Bridge WIM Systems Using Stringers of Plate Girder Bridges

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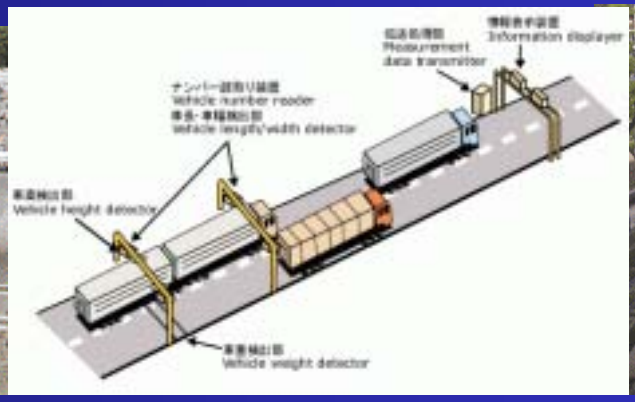
WIM in Japan

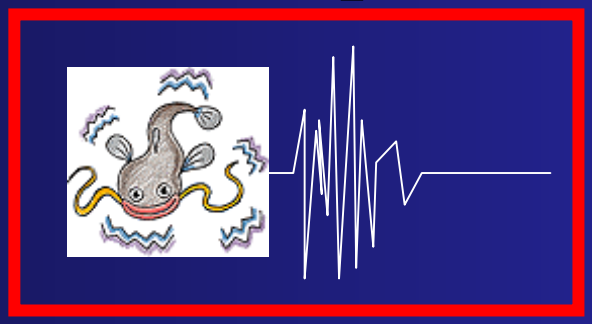
- 1968 : First WIM on Meishin Expressway
  Expressway(Toll Road) : LS-WIM at tollgate
  National highway : ?
- 1990~ Warning system
- 1998~ Direct enforcement

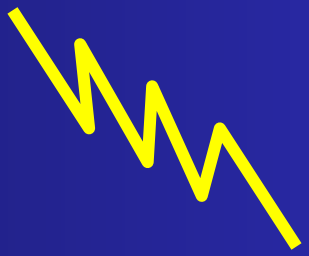


- Load statistics?

Highway Bridge and Fatigue

- Earthquake Lightning Fire Father?

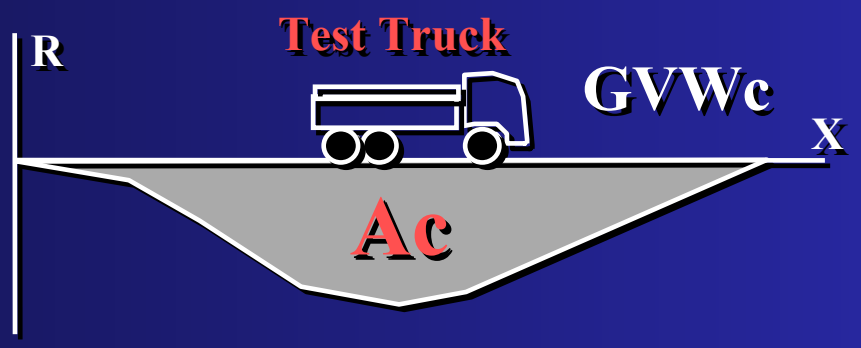


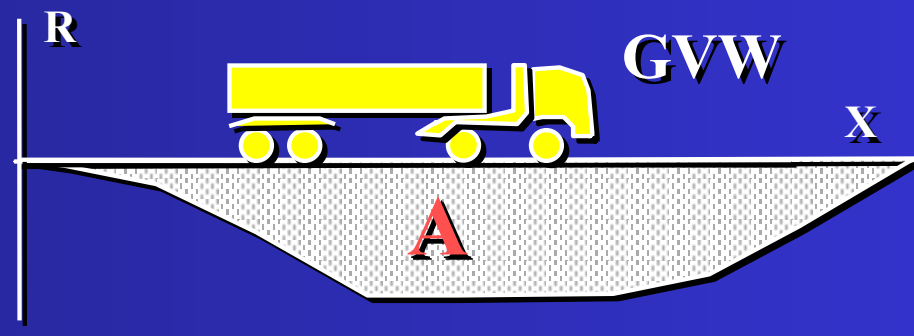


- 1992 : JSSC Fatigue Design Recommendation
- 2002 : Revision of Bridge Design Specification (includes Fatigue Design)
- Fatigue Design Load?
- Simple, FAD-BWIM

