Technical Report: The Future of Infrastructure & the Role of Physical Testing Workshop

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Synopsis

As the UK faces increasing pressure to adapt its infrastructure to meet the challenges of climate resilience, net zero, infrastructure circularity, and long-term sustainability, the role of physical testing facilities in producing actionable insights has never been greater. This half-day workshop served as a platform to:

- Showcase Surrey's testing facilities capable of supporting research in accelerated failure testing under extreme environmental and operational conditions to identify adaptation needs.
- Explore how emerging technologies, such as digital fabrication, 3D printing, automated digital twinning and direct/indirect monitoring, can be leveraged for existing and future structure/infrastructure resilience and unlocking opportunities for reuse, repurposing and sustainable lifecycle extension.
- Demonstrate live applications of micro-to-city scale testing methodologies in fields spanning civil, mechanical, space, environmental, and computer sciences.
- Foster collaboration across the sector to identify pressing research needs and establish a blueprint for the future of infrastructure across grey and nature-based assets.

Introduction

The UK infrastructure, from transport, water and energy to space exploration assets, stands at a critical juncture, facing unprecedented demands to adapt to the escalating impacts of climate change, meet net-zero targets, embrace principles of circularity (reducing waste and maximising resource use), and ensure its long-term systemic sustainability with bounded financial resources. These pressures necessitate a fundamental rethink of how we design, manufacture/construct, maintain, manage and decommission upon reaching service life.

The UK's Modern Industry Strategy, 10-year Infrastructure Strategy, and National Infrastructure and Construction Pipeline collectively highlight the critical need for a resilient, sustainable, and innovative infrastructure system, emphasising the importance of investment in technological adoption and a skilled workforce to meet future demands and global challenges. They also implicitly advocate for robust data-driven evidence, grounded in scientifically rigorous research, in ensuring the successful delivery and long-term performance of infrastructure projects, aligning with national objectives for economic growth and societal well-being. Together, they signal sustained public investment, including £75 billion over the next decade for enhancing existing infrastructure and an additional £24 billion for road and rail maintenance between 2026 and 2030. The £1.1 billion uplift in the core Research and Innovation fund highlights recognition that continued investment in R&D, including leading testing facilities, is essential. While these financial commitments are substantial on paper, they are unlikely to fully address the scale and complexity of the UK's long-term infrastructure needs and given increasing demands (operational and environmental), every pound invested needs to be strategically targeted, efficiently delivered, and supported by innovation and collaboration across sectors. This is critical to unlocking value, driving performance, and ensuring that the infrastructure system evolves in step with future challenges.

In this rapidly changing landscape, the role of physical testing facilities, from nano-scale material synthesis, atom-to-micro-scale material characterisation, meso/macro component testing to full-scale structural performance and accelerated mechanical and environmental failure testing, has never been more critical in providing strategies and actions founded in data-driven insights. Physical testing in industries such as aerospace, biotechnology and pharmaceuticals is not optional but an absolute necessity due to immediate/short-term high stakes and perception of unforgiving nature of any form of failure. In contrast, the built environment and infrastructure sectors have been slower in leveraging and integrating systemic experimentation and 'rehearsal' into their processes, and where testing occurs, it is often fragmented, siloed or underutilised/undervalued.

Given Higher Education Institutes' access to high-quality laboratories and a pool of emerging talent, the need for close collaboration and 'camaraderie' between industry and academia in exploiting these resources to drive innovation and prepare the workforce for the challenges of tomorrow has never been greater. The emphasis is on camaraderie as opposed to partnership, alliance and strategic alignments, which speaks to a deeper, trust-based long-term commitment in working towards a shared purpose of tackling complex interdisciplinary challenges of our existing ageing and future infrastructure. Sponsored by the Institute for Advanced Studies, the workshop served as a platform to showcase what is on offer locally and how these can be leveraged to address the pressing industry challenges across the built environment.

This is also closely linked to the urgent need to evolve HEIs' training and education curricula to fit today and tomorrow's purpose. Whilst the core principles and competencies, such as intuitive understanding of structural integrity, safety and a deep understanding of mechanics and materials, remain non-negotiable, the future demands for training engineers to effectively leverage digital tools to augment their capabilities. The future demands a rapid adaptation, but it also requires healthy scepticism rooted in critical thinking and evidence-based risk aversion.

The future of infrastructure demands master integrators, critical evaluators, creative thinkers and not just users of automated tools. It requires a commitment to challenging and understanding the inputs and outputs to the "black boxes" of AI and automation, ensuring humans remain in control of the infrastructure lifecycle.

"'Demography is destiny' and the shaping force of population trends holds true not only for people and skills but also for infrastructure itself. "

'Demography is destiny' and the shaping force of population trends holds true not only for people and skills but also for infrastructure itself. As the skills gaps continue to widen, there is an urgent need to invest in training and means of adaptive strategies to meet the demands of skilling the next generation of the engineering workforce. In tandem, much of the UK infrastructure asset stock is being pushed beyond its original design boundaries, driven by shifts in population density, mobility patterns, technological advancements (e.g. heavier vehicular loads) and increasingly harsher environmental conditions. This growing mismatch between current demands and legacy design capacity demands a systemic demystification of degradation profiles under different mechanical and environmental loading and a deeper understanding of the interaction with both environment and humans, to ensure we leave behind a defensible legacy for generations to come.

Infrastructures inherently have longevity built in, and today's UK built environment owes much to the ingenuity of Victorian-era engineering's bold thinking, precision and ambition; a great reminder that what we do today will shape consequences for centuries to come. The legacy of past decisions also shapes today's deeply risk-averse mindset, as seen with asbestos, once known as a 'miracle mineral', now responsible for 5,000 annual deaths. As we now push for circularity, reuse, repurpose and recycling, we must do so with evidence-grounded caution, as well-meaning efforts may lead to unintended consequences. The challenge is to move forward boldly and imaginatively but also responsibly, guarded and guided by scientific evidence, systemic experimentation and commitment to long-term stewardship.

Experimentation is empowerment with guardrails, for not only provides an opportunity to explore known unknowns, explicitly process and leverage unknown-knowns, and cautiously engage with unknown-unknowns, but also facilitates means of immersive learning and training for the future engineering workforce.

