Capability Statement:
Materials Technology for Marine Structures

Jon Knights Materials Consulting Ltd

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Introduction

A vital step in the design of any structure or the repair and rehabilitation of existing structures, is the selection and specification of the appropriate materials, taking into account the type of structure, its intended use, the environment in which it is situated and the expected service life.

To do this requires an understanding of both the process of using the materials, and their behaviour during construction and through the life of the structure. Control of these factors influences the performance of the materials employed, which ultimately affects the 'in-service' performance of the structure itself.

Jon Knights is an independent consultant with specialist knowledge and experience of the requirements and behaviour of materials in the built environment, with particular specialism in concrete and materials technology for maritime conditions.

Selected Marine Projects

South Arne Gravity Base Structure

- Concrete development and testing programme, South Arne gravity base tank
- Development of concrete mixes at three different densities.
- Comprehensive testing programme on mechanical and thermal properties
- Technology transfer of mixes to site to ensure production problems kept to a minimum from highly demanding mix requirements.
- Thermal modelling and ongoing technical support
- Compliance testing programme for high performance lightweight concretes, UK. Compliance testing programme of 3No previously designed high performance lightweight concretes to assure the client of desired properties. Testing included, compressive strength, elastic modulus, tensile strength, creep, drying shrinkage, thermal expansion coefficient.

The New Al Garhoud Bridge, Dubai. UAE.

- Durability design and specification for bridge piers, abutments and deck for 14 lane highway bridge.
- Thermal Modelling analysis - both in-house finite difference models and advanced finite element modelling undertaken to provide measures to reduce the risk of cracking. Continued technical support to site.

Hong Kong-Zuhai-Macao Crossing, China

- Probabilistic durability analysis and design of reinforced concrete structures (sub- and super-structure) for ~6km section of the 40km long Hong Kong Macao crossing in aggressive marine conditions for a 120 year design life, including steel coatings and cathodic protection.
- Production of durability strategy report, and comprehensive concrete specification for tender design.
- Work undertaken overseas in China, developed good relations with client on this and wider technical issues regarding bridge durability

Thames Barrier Leak Sealing Project

- Installation of monitoring to assess causes of leakage
- Study of mechanisms of leakage within the piers, installation of monitoring and review of repair/remediation solutions using value engineering techniques.
- State-of-art review of leak sealing technologies
- FE modelling of piers to derive novel solutions to eliminate leaking.
- Innovative approach to finding the symptoms of the leakage and attempting novel solutions to stop leakage within the piers.

Caissons at new deep water port, Tangiers

- Concrete mix and durability expertise and consulting
- Review of durability design and adhoc support to client on construction matters

Devonport Royal Dockyard

Design of Underwater Concrete. Designed high performance concrete for placement underwater, for foundation mass concrete of a low level refuelling facility at Devonport Royal Dockyard. Successful delivery of the technology to site in liaison with the contracted ready-mix company. Formulated successful quality control scheme during placement. 12,000 cubic metres of concrete placed 50 ft underwater.

Qatar-Bahrain Causeway.

Durability Design Dual two lane, 40km long, causeway, linking Qatar and Bahrain, consisting of roadway sections on reclaimed embankment, rest islands, 22km of viaduct bridge structures and long span signature bridges .Specialist technical advice on materials and durability. Design review and checking using probabilistic concrete durability modelling techniques of sub-and superstructures. Detailed review of durability strategy and consultation with designer/contractor on key durability issues, to provide durable solution for 120 years in an aggressive Middle East environment.

Kennecraig Mooring Dolphin.

Thermal Design and Mix Evaluation, UK. Design of early thermal crack control measures for large marine dolphin. Estimation of temperatures and formulation of control plan and crack control design in accordance with CIRIA C660. Technical advice on mix design and quality control of precast and insitu concrete.

Other projects

- Floating dock for nuclear submarines, Faslane
- Saudi Arabia/UK: Red Sea Gateway Project, Jeddah, Saudi Arabia.
- Rosyth Royal Naval Dockyard, UK.
- Tristan de Cuhna harbour, South Africa.
- Appledore New Quay Works, UK.
- Phase IV Yard Expansion Freeport, Barbados, technical support
- Salalah Port, Oman, materials resources for construction.
- Port of Balboa, Pile Defects Investigations and Remedial Works. Panama.
- Al Raha Beach Development, UAE.
- Port of Balboa Phase 3 Condition Survey and Future Serviceability of Reinforced Concrete Pontoons, Berth 18, Panama.

Relevant Publications

UK: CIRIA C674 The Use of Concrete in Maritime Engineering – a good practice guide.

Technical advice and Lead Author. Written contributions to the production of technical report for the design of concrete in the marine environment. Chapter on durability design and modelling submitted, editorial work.

CS 163. Guide to the Design of Concrete Structures in the Arabian Peninsula.

Contributing working party member of Concrete Society guide for durable design in the Gulf region, including comment and advice on specification for durability of concrete in aggressive environments

CIRIA C660 Steering Group Committee on Early Age Thermal Crack Control of Concrete.

Attendance and regular input into the steering group for the assessment of early age thermal behaviour and mitigation of early thermal cracking.

Standards Committees

Assistance in the production of recently re-published Code of Practice BS 6349-1-4: Maritime Structures – Materials. Includes the production of enhanced durability tables to rationalise the use of cement replacement materials and combinations.

Advising BS 8500 committee on durability of concrete for current and future standards.

Contact

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