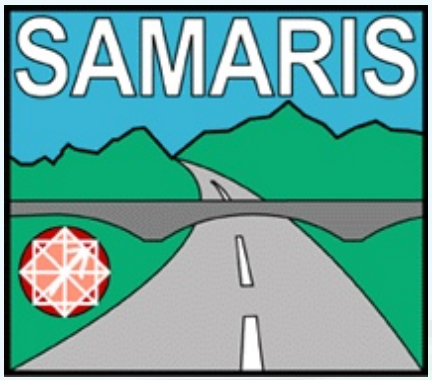


SAMARIS

Sustainable and Advanced MAterials for Road InfraStructure

DELIVERABLE D19

STATE OF THE ART REPORT ON ASSESSMENT OF STRUCTURES IN SELECTED EEA AND CE COUNTRIES

Introduction

- Differences in traffic loading on bridges exist across Europe
- Both in terms of volume and statistical distribution of Gross Vehicle Weights (GVW)
- Influenced by geographic location, economic development and regulatory/enforcement practices
- This study focuses on the corresponding differences in bridge repair needs, through the examination of characteristic load effects and Eurocode Alpha-Factors

- Traffic data from Weigh-in-Motion (WIM) stations in the Netherlands (NE) and Slovenia (SI)
- NE and SI sites assumed to be representative of older and newer EU member states respectively