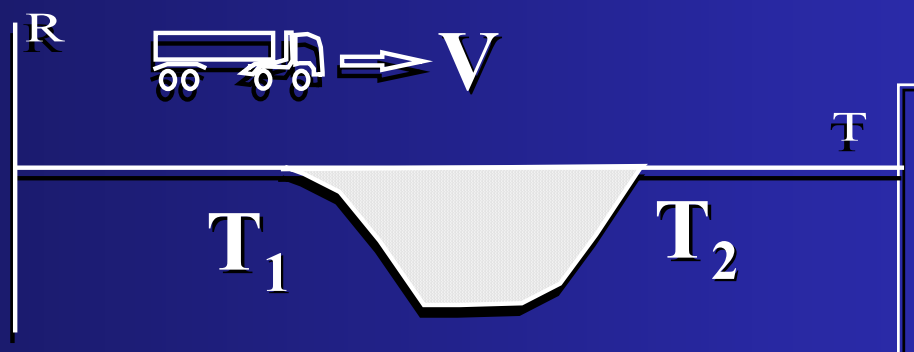
Influence Area and GVW

- Simple method for GVW estimation





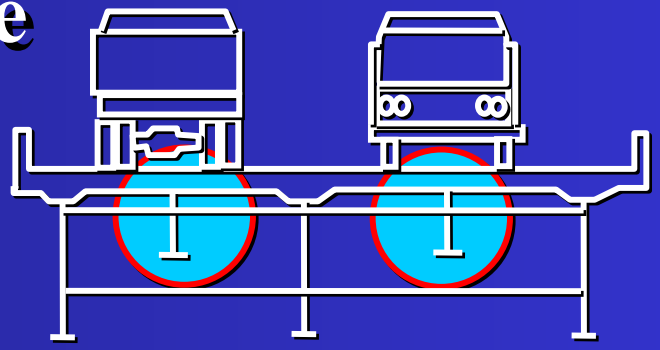
$$GVW = \frac{A}{Ac} \cdot GVWc$$



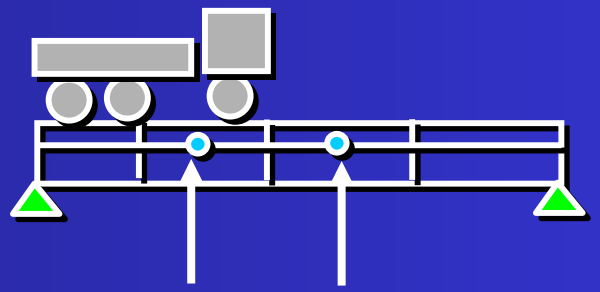
$$A = V \cdot \int_{T_1}^{T_2} R(t)\,dt$$

BWIM Using Stringers

- Stringer in plate girder bridge
  Reinforcement for RC slab
- Span : about 5m
  => Sensitive for wheel load
- Two stringers for one lane

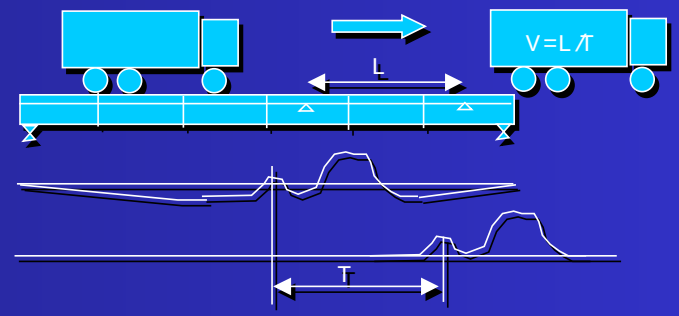


- Three test site (1999-2000)