The recent infrastructure incidents are urgent reminders that our existing infrastructure is being subjected to unprecedented change in loading/demand and degradation of capacity, often far beyond its originally intended design. This also reflects the growing complexity and interdependence, and the only way we could untangle the mess is by leveraging the power of systemic and 3P-scenario (probable, plausible and possible) digital and physical experimentation.

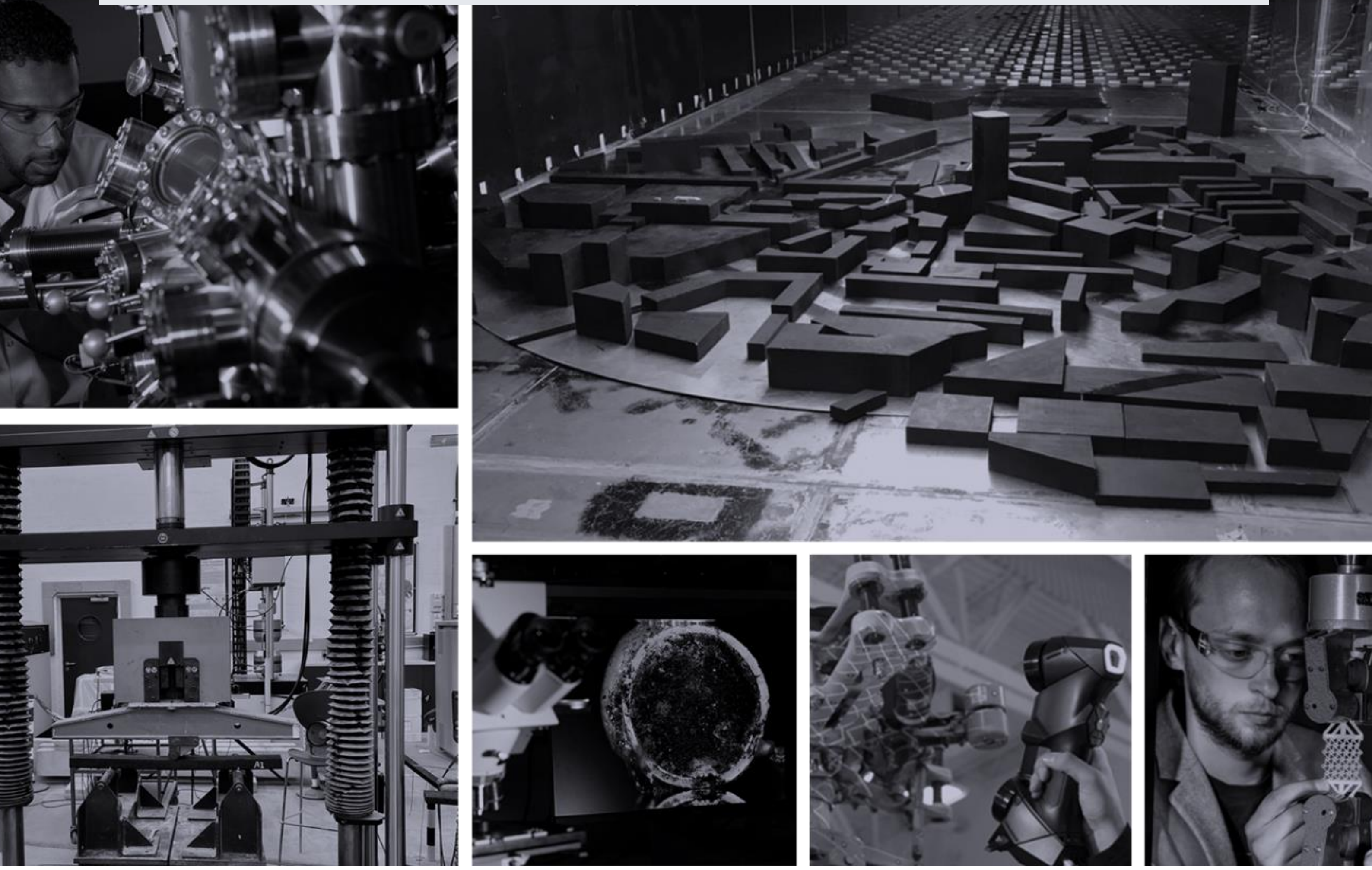
In the face of a rapidly advancing technological landscape and the transformative pace at which AI is reshaping every aspect of our lives from personal interactions to global industries, fight or flight is not a choice - we need to adapt and adapt fast. To mitigate the risk of the next generation of trained engineers bypassing the learning process, the HE sector needs to reimagine learning and education, seeing it not as learning facts or the process of acquiring knowledge and understanding, but as 'training the mind to think', redefining intelligence through live experience (discovery, experimentation, reflection and action), deriving meaning, connections and feelings.

To this end, the primary objectives of the workshop were multi-faceted:

- **What is on offer**: To showcase Surrey's testing facilities and demonstrate the capability to support experimental research in accelerated failure testing under extreme environmental and mechanical conditions for new and existing materials and structures. This included demonstrating live applications of diverse testing facilities ranging from micro-scale material characterisation to city-scale system analysis, spanning a wide array of scientific and engineering disciplines, including maths, physics, civil, mechanical, space, environmental, and computer sciences, highlighting the inherently interdisciplinary nature of modern infrastructure challenges.
- **What are the problems (aka Problem-derived, Purpose-focused Solutions):** To collectively identify the most pressing research needs and lay the groundwork for a robust blueprint for the future, encompassing both conventional "grey" assets (e.g., roads, bridges, buildings) and increasingly important nature-based solutions (e.g., sustainable drainage systems, green infrastructure). This involved exploring the synergistic relationship between traditional physical testing and emerging technologies, delving into how innovations such as digital fabrication, 3D construction printing, automating digital twinning workflow, and direct/indirect monitoring can be leveraged to enhance the resilience of both existing and future structures, unlocking opportunities for reuse, repurposing, and extending the sustainable lifecycle of infrastructure.

