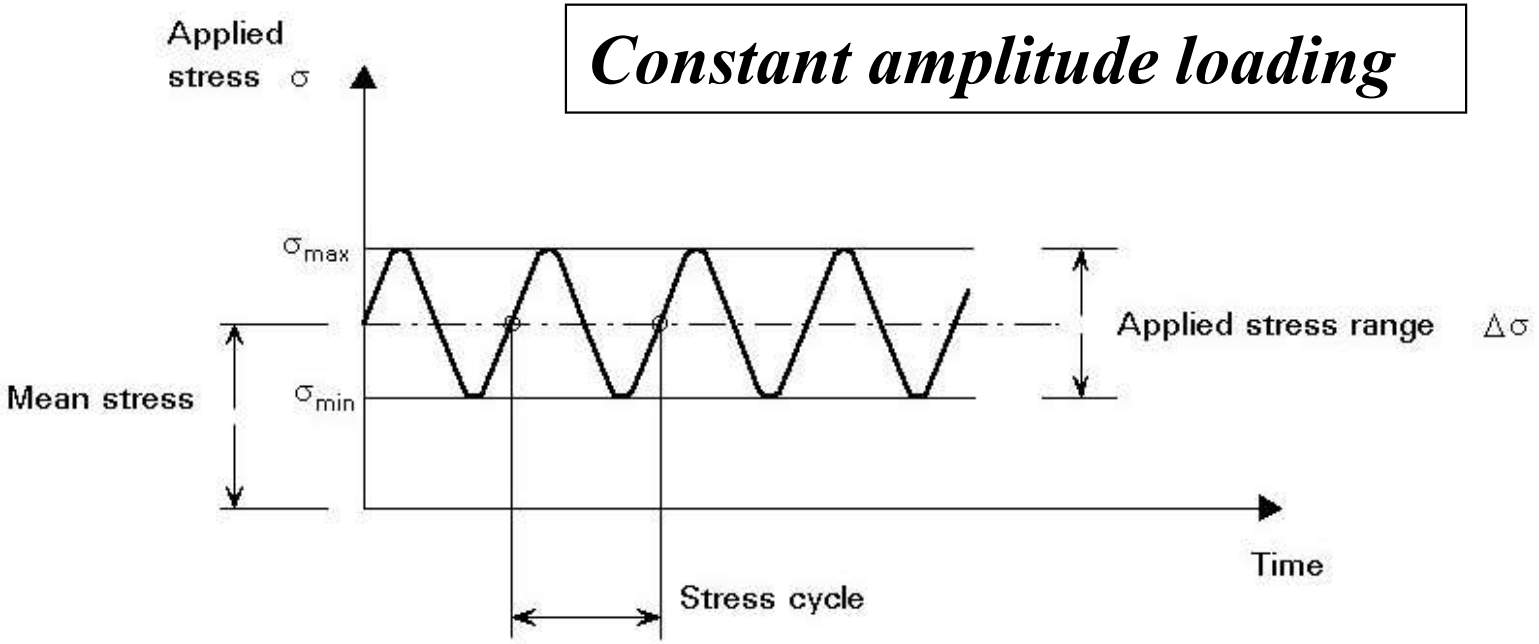
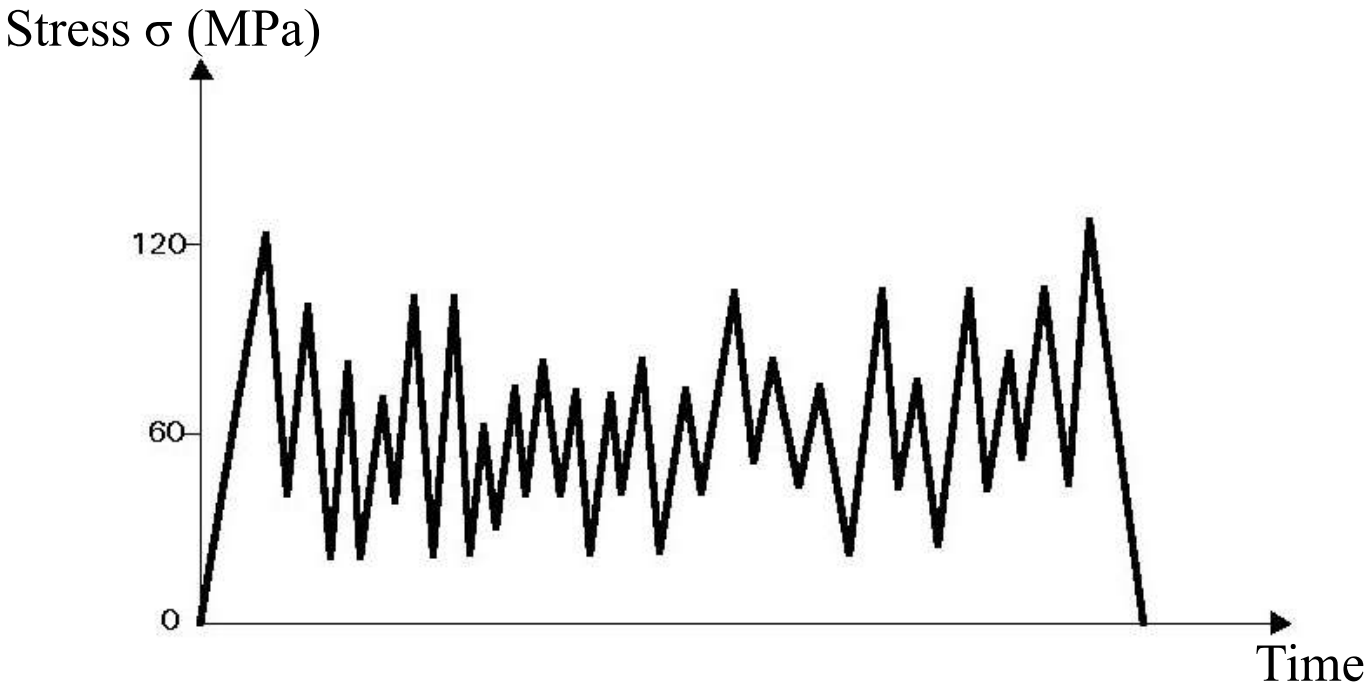
Fatigue loading



