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26th ITS World Congress
21–25 October

Smart Mobility, Empowering Cities

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IFSTTAR

Traffic Load Data for Compliance and Bridge Safety Assessment

Transforming Freight Movements through ITS – Part I (SIS25)

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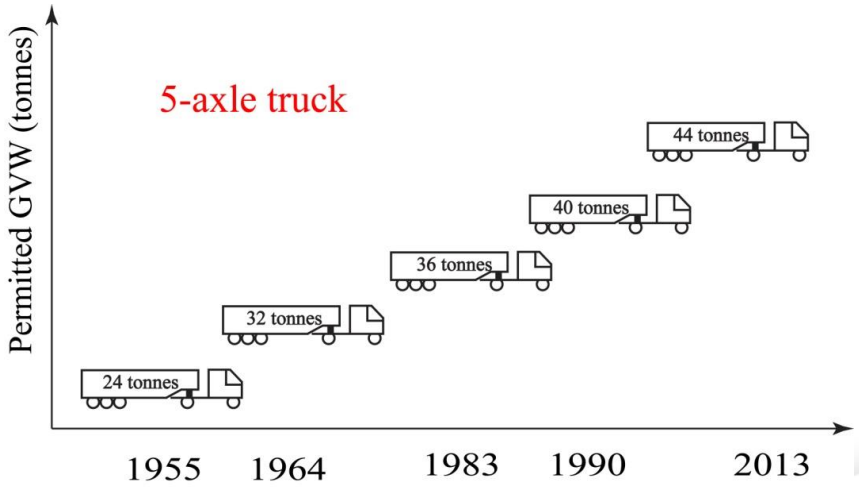
Challenges and issues

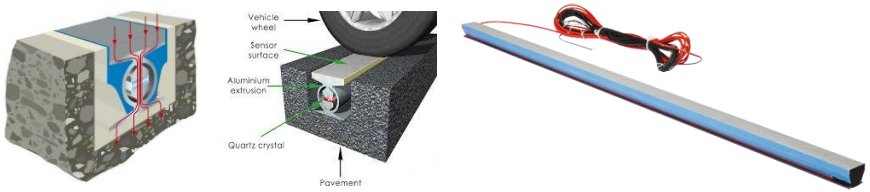
- Continuous increase of the permitted gross vehicle weights and length, and of the heavy traffic volume/flow (+1 to 2%/year in the EU)
- Ageing infrastructures, limited resources for maintenance and repair *(*https://www.itf-oecd.org/policies-extend-life-road-assets*)*
- Fair competition (companies/modes), EU: unique market, taxes and road pricing
- Requirements for overload monitoring/reporting: revised Directive EU 2015/719, art. 10d, e and g (https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:32015L0719)



Weigh-in-motion (WIM) technologies

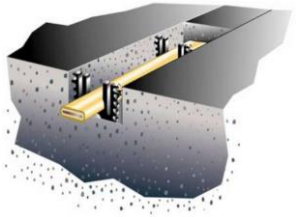
- Road sensors WIM

  Sensors are mounted in the road (mainly in the pavement upper layer)
  - Scales: load cells, bending plates
  - Strips and bars: piezo (polymer, ceramic, quartz), fibre optics
  - Mats (capacitive, fibre optics)
  - Instrumented beam (using strain gauges)



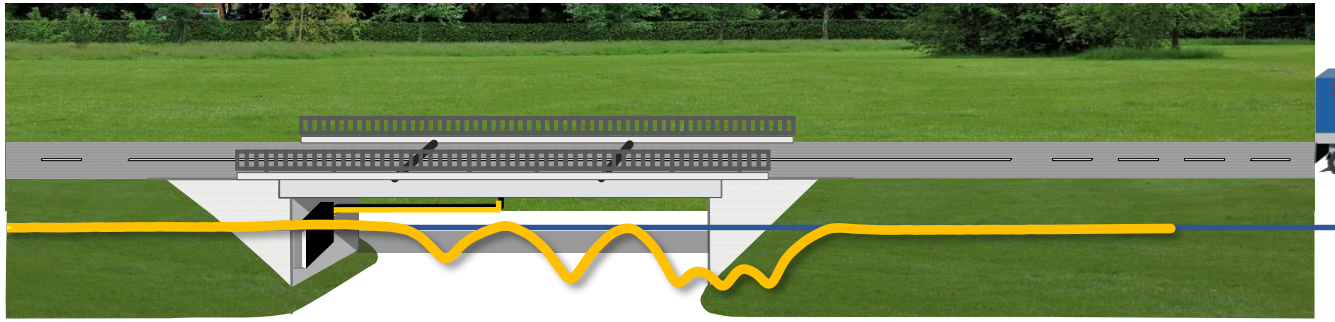
Piezo-quarz (Lineas, Kistler)