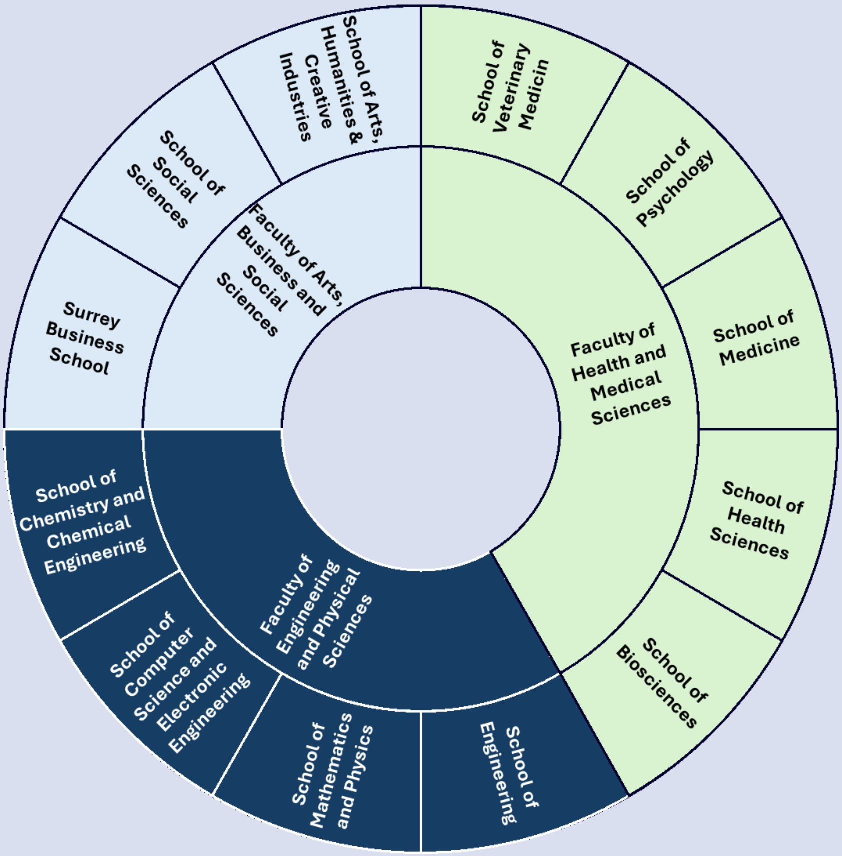
- **Identify Who is Missing**: to discuss what the key skills gaps are and how the HE sector needs to adapt to address these gaps in skilling future generation, but also upskilling the current workforce.

To this end, the workshop included a provocation scene setting by Santosh Singh, Structures Group Manager at National Highways, an overview of testing facilities across different faculties and schools, a tour and live demonstration at several laboratory facilities. Acknowledging the inherent challenges within the sector, the workshop discussions delved deeper into the pervasive issue of ageing asset stock requiring significant attention, the limited budgets often available to address extensive maintenance backlogs, and the constant need for adaptability to increasing demands. These demands include not only higher operational loads but also the imperative to respond to evolving environmental stressors and regulatory requirements. The overarching theme implicitly woven through the discussions was the need to achieve "more with less"—optimising current assets while strategically planning and investing for a resilient and sustainable future. This report reflects and summarises the activities and discussions during the workshop.



Overview of Surrey's Faculties, Schools and Infrastructure Research Facilities

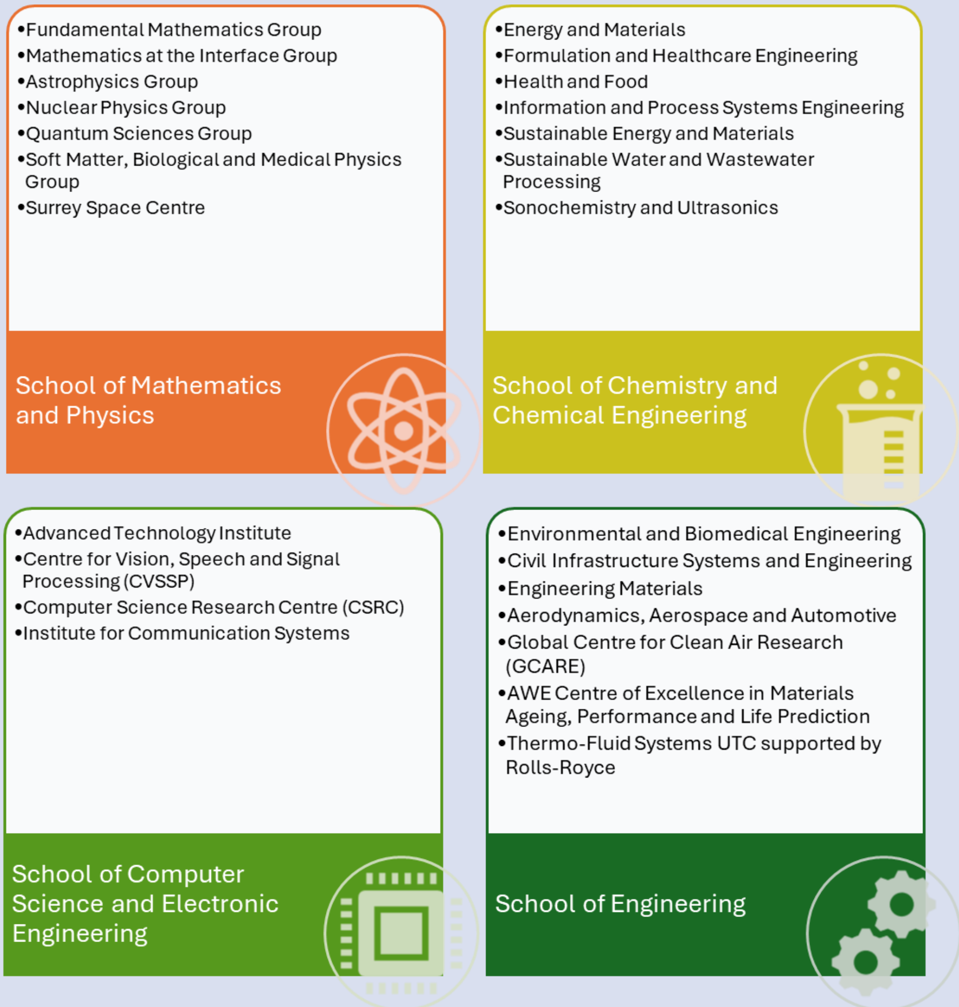
At Surrey, research work is inherently interdisciplinary, structured around three core Faculties, each housing a diverse range of Schools with specialist expertise. Beyond the faculties, the University also has three Pan-University Institutes designed to facilitate interdisciplinary collaboration around grand societal challenges. The Institute for Sustainability, the Surrey Institute for People-Centred Artificial Intelligence, and Space Institute, bringing together diverse academic strengths to deliver an inclusive and responsible force for good. The domain expertise in all three institutes spans across engineering and physical sciences, human and animal health, law and regulation, business, finance and social sciences.