- Stress range $\Delta\sigma = \sigma_{max} - \sigma_{min}$
- Mean stress $\sigma_m = ½ (\sigma_{max} + \sigma_{min})$
- Stress amplitude $\sigma_a = \Delta\sigma / 2$
- Stress ratio $R = \sigma_{min} / \sigma_{max}$

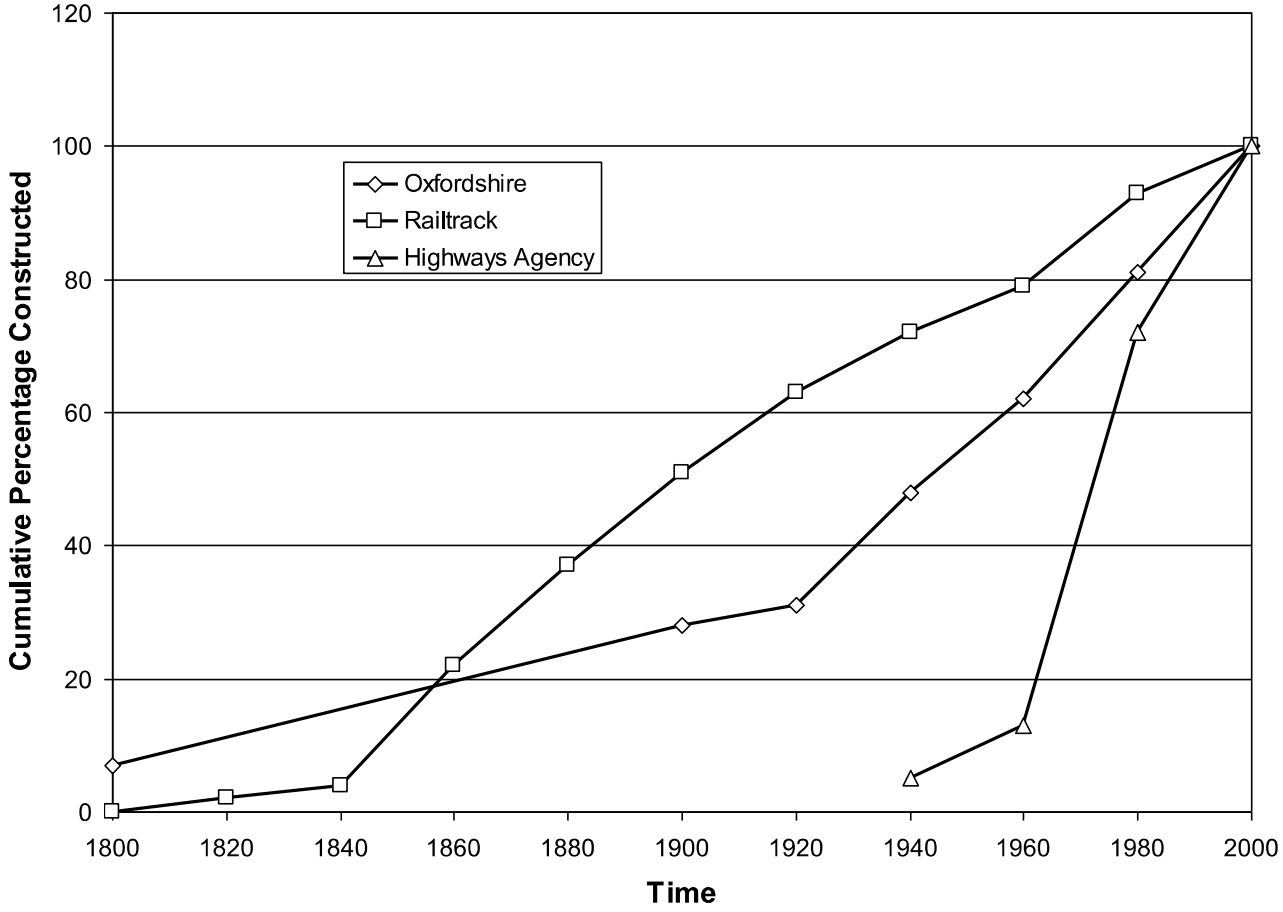
Fatigue loading



Variable amplitude loading

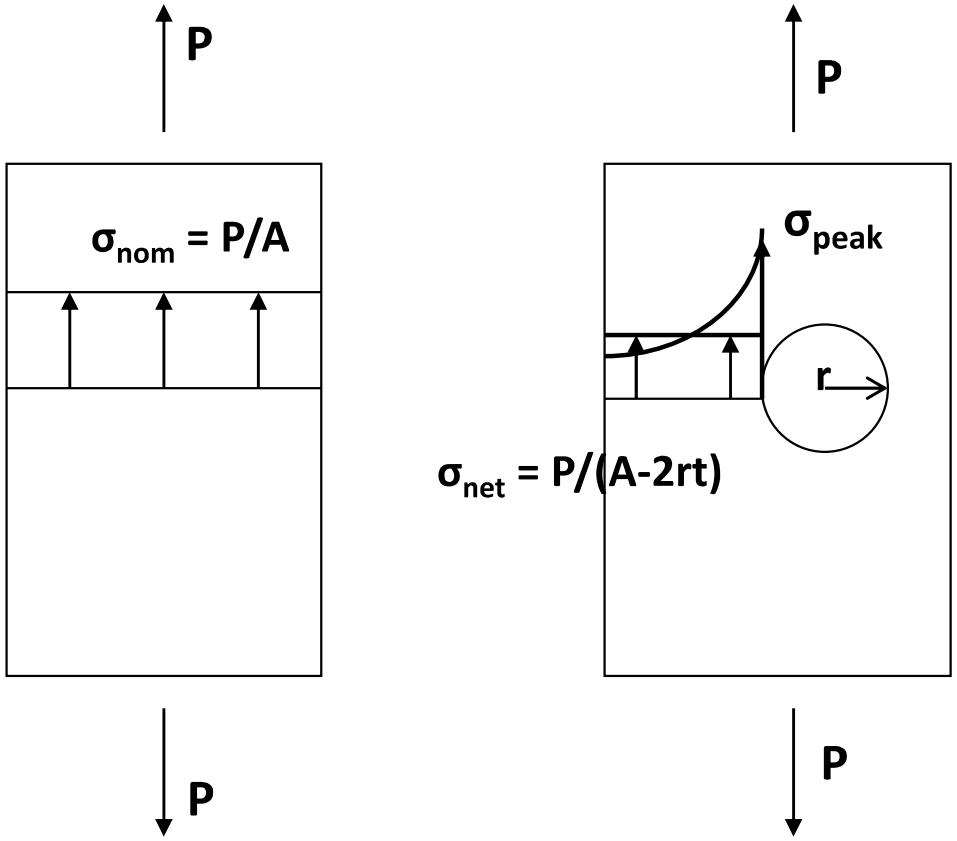
Bridge loading from live loads (e.g. vehicles, cars, trucks, trains)

Need for managing bridge fatigue



- Bridges built over the last 50 years or so are designed to be fatigue-resistant
- BUT there is a large number of steel bridges not designed for fatigue!
- Uncertainty and increase in traffic loads may lead to fatigue cracking
- Inspection and maintenance schemes need to be set on a rational basis