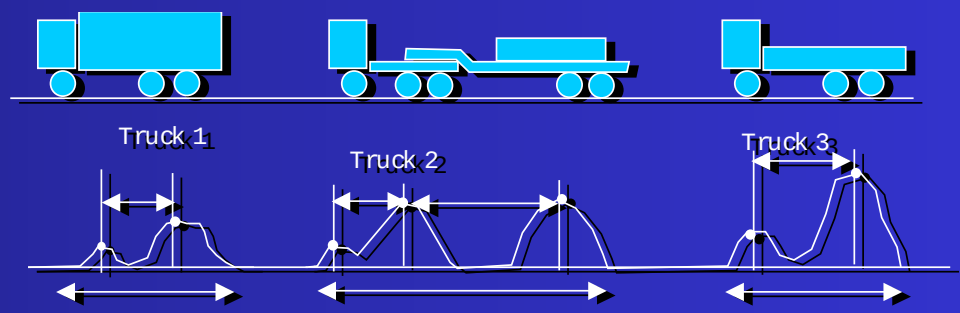


Algorithm of BWIM

- Velocity

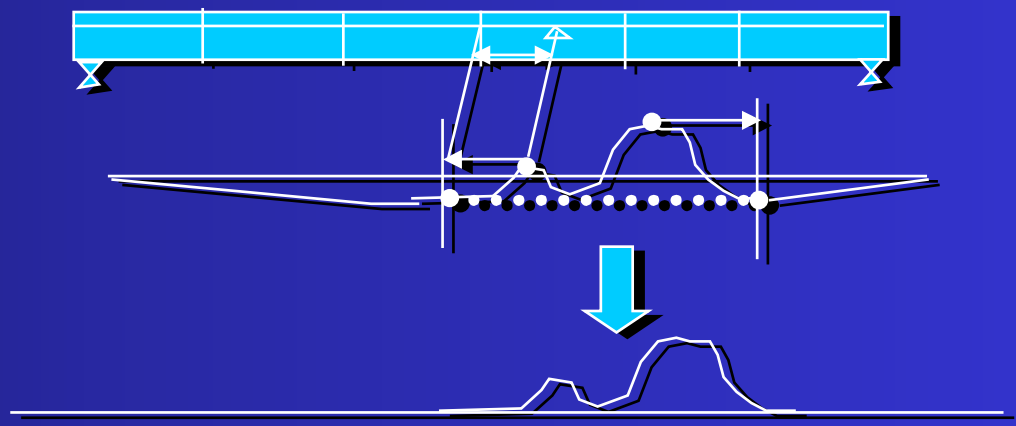


- Truck identification



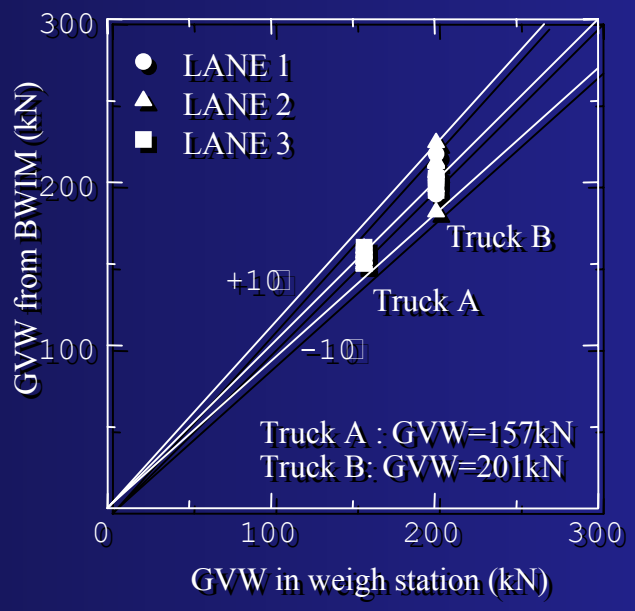
- Influence area

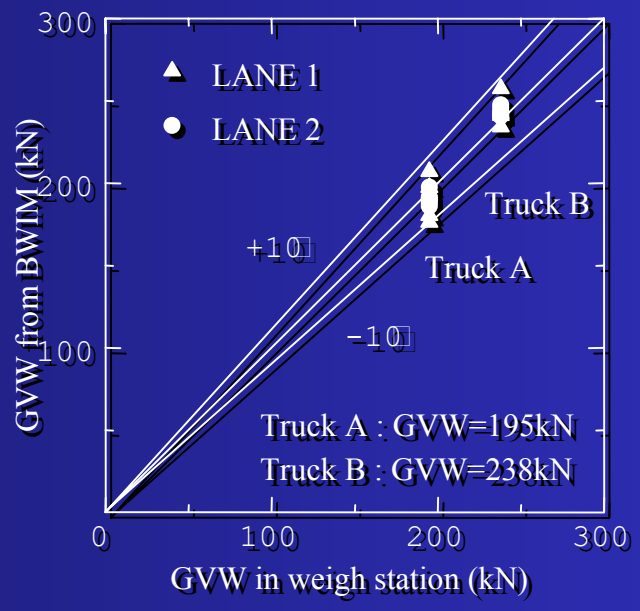
$$A = V \cdot \int_{T_1}^{T_2} R(t)\,dt$$

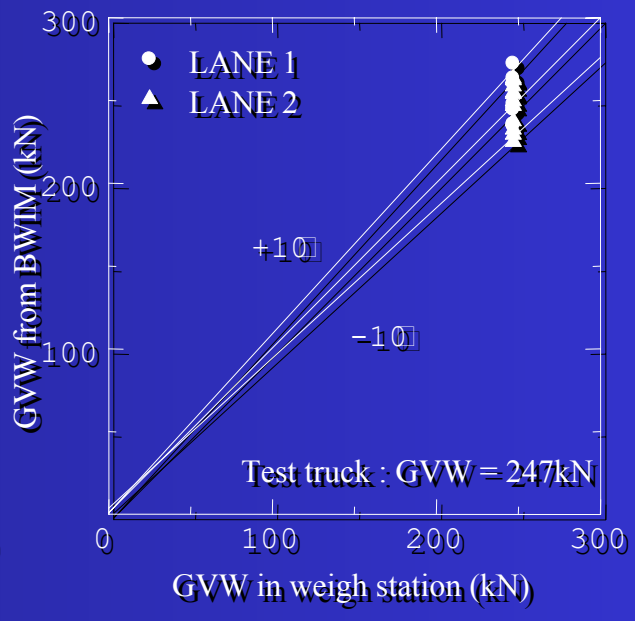


Accuracy of BWIM

- Three test sites
- 10% for calibration trucks
- D(20) or D(25) in COST-323 spec.