NE WIM Sites

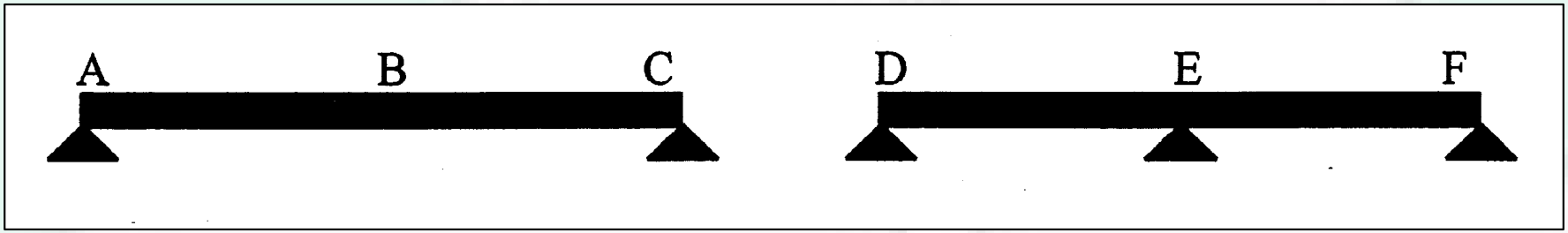
SI WIM Sites

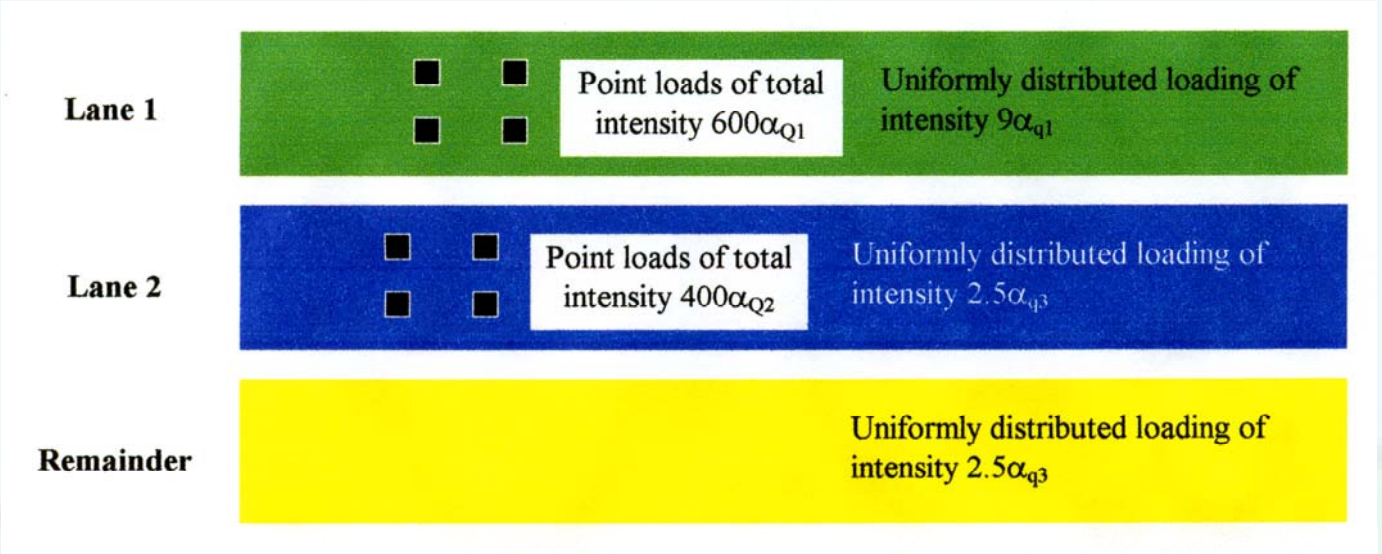
- For the SI and NE WIM sites, data consisted of:
  - Hourly flow rates for each direction
  - Composition of truck traffic (no. of axles) for each direction
  - GVW based on number of axles and direction

- Other information required was taken from French WIM Data, and consisted of:
  - Speed, per direction
  - Axle spacings for each direction and vehicle class
  - Axle weight distributions as a function of GVW for each class and direction

Eurocode Alpha Factors

- Load effects calculated using statistical extrapolation methods, results compared to Eurocode for trafic loading, EC1, Part 3 (1994)
- 3 Bridge lengths examined (15m, 25m, 35m)
- 3 Characteristic load effects examined:
  - Bending moment at midspan B
  - Hog bending moment at E
  - Shear at A