Within the Faculty of Engineering and Physical Sciences, which covers the core engineering disciplines of aerospace engineering, civil engineering, chemical engineering, electronic engineering, automotive engineering and mechanical engineering, alongside the specific disciplines of chemistry, computing, mathematics and physics, Surrey has invested over £6.5m in new and upgraded facilities. The research work within the faculty, underpinned by strong industrial links, ranges in scale from nuclear physics to interplanetary space exploration, contributes to improving our environment, health, communications, transport, security, information technologies, energy and water.

The presented facilities were structured around four interconnected thematic areas of Materials and Structural Intelligence, Environmental Intelligence, Intelligent Systems and Human-centred Infrastructure, forming a platform for prototyping an accelerated failure testing of existing and next-generation infrastructure systems. At core, the research conducted across the four themes seeks to gain a deep understanding of *intelligence* embedded within materials, environments, and the *intelligent* systems that manage them, keeping human interaction central to solution design space.

The **Materials and Structural Intelligence** focuses on the physical and chemical behaviour of materials and structures, investigating how infrastructure materials perform under mechanical loads, environmental stressors, and long-term degradation. Within this theme, testing spans from the nano-scale manufacturing and characterisation to macro-scale setups where entire infrastructure components are exposed to operational and extreme failure loading conditions, as well as accelerated ageing under controlled extremes such as high humidity, heat, radiation, and vacuum, simulating decades of wear within weeks.

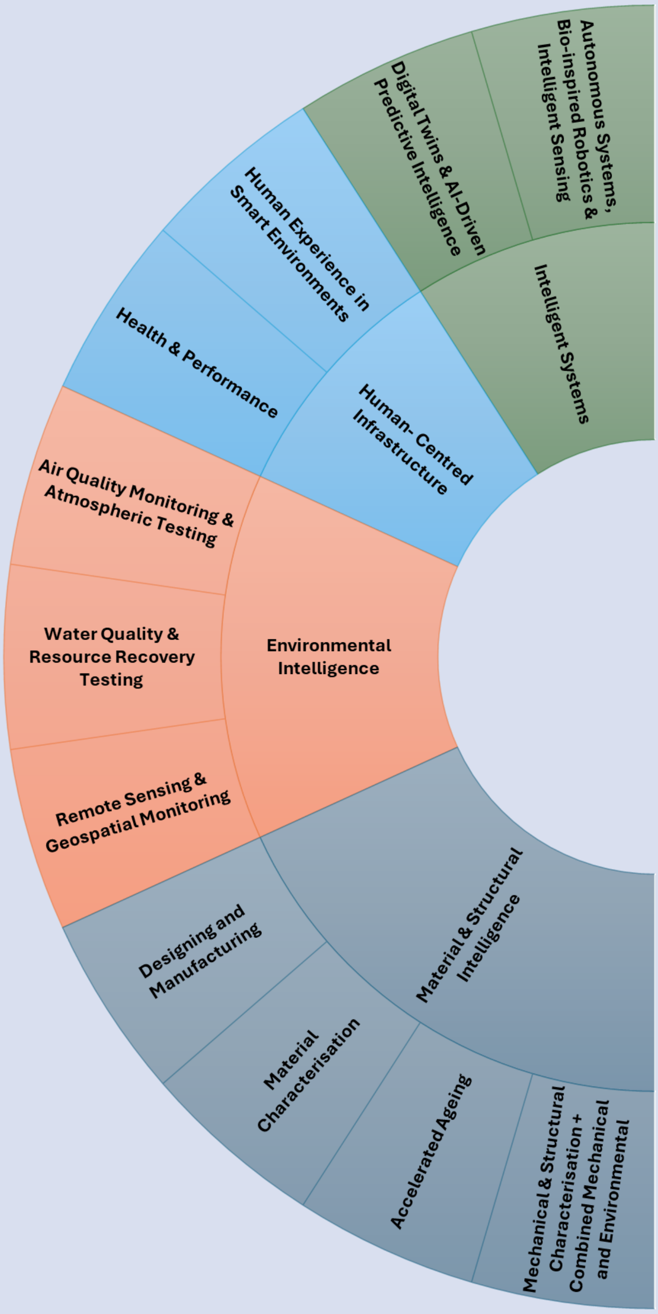


In addition to conventional materials testing, the facility supports prototyping and experimentation with novel, sustainable materials, such as self-healing and self-sensing materials, recycled plastic waste transformed into acoustic insulation panels, and pavement materials with geothermal functionality to moderate surface-level temperature and reduce pothole formation.

The **Environmental Intelligence** strand addresses the interface between infrastructure and the natural environment, with particular focus on air and water quality systems, as well as climate and pollution modelling. Facilities within this theme include wind tunnels and flow labs that simulate urban airflow, pollution dispersion, and microclimatic behaviour, as well as mobile labs and low-cost sensors that track real-time urban air quality.