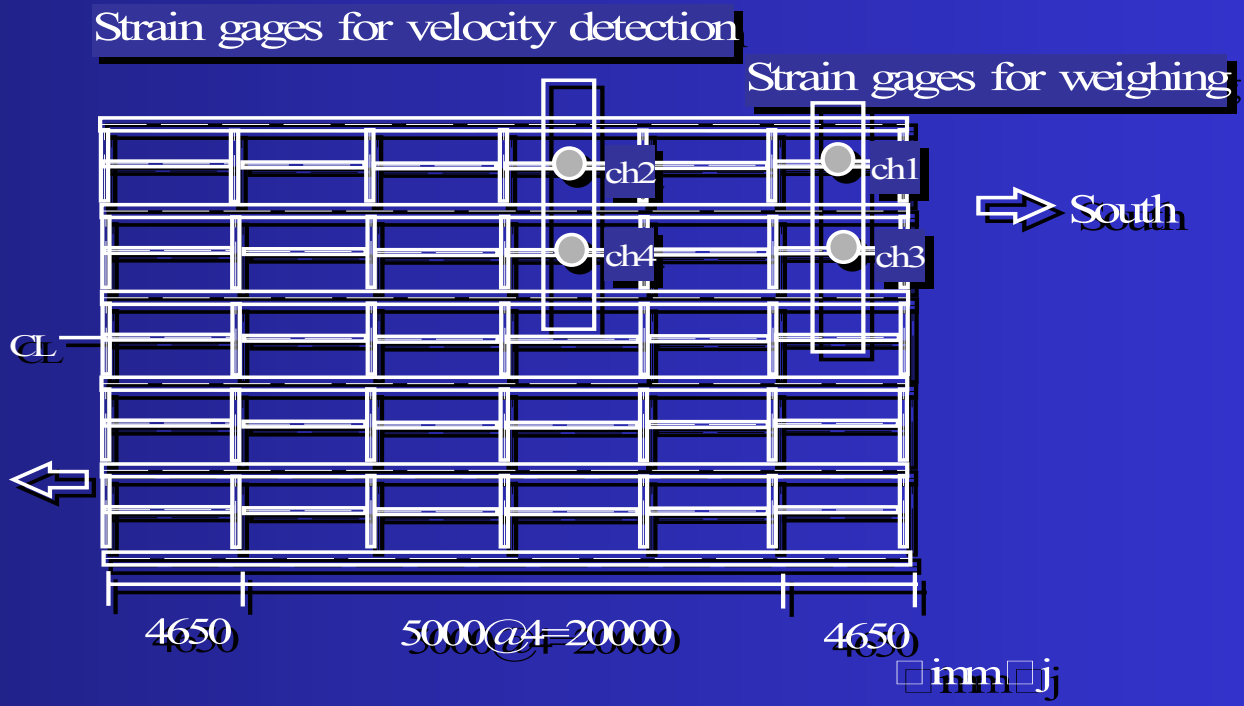






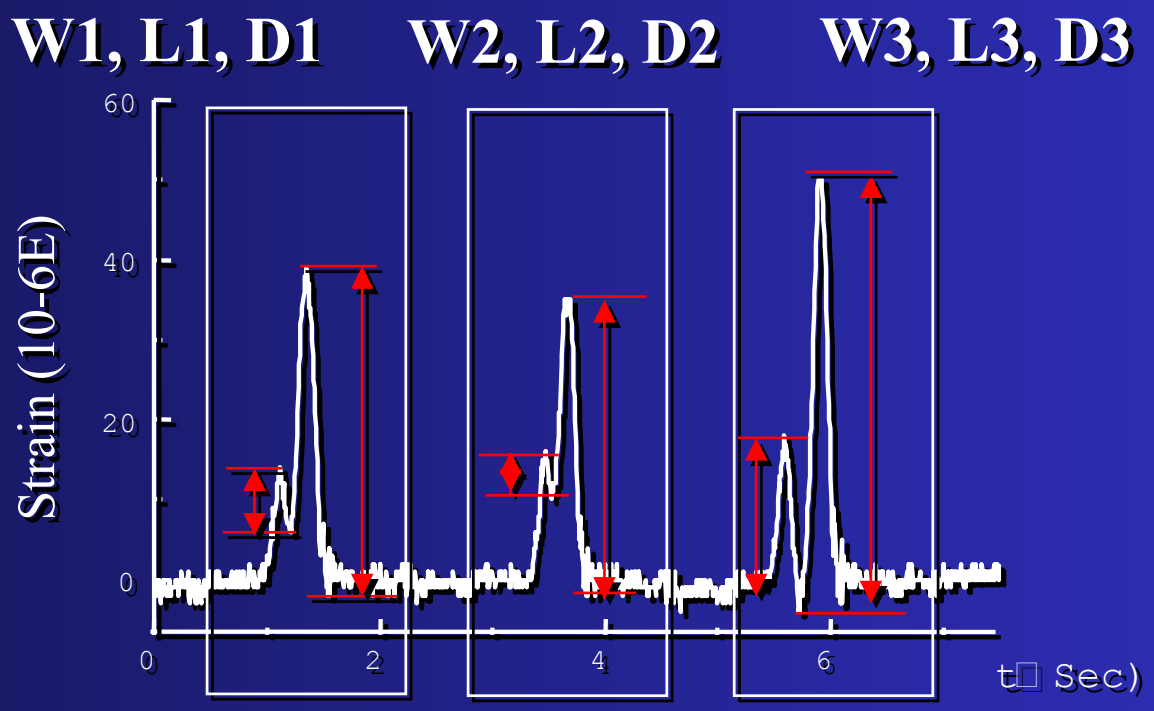
Yokkaichi Viaduct

- National route 23, Yokkaichi city (Yokkaichi petrochemical complex)
- Long term monitoring (1 week)