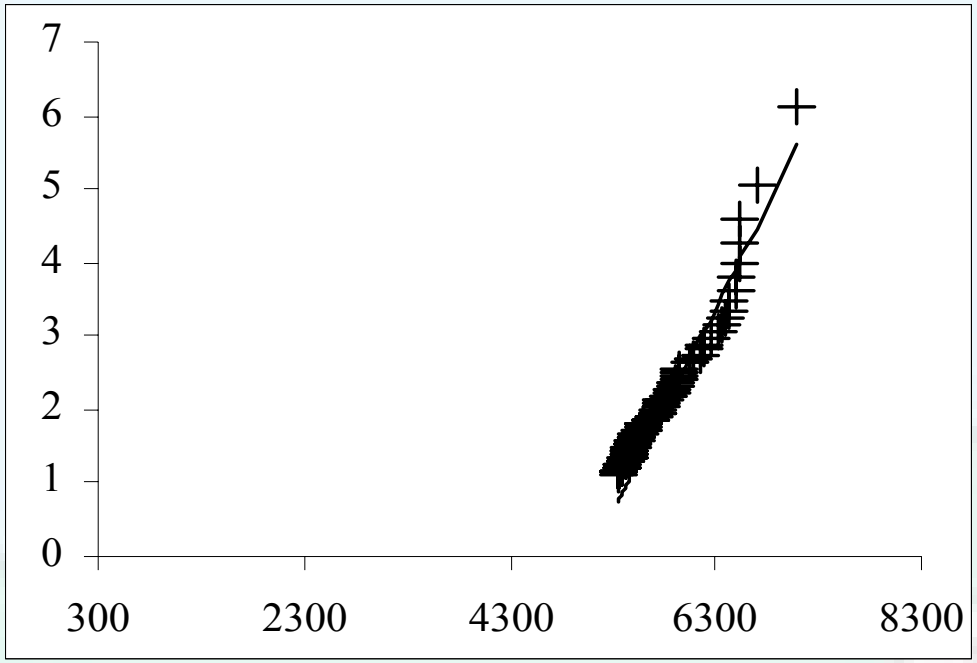




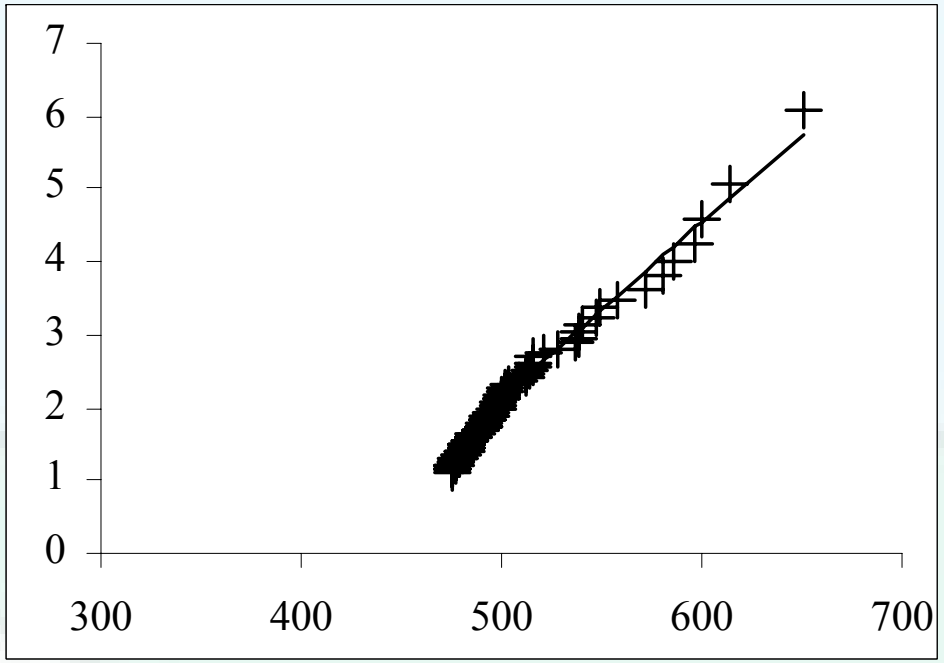
- Bridges assumed to be 8m wide, having two notional lanes of 3m each
- In each case, a Eurocode calibration factor (alpha factor) was calculated as the ratio of the characteristic static load effect to the corresponding load effect using the Eurocode Normal Loading model

Simulation

- 5 runs of 50-day simulation periods carried out
- Same bridge lengths and characteristic load effects as described earlier
- 250 daily maxima obtained (for each effect and length) were extrapolated using the Gumbel distribution giving the 1000-year return period characteristic value
- Best fit is to the $2\sqrt{n}$ greatest of the maxima, where n is the no. of maxima (Castillo 1991)