Fatigue & stress concentrations



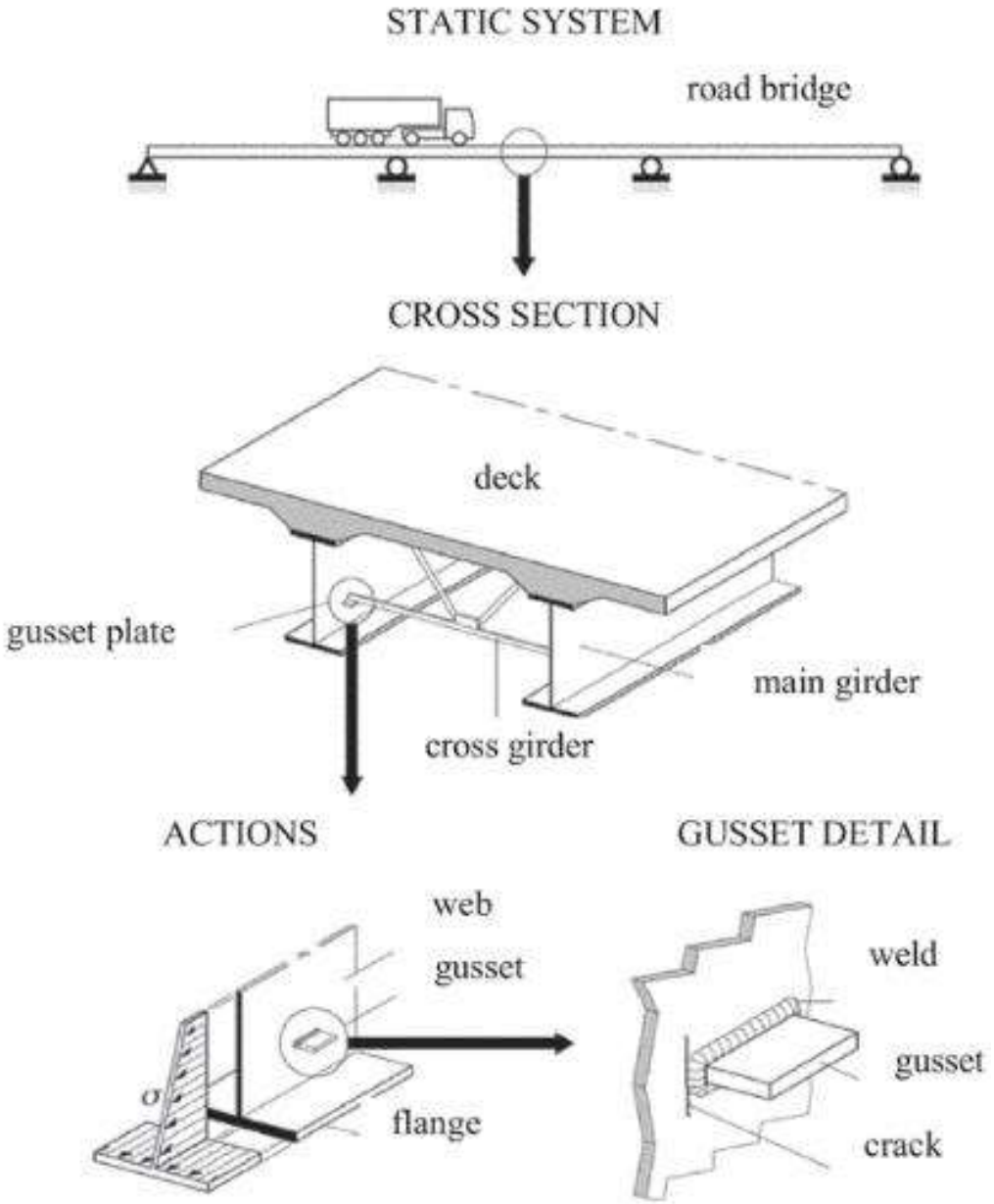
Stress concentration factor

$$K_t = \frac{\sigma_{peak}}{\sigma_{net}}$$

The higher K_t, the lower the fatigue life

- A stress concentration is the elevation of stresses, locally, beyond their nominal values
- Stress concentrations arise from any change in geometry, which disrupts the normal flow of stress
- Holes, notches and the connection of different elements give rise to stress concentrations
- Fatigue cracks are expected to form at the position of these local stress risers

Fatigue & stress concentrations



Possible location of a fatigue crack in a road bridge