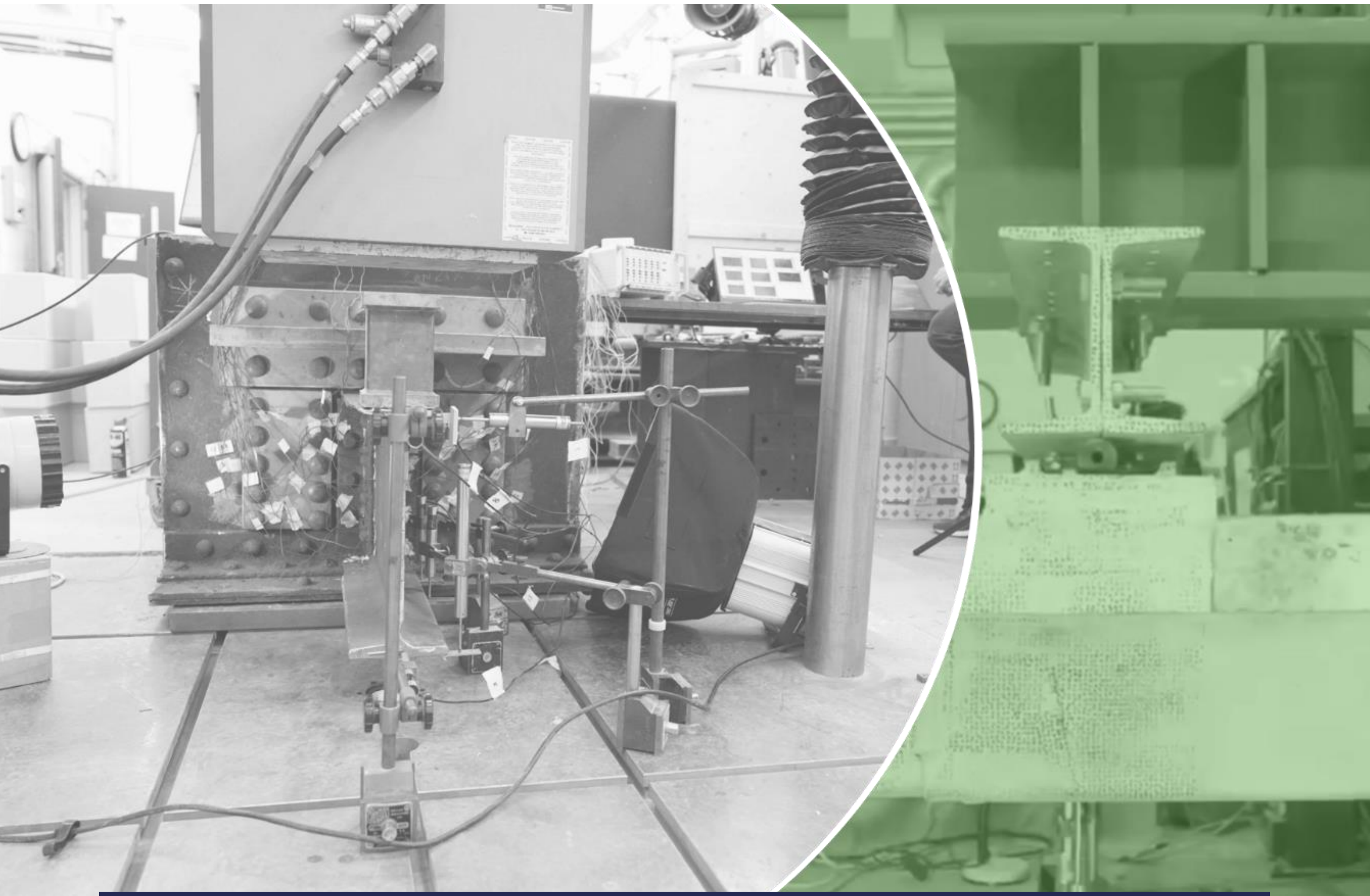
There are also facilities capable of experimentation with different water purification and wastewater treatment systems, including membrane filtration, anaerobic digestion, and UV-based sanitation. This theme also includes Remote sensing technologies and earth observation used in environmental monitoring, ranging from satellite imaging of carbon content in soil to digital agriculture solutions and crop monitoring.

The third theme of **Intelligent Systems** covers the wide range of work on robotics and sensing technologies where infrastructure is monitored, inspected, and maintained using autonomous systems and high-fidelity multi-physics digital twinning and computational modelling, facilitating digital experimentation beyond existing physical testing capabilities. This includes a range of robotic dogs and bio-inspired robots navigating complex terrain to autonomous rovers interacting with soil in sandboxes, prototyping and testing embedded wireless and self-powered sensor networks to full-motion flight and engine simulators and combustion systems, damage identification through instrumented vehicles and heritage asset information modelling through LiDAR scanning.