Load Effect 1, 35m length

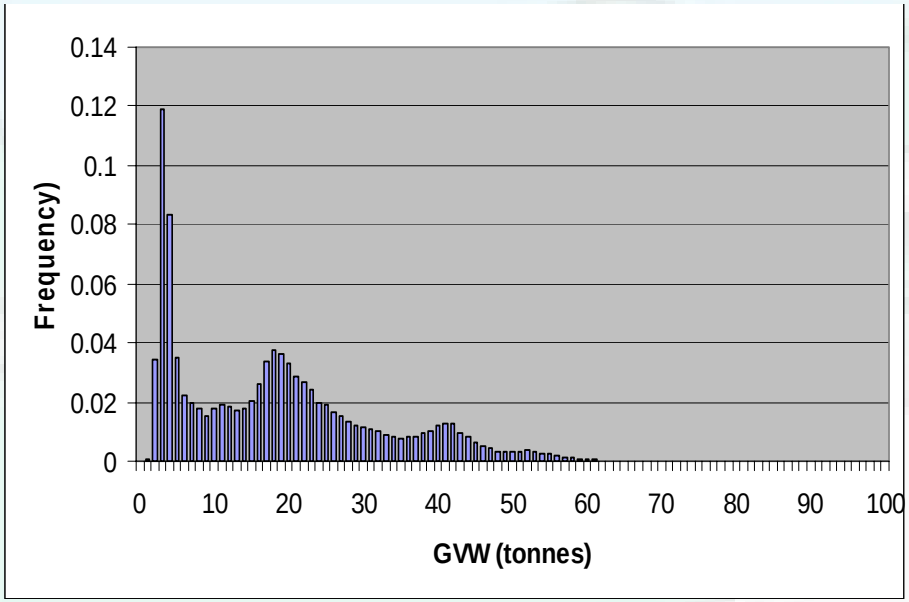


Load Effect 3, 15m length

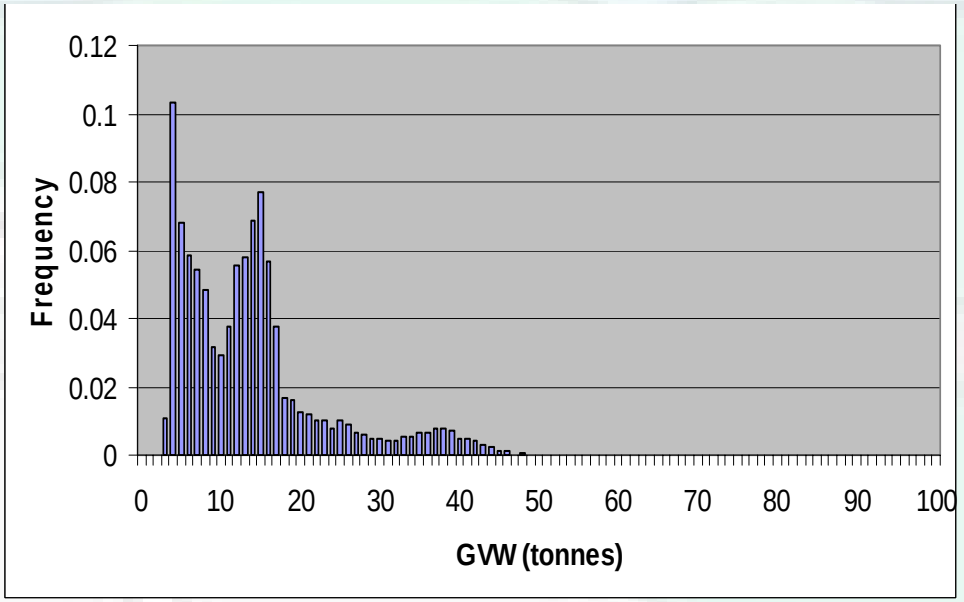
- Typical plots of daily maxima for NE Site 1, to an inverse Gumbel scale (probability paper) are illustrated above

