School of Civil Engineering
FACULTY OF ENGINEERING

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Centre for Infrastructure Materials at the University of Leeds

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UKCRIC

Construction products
4.5% of UK GDP (£50B)

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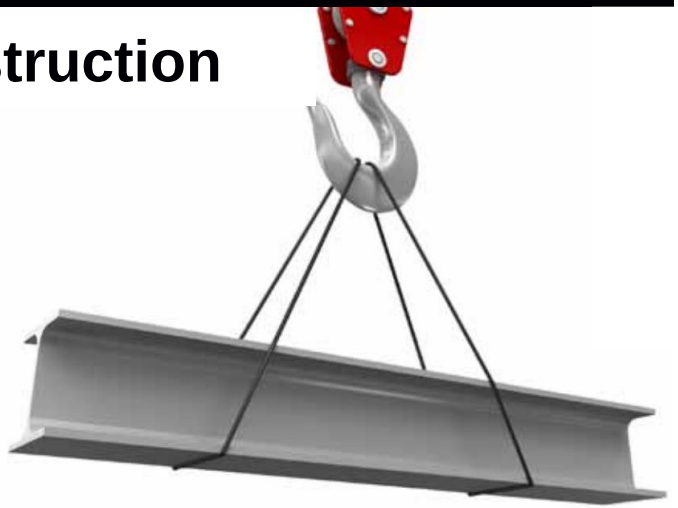
- 4.0 Bt cement
- >10 Bt concrete
- ~1.0 Bt steel
- 55 Mt aluminium
- 45 Mt glass
- 5.3 M m^3 timber

- ~20% GHG.
- Increased urbanisation particularly in global south.
- Offers opportunities, but also requires a need to think smarter.

Steel in Construction

Infrastructure
150 Mt
14 %

For infrastructure: 24% of steel is in structural sections; 54% is reinforcing bars; 6% is hot rolled train rails (providing a strong, wear and fatigue resistant contact surface); 16% is in pipes formed by welding rolled steel, with high corrosion and fatigue resistance, and high strength to resist internal pressure and installation stresses.



Buildings
433 Mt
42 %

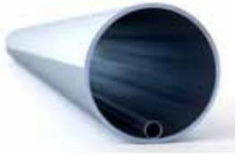
25% of the steel in buildings is in structural sections, mainly hot rolled sections but also some welded plate. Sections form a strong, stiff structural frame. 44% is in reinforcing bars, adding tensile strength and stiffness to concrete. Steel is used because it binds well to concrete, has a similar thermal expansion coefficient and is strong and relatively cheap. 31% is in sheet products such as cold-formed purlins for portal frame buildings and as exterior cladding.

Steel in Infrastructure

Roads and rail
107 Mt
18 %

Transport networks require steel for bridges, tunnels and rail track and for constructing buildings such as stations, ports and airports. 60% of steel-use in this application is as rebar and the rest is sections and rail track.

Utilities (fuel, water, power)
43 Mt
7 %



Underground pipelines distribute water to and from houses, and distribute gas to final consumers. These pipes use just over half of the steel in this category and the rest is mainly rebar for associated constructions including power stations and pumping houses.

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Aim to improve whole-life performance of infrastructure materials

- Lab-scale and large-scale accelerated exposure facilities
- Field exposure site
- Geo-energy facilities
- Dynamic structural monitoring
- Infrastructure robotics

Accelerated ageing chambers

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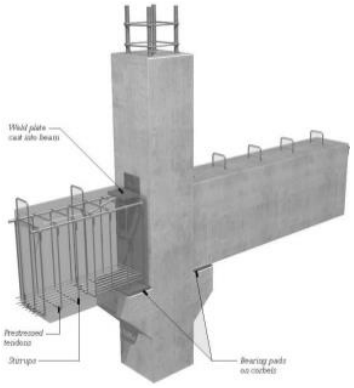
Lab-based chambers:

- Small samples
- Controlled environments
- Standard test methods
- Bespoke systems for combined effects

Large Exposure Chamber

- Real-sized elements.
- Combined loading and exposure



Dedicated advanced characterisation facilities

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Solid state NMR spectrometer

Environmental scanning electron microscope

X-ray microtomography

Field site

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- Long-term exposure facilities
- Fully equipped with meteorological monitoring
- Exposed and sheltered racks
- Designed for a range of materials

Geo-Energy Facilities*

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- A space for construction of novel ground heat exchangers
- An energy test pile
- A ground heat exchanger heating and cooling system
- Distributed temperature sensing system (fibre optic analyser and associated equipment)
- Thermal testing and monitoring, including for weather conditions, ground temperatures, moisture conditions, and thermal properties

* to be completed

Full/Laboratory-Scale, Multi-Use Dynamic Monitoring

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Multi-Camera Displacement Measurement System