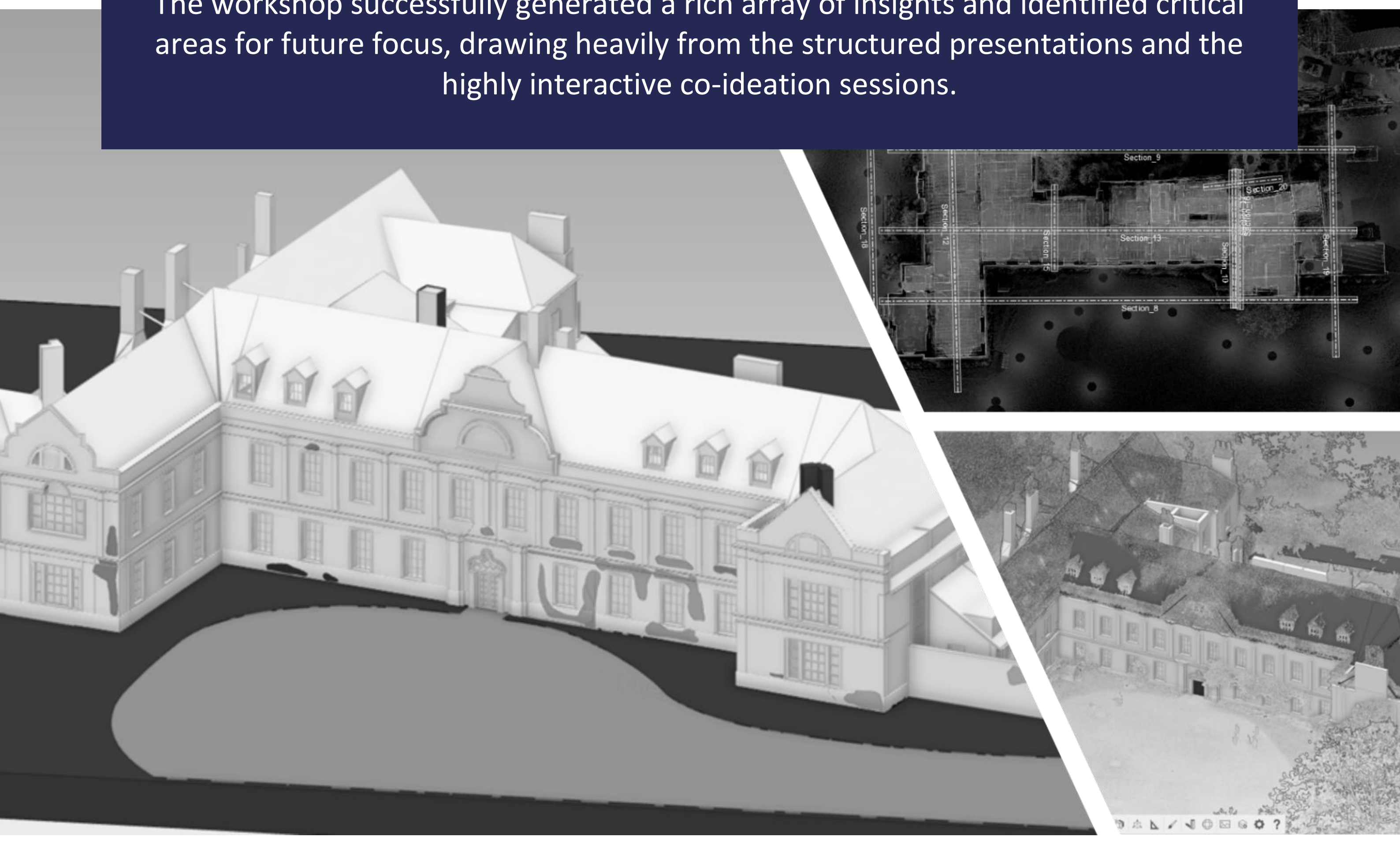


The fourth theme of **Human-centred Infrastructure** represents an integrated ecosystem of testing facilities linking human interactions and health with environment through robotic platforms, computational models, and environmental sensors, enabling a powerful loop of experiment, simulate, and validate.

As part of the main outputs of the workshop, a brochure containing an overview of the existing facilities along with a virtual tour of selected spaces will be made available online to improve the visibility of what is on offer at Surrey.



The workshop successfully generated a rich array of insights and identified critical areas for future focus, drawing heavily from the structured presentations and the highly interactive co-ideation sessions.



Santosh Singh's Scene of Provocation: "Assumptions to Assurances"

Santosh Singh's keynote address set the scene for the discussions on the day, emphasising that the global infrastructure sector is at a pivotal historical moment. The ongoing climate crisis, the widespread challenge of ageing infrastructure, and the urgent demand for sustainable growth collectively necessitate infrastructure that is not just functional but profoundly resilient.

He highlighted that three core challenges define the sector today:

1. System Thinking: Traditional approaches often view individual infrastructure components in isolation. Today's ever increasingly interdependent systems make it an imperative to adopt a system-based approach, recognising that transportation networks, energy grids, and water systems are interconnected and their failures can cascade and understanding these interdependencies is critical for social and technological resilience.

2. Building Resilience: Beyond merely meeting current building codes and standards, infrastructure must be designed and adapted for future uncertainties. This includes anticipating more frequent and intense climate events (e.g., extreme heat, flooding, high winds) that push assets beyond their historical design parameters. Physical testing becomes an indispensable tool to stress-test designs against such future scenarios.

3. Accelerating Towards a Low-Carbon Economy: The transition to a low-carbon economy requires rapid innovation in materials and construction practices, which necessitates exploring and validating new, sustainable materials that minimise environmental impact throughout their lifecycle.

> "Physical testing becomes an indispensable tool to stress-test designs against future scenarios."

Santosh highlighted that physical testing is not a relic of the past but a critical enabler across multiple facets of infrastructure development and management:

- Serving as the vital bridge between theoretical models and real-world performance, allowing engineers to simulate complex loading scenarios, test novel materials under realistic conditions, and validate structural behaviours even under extreme environmental stressors. This is particularly key for adapting emerging solutions such as 3D construction printing, advanced composites, and smart materials, where confidence in performance and durability is fundamental for regulatory acceptance and widespread adoption, where testing helps turn innovative concepts into proven, policy-ready solutions.
- Offering a pathway for the vast network of ageing infrastructure to more intelligent asset management, allowing the building of benchmarks for degradation and failure mechanisms, supporting the calibration and validation of digital tools and sensors used in structural health monitoring (SHM), and helping in enforcing new standards and regulations. This data-driven, scientific, evidence-based approach facilitates a critical shift from costly, reactive maintenance (fixing things only when they break) to strategic, preventative interventions, leading to more efficient investments, extended asset lifespans, and significantly fewer unexpected failures. The example of the M25 bridge project reflects how extensive physical testing facilitated the maximum service life of a critical asset and allowed for the safe integration of novel repair technologies from other sectors, such as marine shipping.
- Providing the empirical evidence needed to design for unprecedented climate conditions and scenarios, ensuring that assets are not just "fit for purpose" today but "future-proof." Furthermore, in the pursuit of net-zero targets, the rapid development of low-carbon materials necessitates rigorous testing to ensure their durability, safety, and long-term value are not compromised for the sake of sustainability goals. Testing helps to provide the "assurance" that these innovations are truly viable. The concept of "measuring resilience" through testing was also introduced, highlighting the need for quantifiable metrics beyond qualitative assessments.

The keynote concluded by emphasising that the decisions made today regarding infrastructure will profoundly shape future economies and public safety for decades. Therefore, these decisions must be grounded in independent evidence derived from rigorous testing and supported by interdisciplinary collaboration. This collaborative spirit, combining expertise from structural mechanics, data science, material chemistry, and experimental work, is essential to accelerate innovation and ensure that the future of infrastructure is indeed resilient, intelligent, and sustainable. This requires a willingness to constantly test ideas and challenge assumptions at speed and scale.