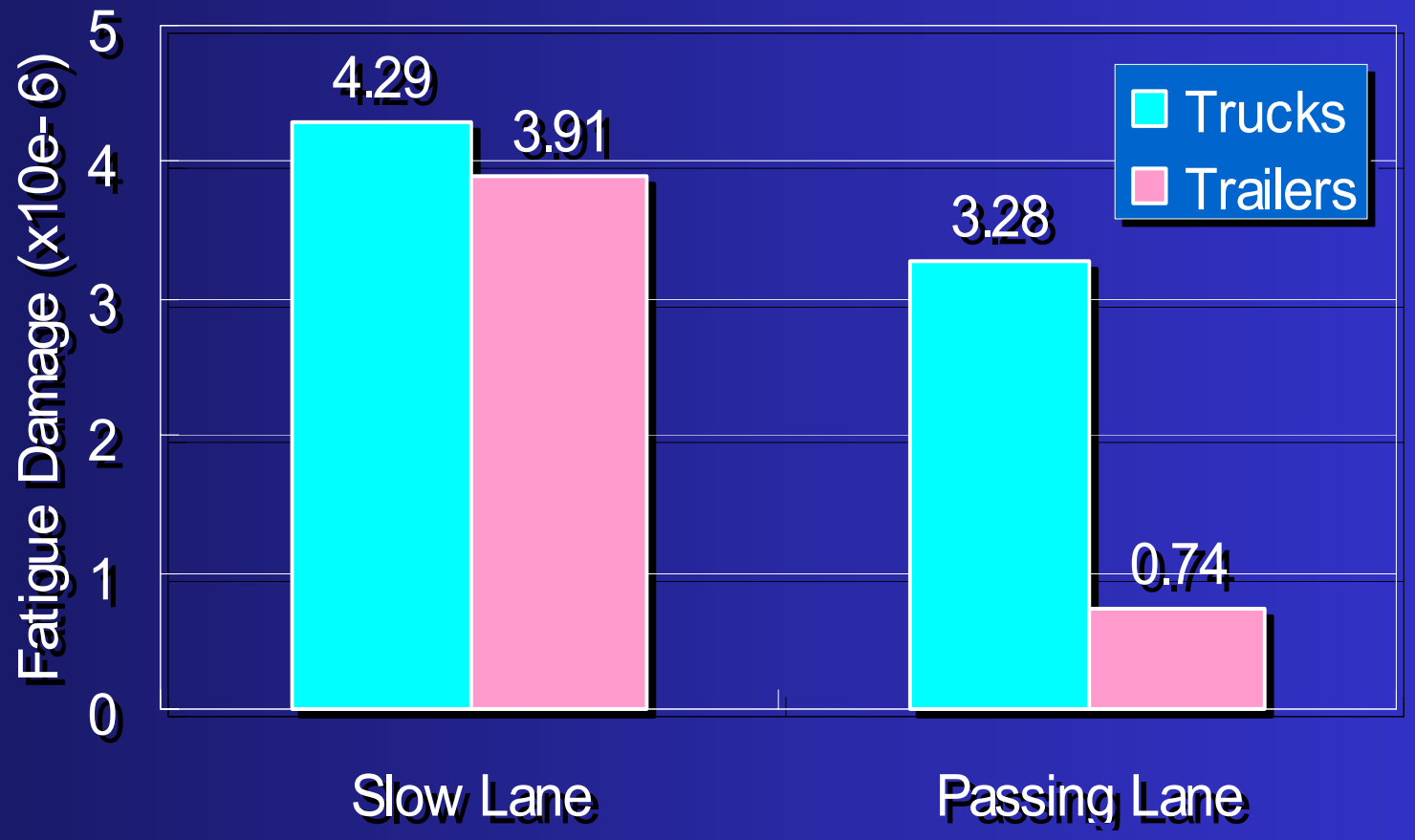
Damage Analysis for Stringers

- GVW, length and damage : Wn , Ln, Dn
- Stress range count for each truck
- Fatigue damage evaluation (JSSC-D)