iMETRUM
NON CONTACT PRECISION MEASUREMENT

KINEMETRICS

OROS
MEASURING NOISE & VIBRATION

Vibration Monitoring and Excitation System

Radar-Interferometry Displacement Measurement System

IDS
GeoRadar

APS

Infrastructure Robotics

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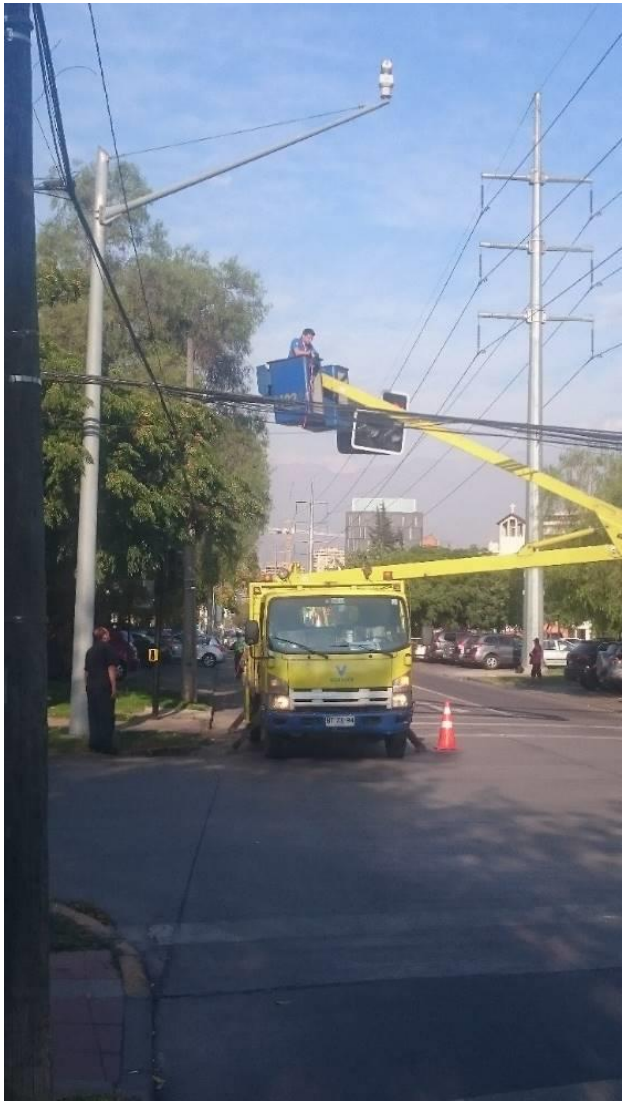
Institute of Design,
Robotics and Optimisation

- Range of flying and crawling robots.
- Hyperspectral camera
- Allow non-invasive monitoring of infrastructure.
- Reduced costs, reduced disruption, improved H&S



Multi-Axis Shake Table (MAST)

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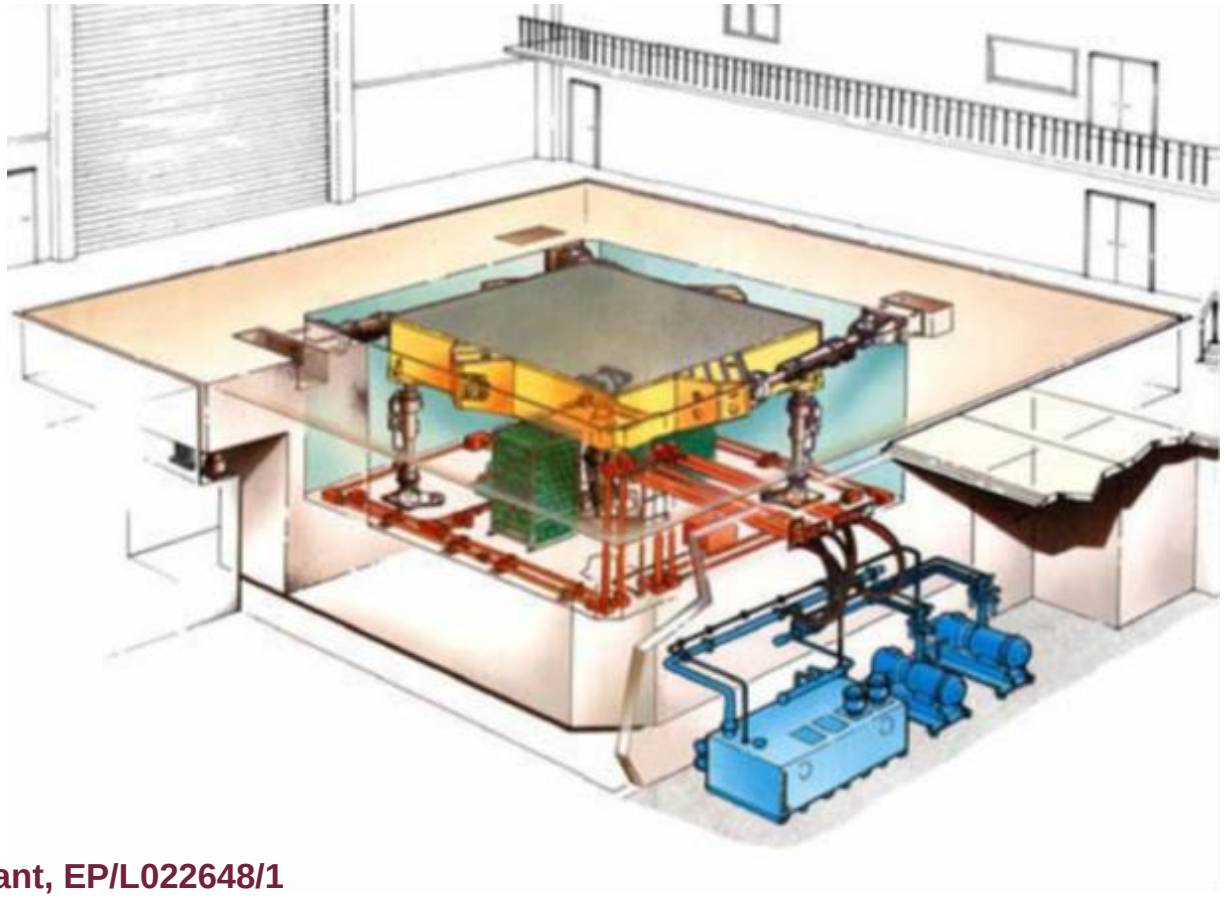
- £1.1 M
- 3 m x 3 m
- 6 DOFs
- ±150 mm
- 50 kN payload$^{(1.5\ g)}$



EPSRC Engineering and Physical Sciences Research Council

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Thank you for your attention!

See me for more information

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