Effect of Histogram Shape

- Significant differences in shapes of histograms between NE and SI sites

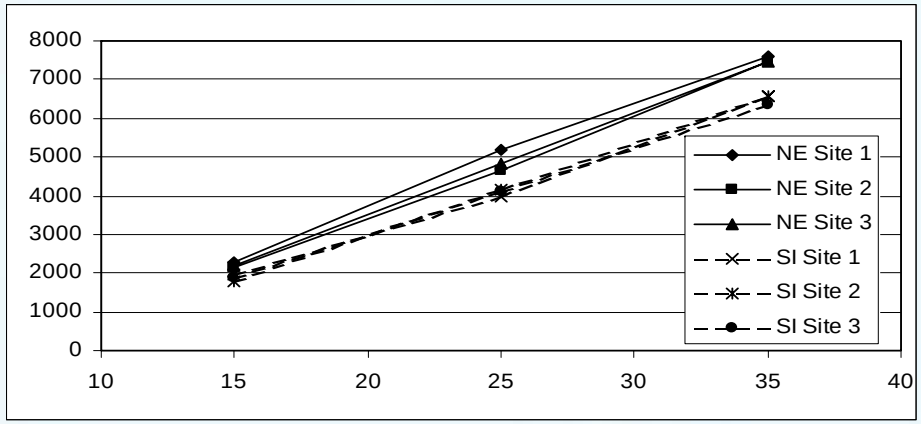


NE Site 2

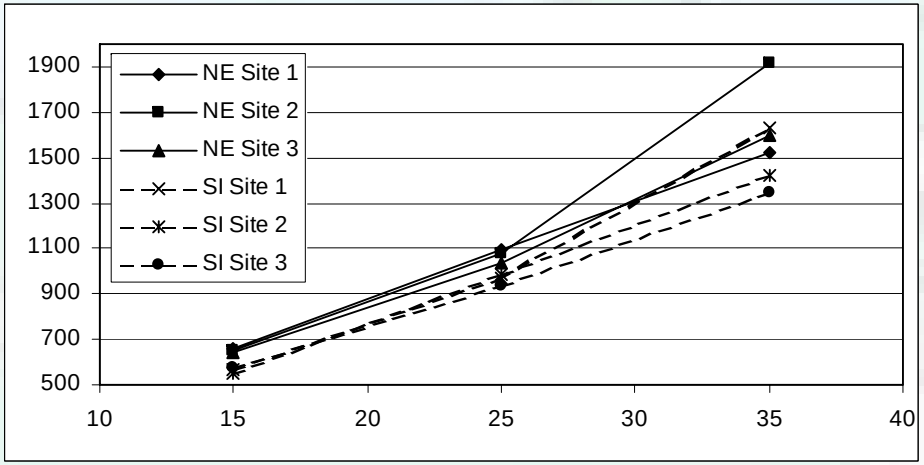


SI Site 2

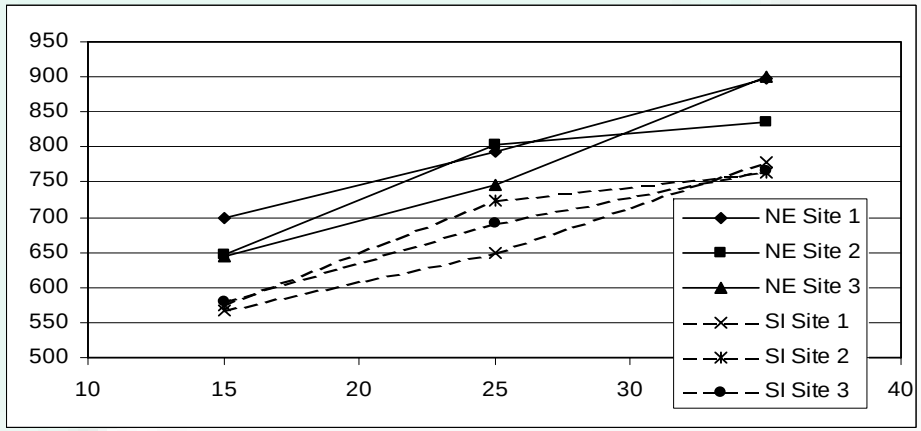
- To identify influence of histogram shape, a notional flow rate was used for all sites