Testing helps to provide the "assurance" that innovations are truly viable. The concept of "measuring resilience" through testing was also introduced, highlighting the need for quantifiable metrics beyond qualitative assessments.

Co-Ideation Workshop: Future-Proofing Infrastructure Research Blueprint

The co-ideation workshop was the dynamic core of the event, where diverse perspectives converged to identify the most urgent research needs and conceptualise future-ready problem-focused purpose-driven solutions. The interactive format, encouraging contributions via post-it notes and open discussion, led to a rich tapestry of insights. Attendees were actively encouraged to capture their ideas on "thoughts wall" throughout the day, ensuring that every valuable insight contributed to the collective output and future summary of the discussions.

Key challenges and identified research priorities are thematically grouped into three themes of

i. Material Performance,
ii. Durability and Reusability, Data, Assessment
iii. Monitoring, Infrastructure Performance under Future Scenarios (Future Proofing).

Similarly, the skills gaps are grouped into the following themes with details provided below.

i. Specialised engineering
ii. Advanced Technology
iii. Data science and AI
iv. Interpersonal & Interdisciplinary Skills

Material Performance, Durability & Reusability

Existing Materials:

- Long-term durability, ageing, and fatigue of traditional materials (reinforced concrete, asphalt, wrought iron, early steel) under evolving environmental conditions (climate change, increased loads).
- Characterisation of historic materials; addressing variations in properties and code applicability (wrought-iron research showing large variations, identification of early steel and other material properties for assessment).
- Impact of specific degradation mechanisms (concrete cracking, corrosion in reinforced concrete).
- Testing and assessing reusability potential of elements from existing assets (testing standards to assess reusability, testing to indicate a shift in assessment standards to extend asset life beyond design, concrete reuse).

New/Sustainable Materials:

- Durability testing of recycled plastics (recycled plastic elements in extreme conditions), low-carbon concrete (testing low carbon concrete), and composite materials (recycled materials timber concrete composites).
- Understanding degradation and environmental impact (at what point use of recycled plastic materials on footbridges over water courses introduces microplastic pollution).
- Testing and characterisation of materials for energy transition infrastructure (materials suitable for hydrogen storage, materials for liquid hydrogen and its interaction with other facilities).
- Developing standards and gaining confidence in using alternative and recycled materials for primary structural elements (recycled plastic elements cannot currently be used for main structural elements like beams, recycled plastic beams are made with new plastic, new material technology like reinforced concrete advanced fibres).

Data, Monitoring and Assessment

SHM, NDT and Digital Twins

- Affordable and comprehensive SHM systems that detect changes from steady-state conditions, not just discrete failures (lack of SHM management systems, SHM systems now aim to detect changes from steady-state conditions).
- Standardisation of NDT practices across industries and for specific contexts (NDT practices are increasingly project-specific, variation in NDT standards across industries).
- Improving in-situ testing methods for buildings and validating reinforcement (in-situ testing for buildings, methods for proving reinforcements).
- Developing national datasets from continuous collection and storage of testing data across asset owners (national bridge database, testing data should be collected stored continuously allowing to have national datasets).
- Integrating digital twins into asset management plans, demonstrating their value for proactive maintenance (digital twins feeding into asset management plans, case study to show it allowing asset owners to change from reactive corrective maintenance).
- Developing robust business cases for maintenance and new technologies, moving beyond minimum viable product (MVP) approaches (cost benefit analysis carried out for business case, minimum viable product approach to maintaining a structures, how do we generate business cases for anything other than MVP).
- Understanding and securing finance for asset management (finance for asset management public and private funding).

Data & Information Management:

- Addressing high costs and lack of SHM management systems (cost of monitoring is high).
- Overcoming challenges with data ownership and sharing (data ownership and sharing).
- Recovering and utilising lost or unavailable historical asset information (historic information that has been lost or not available, understanding characterising historical data on assets systems and then condition of asset components to understand the patterns).
- Developing national bridge databases and databases of "bad maintenance" examples for training (national bridge database, database of bad maintenance examples would be useful to train engineers).
- Integrating diverse data types (inspection photos, qualification qualitative data, quantitative data, text) into decision making of maintenance.

Infrastructure Performance under Future Scenarios

Climate Change & Extreme Events:

- Understanding the effects of climate extremes (climate change effects are important, effects of climate extremes on bridges, increased buckling, more derailments, current and previously used material reaction to extreme weathers).
- Testing upper and lower bounds of material performance under these conditions (testing upper and lower bounds).
- Developing flood prevention strategies with available space (flood prevention with unintended space available).

Changing Loads & Usage:

- Impact of increased vehicle weights (increase of car weights, effects of heavier EBS on bridges and associated furniture) on bridges, pavements (high-impact loading on pavement construction), and associated furniture (easy profits).
- Effects of electric vehicles on tunnel fire safety systems (impacts of electric vehicles on fire safety systems, EV fire size).
- Assessing the performance of aging infrastructure (structures designed 50+ years ago, midlife infrastructure going to handle future conditions) under future loads.
- Understanding dynamic behaviour of bridges and various joint types under increased loads (dynamic behaviour of bridges, flowers and existing bridges, cross girders versus Jack autos cross girders encased in concrete, half joints, hinge joints, post-tension reinforced concrete bridges, rainforest concrete multi-storey car parks post tensioned salting grass half joints).

Resilience & Longevity:

- Addressing tunnel safety, including drainage capacity and underground resilience (tunnel safety, drainage capacity).
- Exploring probabilistic approaches and reliability-based design for future infrastructure (increasing emphasis on probabilistic approaches and reliability-based design).
- Extending the service life of existing materials (continue to prolong the service life of these materials) and understanding the impact of specific corrosion.
- Designing and managing drainage systems (drainage clean and foul water, brown Lantern, drainage with low tech solutions).

Energy Transition & Carbon:

- Research into carbon capture and storage (uncertainty about carbon capture and storage, subsurface storage in Australia, Carbon and CO2 sequestration).
- Addressing challenges and infrastructure requirements for transitional fuels like hydrogen (transitional fuels, blending hydrogen with natural gas, liquid hydrogen storage temperatures and infrastructure, hydrogen storage energy transition).
- Developing NetZero bridge specifications and material passports (netzero bridge specifications missing, material passwords).