Piezo-ceramic (LCPC/ECM)



Piezo-polymer (MSI)

- Bridge WIM
  - The bridge deck (or some girders) is instrumented with strain gauges/extensometers, inverse problem: strains $\Rightarrow$ wheel/axle/vehicle loads



- On-Board WIM
  - Vehicle body/suspension/wheels are equipped with various types of sensors + a software which calculate the wheel dynamic impact forces

WIM Data Required by Application (1)

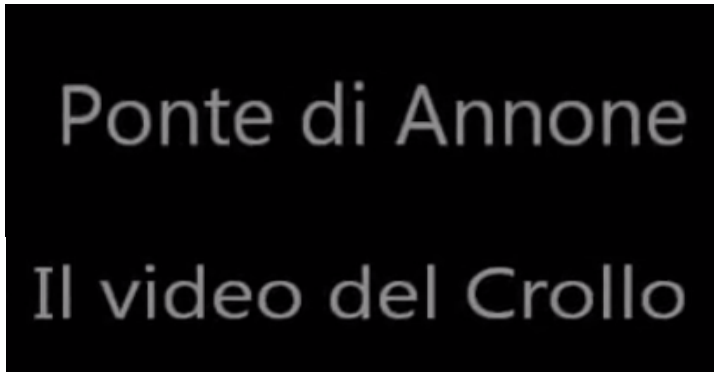
- Infrastructure assessment (pavement, bridge)
  - Pavements: traffic aggressiveness, cracking & rutting assessment → axle and group of axle loads and spacing, statistics (histograms)
  - Bridges assessment, extreme loads, fatigue, safety margins, damage mitigation: axle, group of axles and GVW, transverse and longitudinal location, multiple presence… Detailed data (per vehicle)
  - Accuracy: COST323 B(10)-C(15)
- Overloads screening
  - Screening/preselection + company profiling, WIM coupled with cameras/video,
  - Periodical calibration and checks, quality assurance, off-scale detection
  - Axle, group of axles and GVW per vehicle, AVI/LPR, category of vehicle, speed, lane
  - Accuracy: COST323 B+(7)-B(10)

WIM Data Required by Application (2)

- Direct enforcement
  - Axle, group of axles and GVW per vehicle, category of vehicle, speed, lane + max. permitted loads/mass per vehicle + vehicle owner (LPR + registration database)
  - Legal metrology: type approval + initial and in-service verifications
  - Accuracy: OIML 5 or 10 (> COST323 A(5))
- New main challenge to ensure the compliance with regulations
  - Increase of heavy vehicle flow, safety of interception is questionable
  - Lack of human resources (police, weighing officers…) and of space (in the EU)
  - To limit check avoidance → 24/24 and 7/7 controls
  - In developing countries: may reduce corruption/higher rate of fine recovering
  - Czech Republic pioneered in 2011-2015, Belgium, France, Germany are actively working on that

Bridge Safety

- Higher traffic flow and heavier vehicles, on existing/ageing bridges
- Lighter bridges → increase of the ratio live loads/dead loads → higher sensitivity of the design and maintenance to the live (traffic) loads
- Requirement to extend the life of road asset, to reduce the maintenance costs and to avoid disasters due to overloads…
- ITS solutions, V2I + I2V communication for bridge and traffic monitoring: IAP and SIAP (cf. CEDR/FALCON project in the EU)



Perspectives and Discussion

- **Policies of WIM data collection and use for compliance**
  - Which policy and means allocated to implement WIM systems, collect WIM data and use them for enforcement?
  - Which legal obligation or incentive to do that?
  - Does direct enforcement by WIM become an objective and how to achieve it?
- **Policies to extend the life of bridges and avoid collapses**
  - How is bridge monitoring coupled with traffic load assessment?
  - How are the existing/ageing bridges monitored and re-assessed?
  - Which measures are undertaken or planned to extend the life of bridges?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