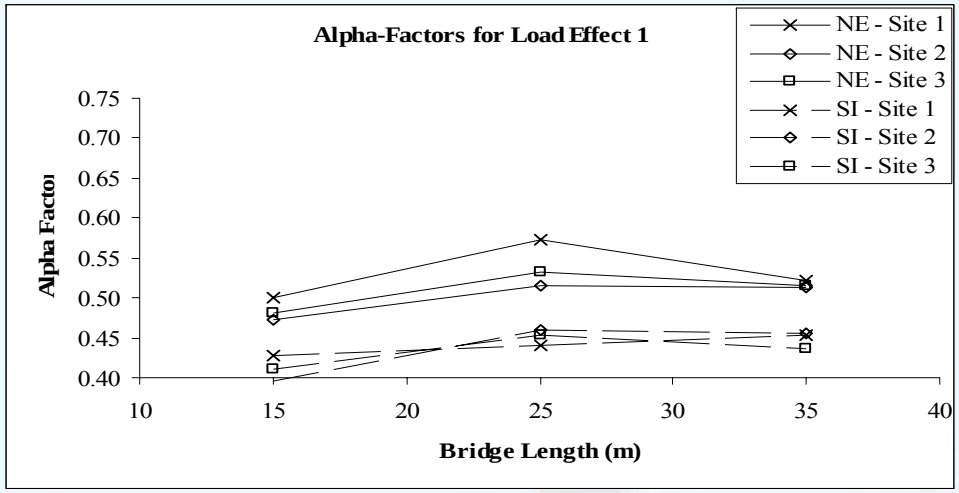
Characteristic Values
for Load Effect 1



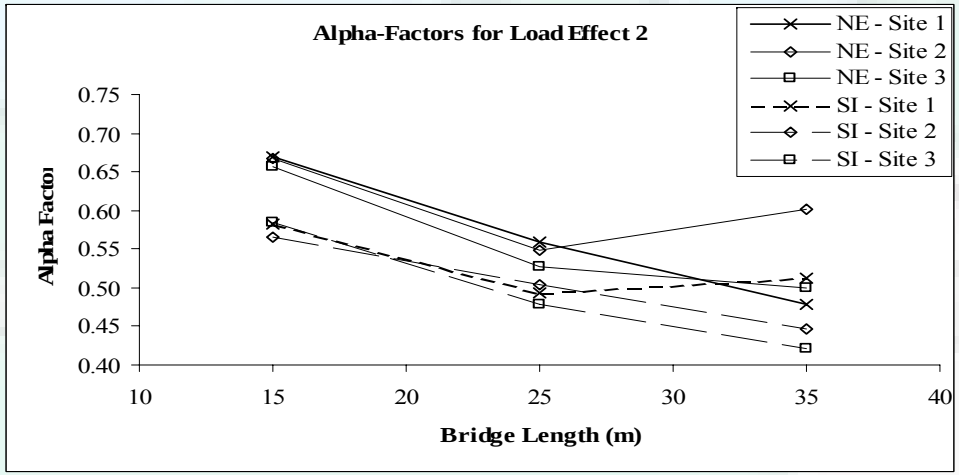
Characteristic Values
for Load Effect 2



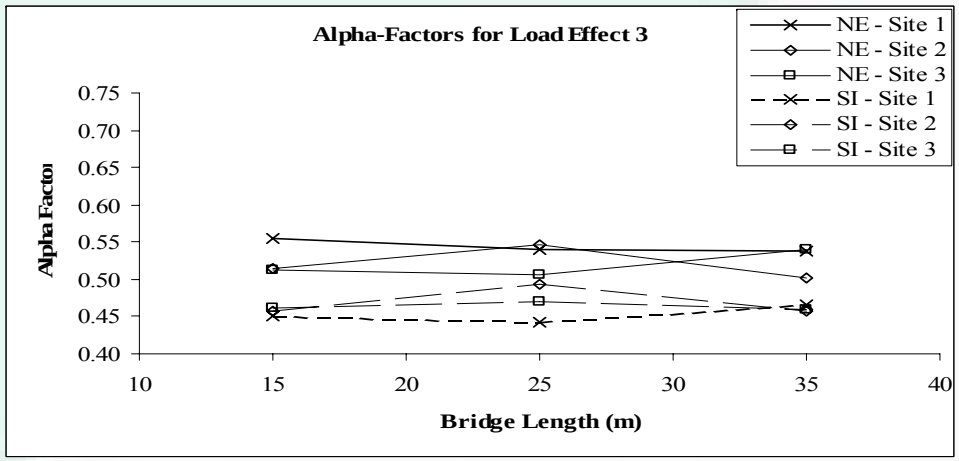
Characteristic Values
for Load Effect 3



Alpha Factors for Load Effect 1



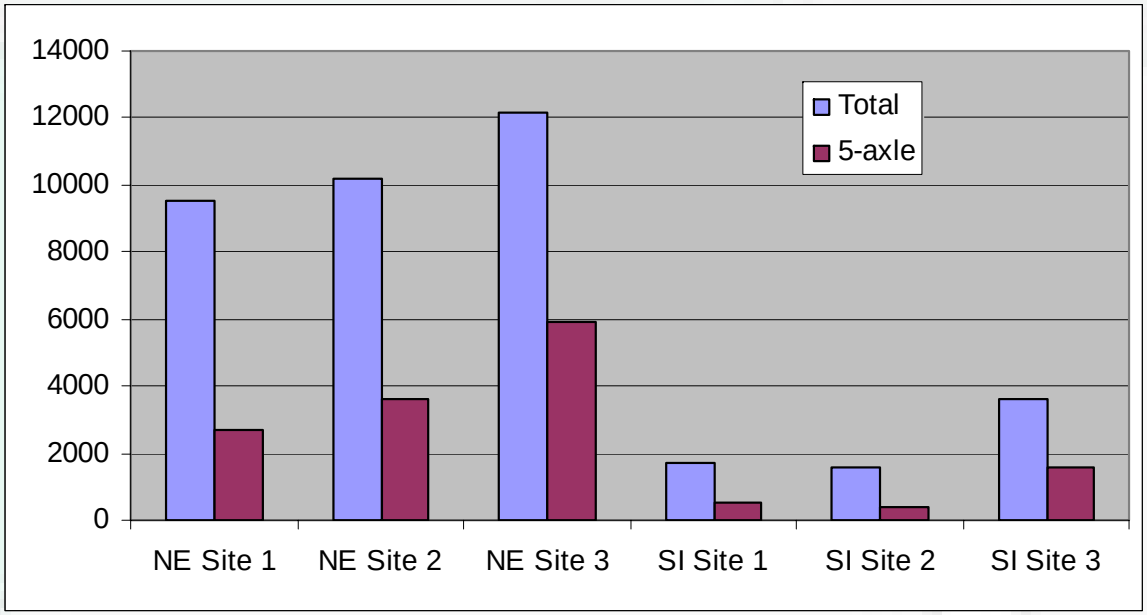
Alpha Factors for Load Effect 2



Alpha Factors for Load Effect 3

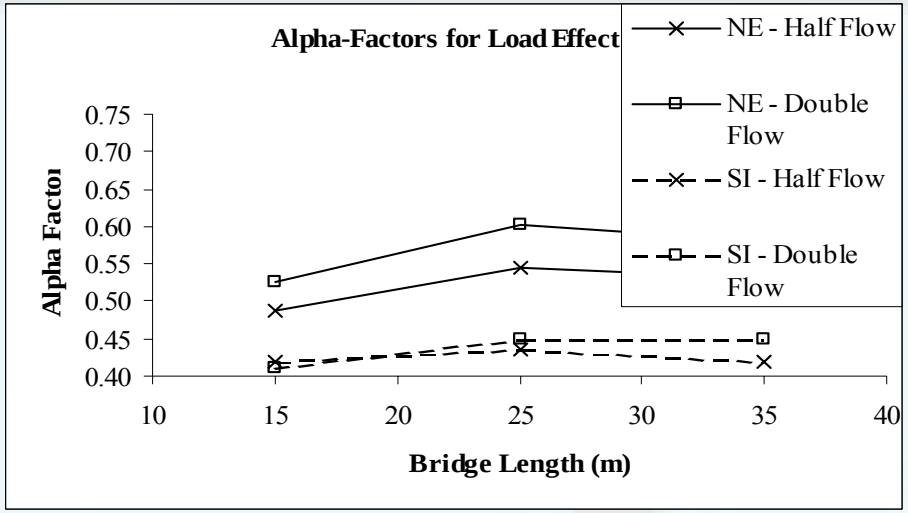
Effect of Flow Rate

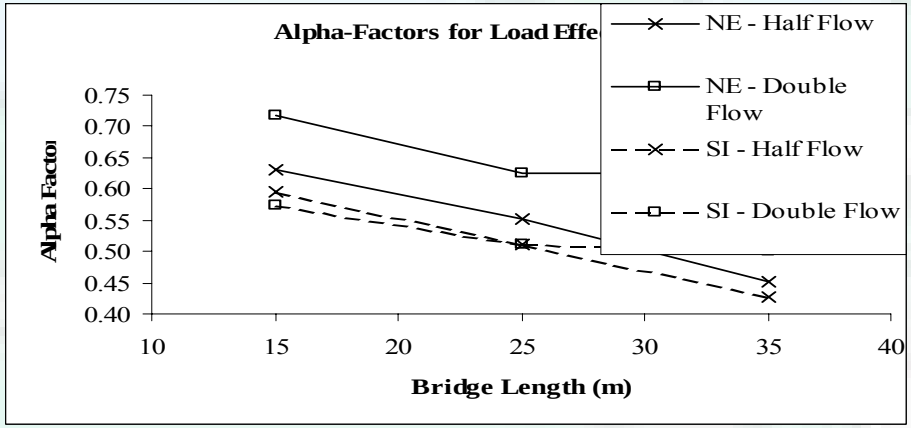
- Large differences in flow rates between NE and SI sites
