technology-driven programme where the key criterion is the production of electricity, to lay the foundation for the environmentally sustainable power plants of the future.

The work presented here deals with a preliminary stress analysis of a plant called the Volumetric Neutron Source (VNS). The VNS is being considered as a new plant for testing full size components to be qualified for DEMO. VNS will be a small-scale tokamak with innovative features. The work carried out at UM dealt with preliminary analyses of the Vacuum Vessel (VV) structure. Sequentially coupled thermal to structural numerical Finite Element Analysis (FEA) models of the proposed design were used for load cases representing various critical scenarios such as normal operation, magnetic fast discharge, vertical displacement events, baking etc. The work provides a preliminary assessment of the structural response of the vessel. Results show that stress values exceed typical limit criteria in certain regions, and that the design must hence be improved before proceeding to a full structural integrity assessment.

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35. A Multi-User Experience Data-Driven Design Support Framework: A Sustainable Smart Take-Away Food Packaging Case Study

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In early design, designers must make important but uninformed decisions based on limited knowledge, due to large amounts of unstructured data. As a result, they risk developing products which are rejected by life cycle stakeholders. To increase the product's impact, designers must understand the needs of potential users, but with the added endeavour of balancing functional, sustainability, and market requirements, this poses challenges to designers. By adopting smart sustainable food packaging as a case study, this research extends on previous work to identify strategies employed in designers' practices. Smart packaging enhances traditional packaging's basic functions by meeting emerging consumer expectations for quality and sustainability through novel technologies. Smart packaging acceptance relies on user values, and given the multi-stakeholders involved, their consideration in design allows for food packaging to evolve towards new advancements that are more mindful of their requirements. Studies with the multi-users of food packaging revealed their needs, and established framework requirements that seeks to support the development of innovative products which enhance multi-user experiences. Hence, the overall research goal is to address the gap in design support systems, which inspired the generation of the SUSTAIN-MULTI-UCD framework. The contribution lies in employment of data-driven approaches to gather diverse user data to help enhance multi-stakeholder experience, such as the application of topic modelling and text classification. This research focuses on providing a knowledge-based framework applied in the early design stages to capture multi-user requirements, and lay the foundation for concept generation.

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36. Innovative Strategies Through Nature-Based Solutions for Sustainable Infrastructure

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Nature-based solutions are considered solutions that are inspired and supported by nature, provide environmental, social, and economic benefits, and support resilience. They lead to locally adapted, resource-efficient, and systemic

interventions. The NBSINFRA Horizon Europe Project supports enhancing the local urban critical infrastructures protection against natural and manmade hazards through the Nature-based solutions (NBS) co-design and co-creation for a climate change resilient society.

Self-healing concrete presents opportunities for civil engineering infrastructure including in coastal areas, exposed to aggressive environment. Self-healing concrete can support durable structures through autogenous or autonomous crack healing. Self-healing can be achieved through bacterial-induced calcite precipitation in concrete mixtures. It is exploited for the consolidation of waste limestone and a sustainable alternative to cement which harms the environment.

Coastal protection relies on civil engineering infrastructure exposed to aggressive environments and the impacts of climate change. Such engineering infrastructure, relying on concrete, can also be integrated through hybrid solutions with reef regeneration as living breakwaters therefore enabling ecosystem regeneration. The research activity explores the potential of concrete types and different environmental conditions, in relation to ecosystem regeneration, as nature-based hybrid solutions in coastal infrastructure.

The Nature-Based Solutions described support engineering solutions, complement existing infrastructure, and mitigate climate change impacts.

The Faculty of the Built Environment, University of Malta is a partner in the HORIZON EUROPE Project NBSINFRA: City Nature-Based Solutions Integration to Local Urban Infrastructure Protection for A Climate Resilient Society.

~~37. Innovative Alkali Activated Material Based on Waste Materials~~

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~~Alkali-Activated Materials (AAMs) offer a sustainable alternative to traditional cementitious materials. This study investigates the development of AAMs using construction and demolition waste, excavated limestone, and quarry waste, aiming to enhance reactivity and mechanical performance. The construction industry generates vast amounts of inert waste, which poses significant disposal challenges and environmental impacts. Recycling such waste reduces landfill dependency and lowers the demand for virgin resources, yet low-quality inert waste remains difficult to repurpose.~~

~~The ReCON Project – Large Volume Waste Recycling for Low-Impact High-Performance Concrete – introduces an innovative approach to utilising excavation waste, particularly lower-quality Globigerina limestone, in alkali-activated concrete production. This process minimises environmental impact while yielding high-performance construction materials. The optimised mix design enhances mechanical properties, enabling the production of durable building blocks, cladding panels, and other structural elements.~~

~~This study establishes a strong correlation between precursor treatment and material performance, identifying optimal mix ratios that maximise strength and durability. By utilising locally sourced raw materials, the research advances sustainable construction practices and significantly reduces carbon emissions. The findings contribute to the transition toward eco-friendly, low-carbon building solutions, reinforcing the role of AAMs in the future of sustainable construction.~~

~~The ReCON Project at the Faculty for the Built Environment, is financed through XJENZA Malta, FUSION Research and Innovation TDP Technology Development Programme.~~