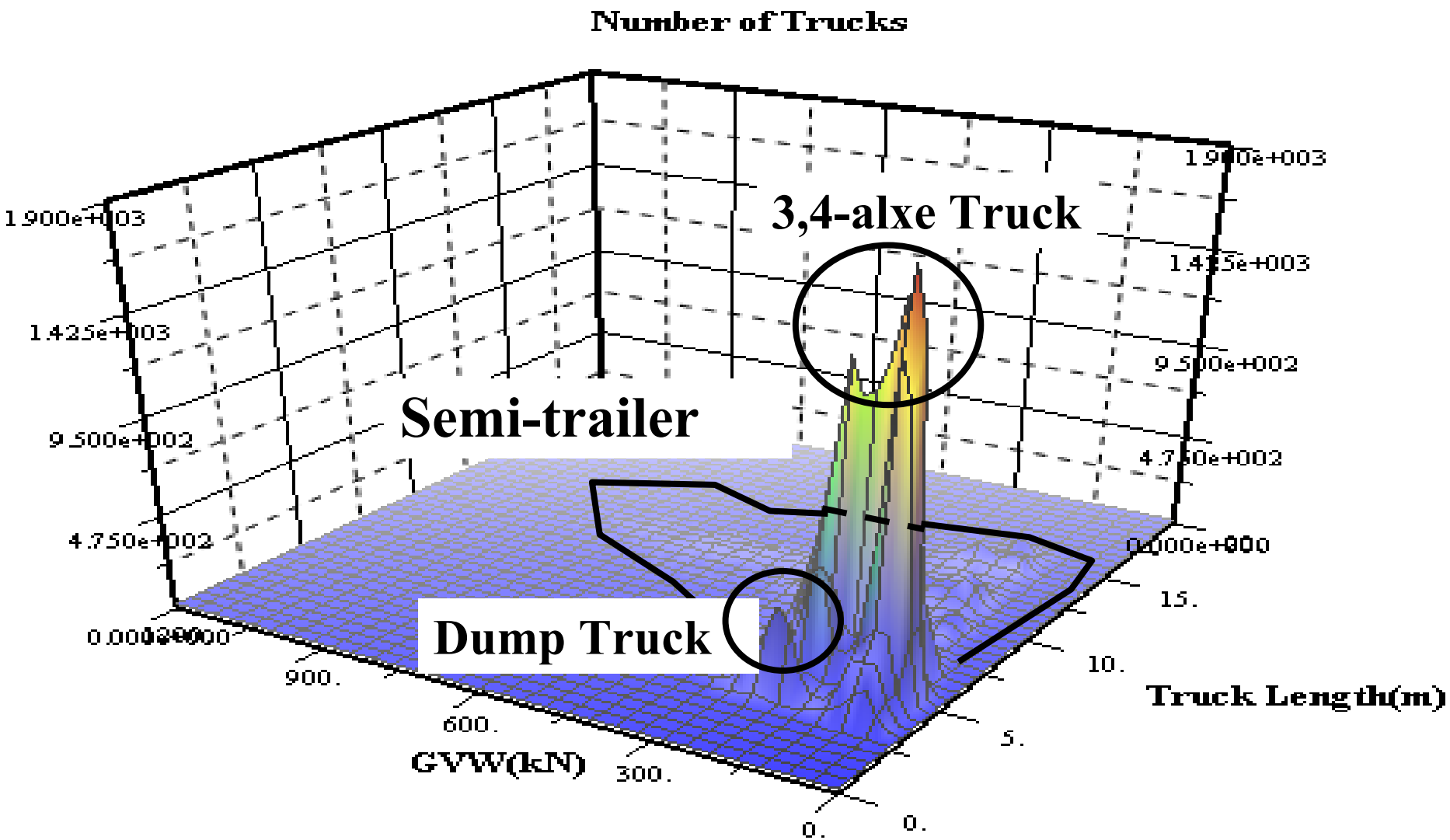


Traffic Volume, Fatigue Damage

- Trucks < 8m < Trailers (tractor&trailer)
- Damage per vehicle : trailers > trucks