Security & Efficiency:

- Understanding cyber-attacks on satellite interfaces and heating up existing building stock (cyber attacks satellite interfaces, heating up existing building stock).
- Strategies for more efficient infrastructure delivery (how can we deliver an more efficiently).

Skills Gap

Specialised Engineering:

- Specialist degrees in tunnel engineering, historic masonry assessment, and conservation engineering (lack of specialist degrees/modules)
- Training in the history of buildings and cultural heritage
- Understanding the fundamentals of engineering, maintaining core principles alongside new tech
- Understanding strategy and risk analysis in asset management.
- Ability to assess existing structures on a bridge-by-bridge basis
- Design coordination of multidisciplinary projects
- Assessing uncertainty and reliability (assessment uncertainty, reliability).

Advanced Technologies:

- Digital scanning, NDT accuracy and interpretation, and crack/defect identification using AI (digital scanning NDT DOT accuracy, bridge inspection consistency and objectivity, defect identification data sets).
- Using Augmented Reality (AR) in engineering.
- Integrating basic principles with technological developments (fundamentals of engineering must remain at the core).

Data Science & AI:

- Data interpretation, processing, and application of AI tools (skills gaps in data interpretation, processing, AI etc.
- Understanding computer outputs, challenging digital results, and recognising limitations of datasets (challenging the digital results).
- Addressing AI ethics and legal considerations.
- Guidance for young engineers on using future AI tools.
- Practical understanding of "Rolls Royce solutions" vs. affordable options.

Interpersonal & Interdisciplinary Skills:

- Communication, presentation, and collaborative problem-solving.
- Interdisciplinary thinking, moving beyond purely mechanical calculations (collaborative problem-solving, cross disciplinary training useful).
- Interface training between engineering disciplines.
- Improving communication between industry and academia (does industry know what academics are working on).
- Awareness of holistic assurance
- Creativity in extending the use of existing

What is Next: From Ideas to Impact

The co-ideation workshop revealed not only critical challenges across infrastructure systems and skills but also a shared appetite for collaborative, action-oriented solutions. The rich insights gathered from discussions, the thought wall, and open exchanges highlight a clear imperative that the time for passive observation has passed and now is the moment to mobilise innovation through partnership, experimentation, and strategic investment. To build on the momentum of this workshop, several immediate and longer-term actions are proposed:

1. Undergraduate & Postgraduate Project Pipeline

To engage the academic community directly in addressing identified research needs, a targeted project proposal portfolio will be developed, which will include UG and PGT level projects co-designed with industry, focused on themes highlighted during the workshop, but also used as a living list to capture continuous inputs. The "Oven-ready" research briefs will be regularly shared across different schools to recruit dissertation students or align group capstone work in addressing industry needs.

2. Sharing of Decommissioned Infrastructure Samples

Access to real-world data and materials remains a major barrier. One of the discussed actions was to facilitate the curation and exchange of decommissioned material samples (e.g., corroded steel, degraded concrete, RAAC, legacy pipe materials) between asset owners and research institutions. These samples can support accelerated testing, machine learning training datasets, and physical validation of novel inspection or analysis tools.

To operationalise this, a regular call for material samples will be established to enable systematic collection, documentation, and distribution, creating a shared resource to benefit cross-institutional and industry-led research.

3. Annual Gathering & Follow-Up Workshop

To sustain momentum and evolve ideas, a follow-up co-ideation workshop will be hosted annually to revisit challenges, share findings from early-stage pilot work, and generate new research questions and centre around “Future-Proofing Infrastructure: Scaling from Prototype to Practice”. This will be linked to UG and PGT dissertation poster exhibitions, providing a platform for students to showcase applied research, engage with industry, and connect their work to infrastructure challenges.

4. Facilitated Site Visits & Site Access

Several attendees expressed willingness to host site visits to operating or decommissioning infrastructure, which would be valuable in enabling field data collection for student projects, real-world exposure for trainees and early-career researchers and validation of digital models and testing equipment in uncontrolled environments.

Similar to a call for material samples, an online live form will be created to keep abreast of opportunities for site visits.

5. Co-Ideation Lab: Infrastructure Research Blueprint

A central aspect of the discussions was the “Future-Proofing Infrastructure Research Blueprint”, built collectively during the co-ideation sessions and the next steps will include structuring this blueprint into key thematic areas (e.g., testing, materials, failure databases, education) and publishing a working document to serve as a living agenda for academic–industry collaboration, inviting attendees to contribute to this evolving resource via shared platforms and subsequent workshops.

6. Enhancing Infrastructure Education & Training

The skills discussion revealed immediate opportunities to launch a pilot site-based training facility, incorporating hands-on Non-Destructive Testing (NDT), digital inspection tools, and asset management techniques, particularly attractive to industry for workforce upskilling. Within the School of Engineering, we will be exploring the opportunity to embed new modules on legacy asset behaviour, failure forensics, and resilience testing under climate extremes into existing UG/PGT curricula. We will also develop short CPD courses on SHM interpretation, tunnelling practices, or AI-assisted diagnostics, tailored for practising engineers and asset managers.

Feedback

The event was valued by speakers and attendees and has offered opportunities for further collaborative discussions and research projects – below is a sample of the feedback received:

"I thought this was a really useful event. It was good to meet others who are interested in infrastructure, and to see the lab facilities. It was incredibly useful to have the discussion in smaller groups about what research topics could help industry, and what skills gaps there are in industry."

"Overall, the workshop was really useful and to engage in the activities and discussions with other industry colleagues was really useful. It would have been useful to have further discussion into the current issues with the infrastructure in the UK and what could be done to resolve these."

"Interesting topic and very timely."

"[facility presentations and tours] were great to show all the possible options in the university."

"The discussions were great – this really showed the quality of those attending – they had great ideas – and also were good at moving onto new points so more could be included on the issues."

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Dasha Pritchard (AECOM)

Amanda Richards (Surrey County Council)

Jason Ridley (Eurovia UK)

Ewan Riley (Mott MacDonald)

Santosh Singh (National Highways)

Megan Smith (Lendlease)

Abigail Vine (Surrey County Council)