- Both the total numbers of trucks and the numbers of 5-axle trucks are significantly different between the two countries

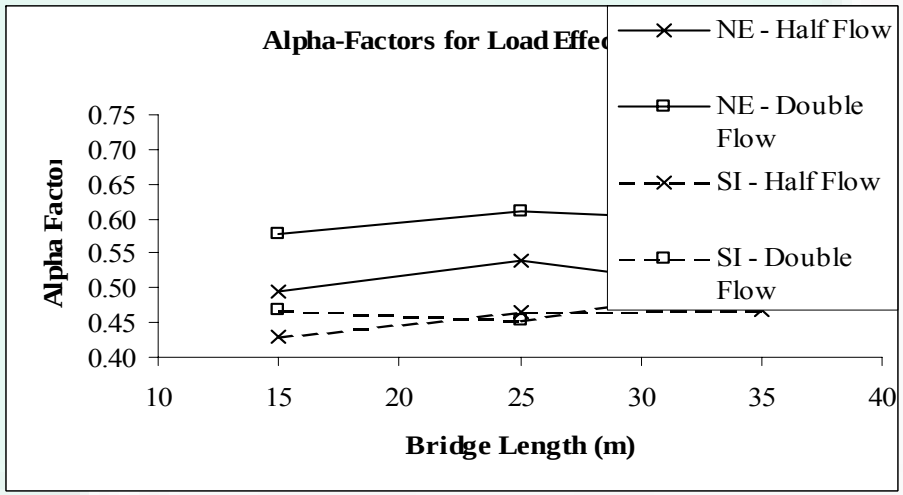


Total no. and no. of 5-axle trucks per day at 3 NE and 3 SI sites

- To identify the influence of flow rate, ‘typical’ shapes of histogram are defined for the NE and SI sites
- Determined by calculating the average for the 3 sites of the normalised frequency for each weight interval
- Two new flow rates considered, half notional and double notional (notional defined as 3100)
- Hence, flow study compares a total flow of 1550 to a total flow of 6200







- For notional NE histogram flow rate has a significant effect
- Increase in flow rates in SI has considerably less effect
- Likely a result of the higher numbers of heavy NE trucks giving an exponentially increasing number of critical meeting events as flow increases

Conclusions

- There are clearly great differences in the flow rates and GVW histograms between NE and SI sites
- For a given bridge capacity, there is a much greater safety margin in SI than in NE due to the lower level of traffic loading
- Less onerous notional load model is appropriate for SI than for NE
- Could prevent unnecessary strengthening and replacement of bridges in new member states