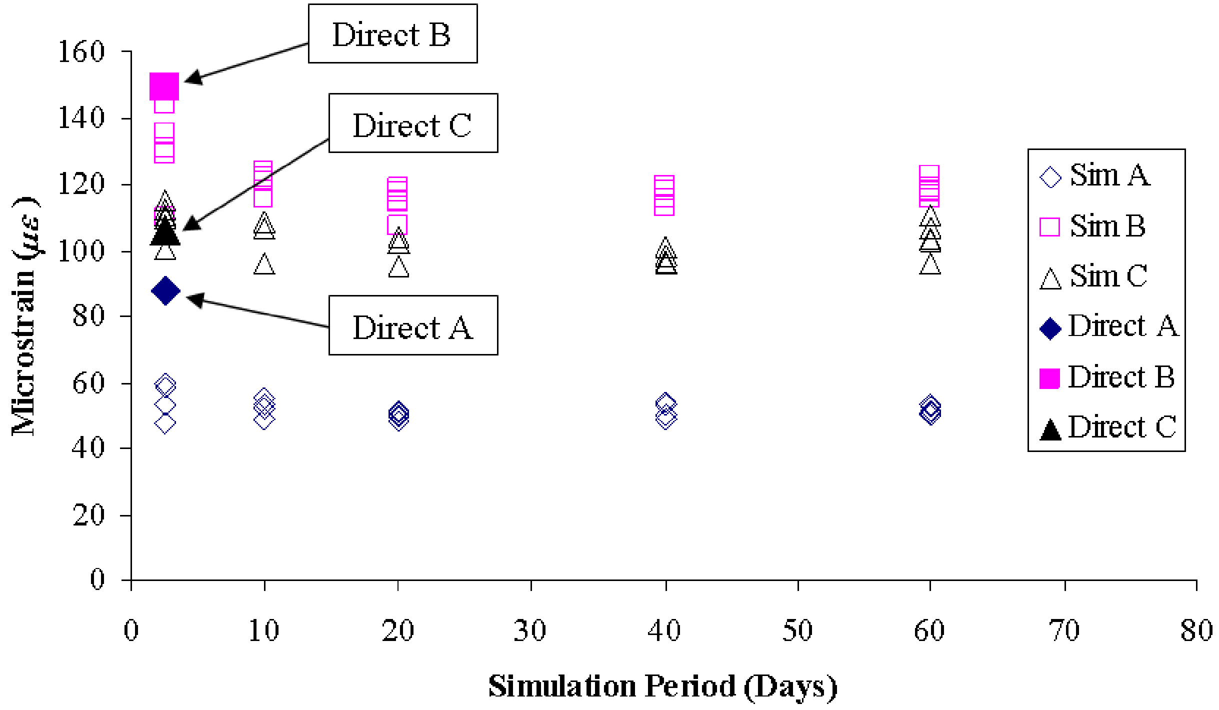
Results

To assess repeatability, 5 runs were produced for several simulation periods.



It can be seen that:

- The results for A and B are poor, whereas for girder C the results are good.

- The simulation results converge with longer periods.

Explanation of Results

- For Girder C, under the slow lane, the simulations and measurements give reasonably consistant results.

- For Girders A & B, both adjacent to the fast lane, the results are poor.

- There was significantly more WIM data available to model the slow lane tha the fast lane.

- The influence lines obtained in each calibration run were more variable for the lane furthest from the Girder.

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- As expected, the simulation results converge with increasing sample period.

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Conclusions

1. **Results are sensitive to the period simulated and measured.**
2. **For different slices of influence surfaces, many calibration runs are required.**
3. **With increasing simulation period, for different runs, the results converge.**

Traffic load simulation is a useful means of determining site-specific characteristic load effects for use in bridge assessment but the accuracy depends on the input and sample period.

Acknowledgments

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