Frequency Map/ GVW and Length



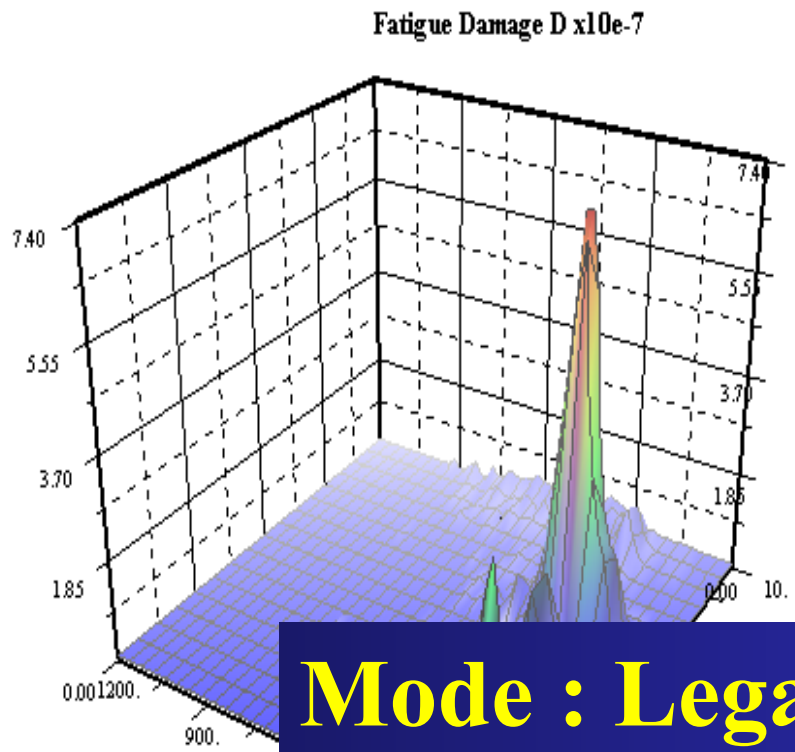
Damage Map / GVW and Length

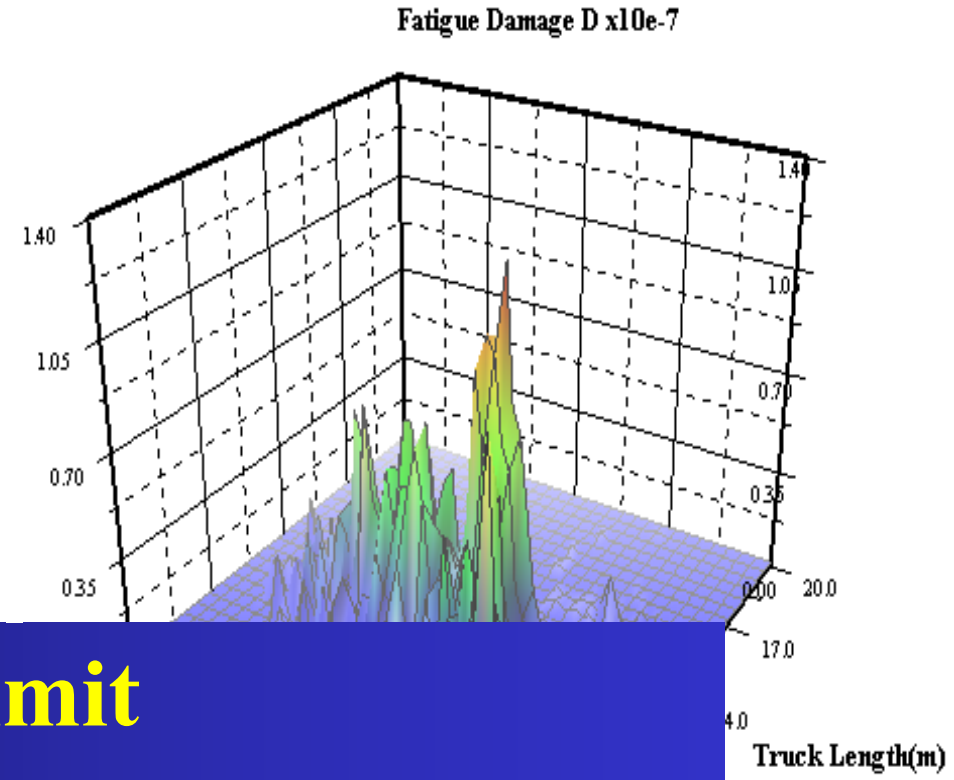
- Trucks

  6.5m 240kN

- Semi-trailers

  10.5m 360kN



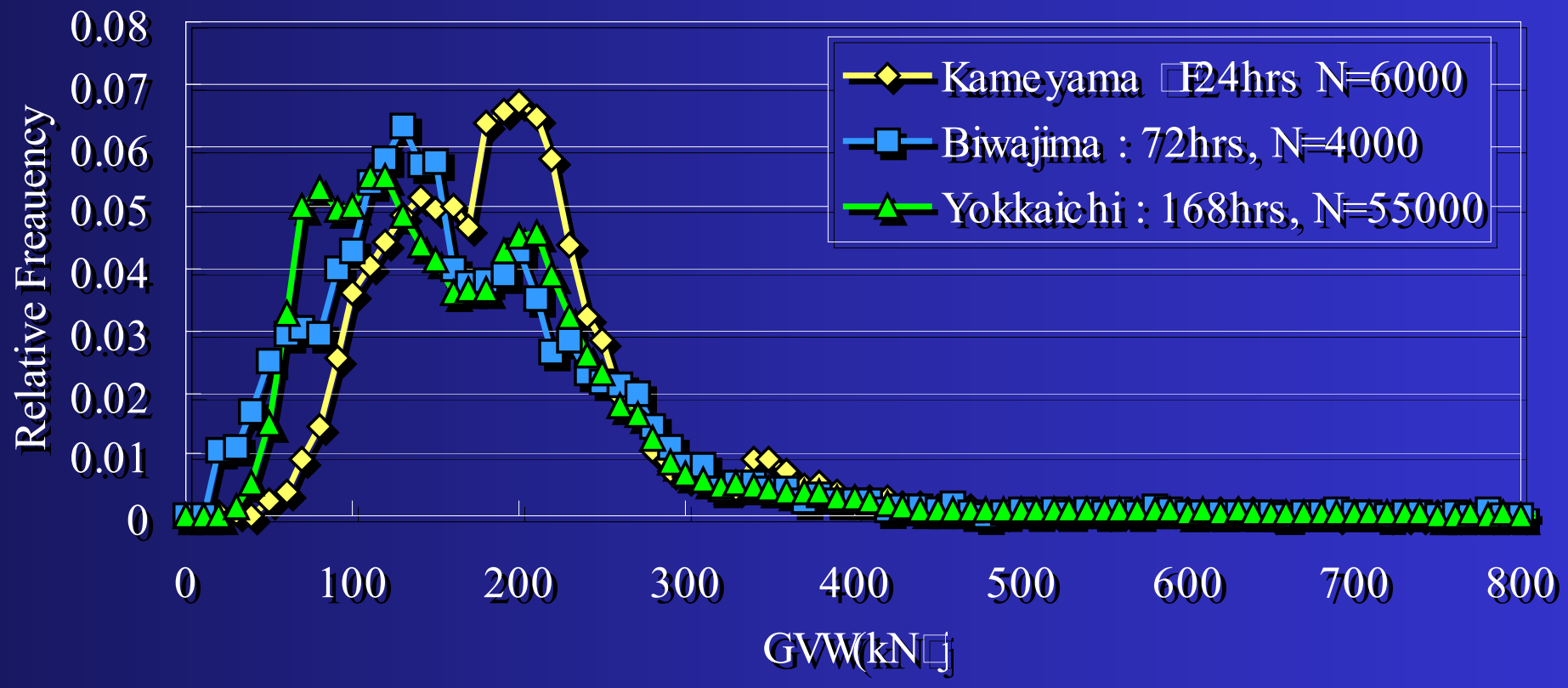


Mode : Legal limit

17% Overloaded : 50% damage

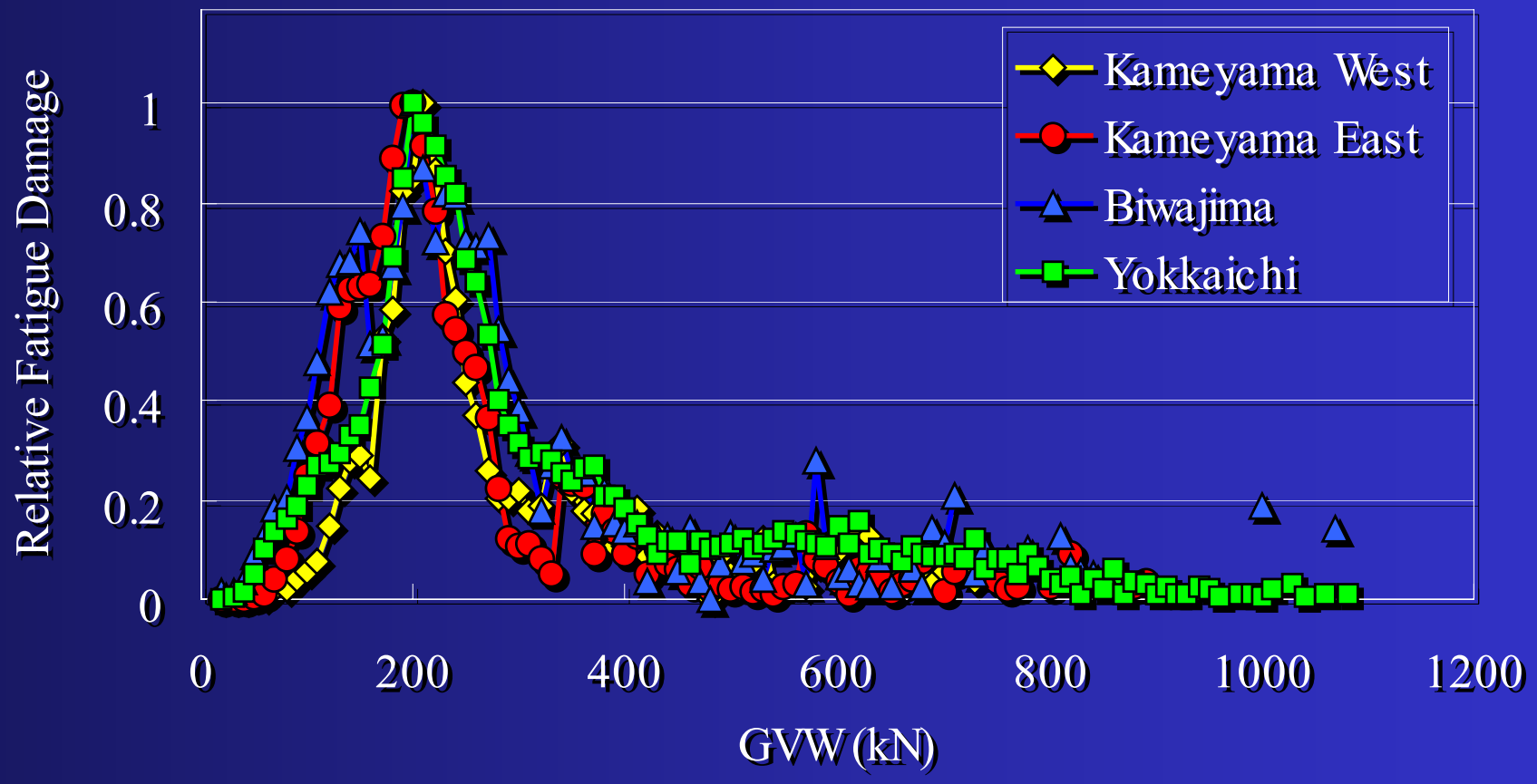
Frequency curve : three test sites

- Local characteristics ? (industrial / city area)
- Different threshold level of data acquisition ?



Damage curve : three test sites

- Loaded trucks : 200-250kN (full loaded)
- Semi-trailers



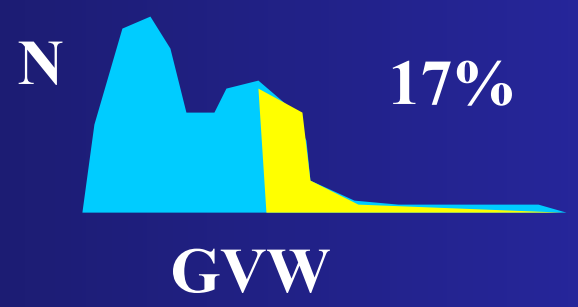
Summary

- BWIM using stringers and influence area
  Accuracy : D(25) in COST-323
- Mode in fatigue damage spectra

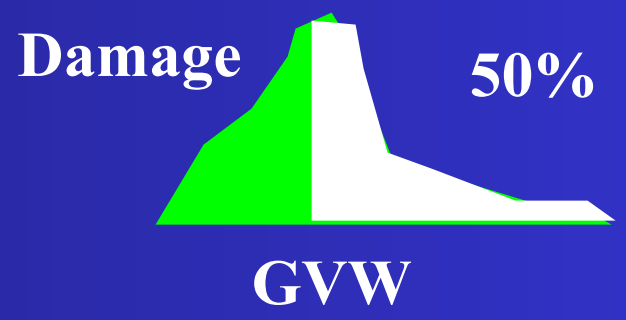
  Rigid truck : 6.5m, 240kN

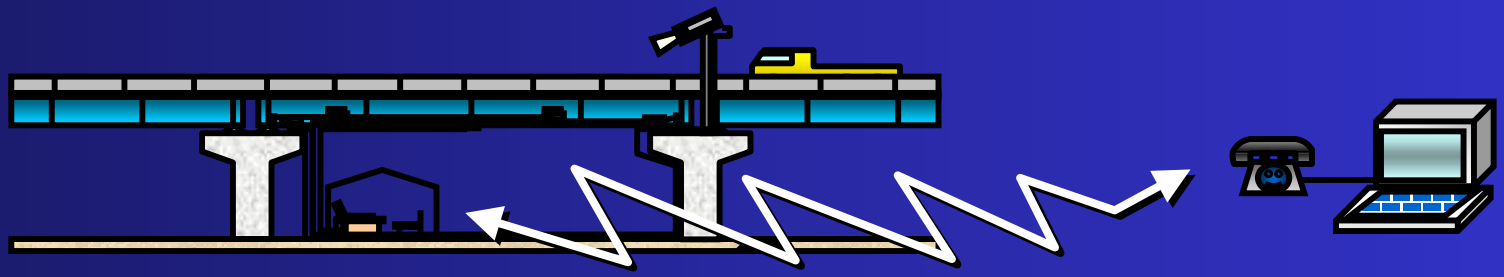
  Semi-trailer : 10.5m, 360kN
- Overloaded trucks

17% trucks



50% damage!



- **Maximum Load : Construction / Destruction?**

Thank You!