SIMPLIFIED APPROACH TO OPERATIONALISE UKC CALCULATIONS

by

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EXTENDED ABSTRACT

1. INTRODUCTION

The widening of the Panama Canal together with the larger new-generation vessels in operation means that port authorities and pilots are being challenged to handle larger vessels than they are accustomed to. This requires them to make critical safety judgements on situations for which they have not had years of experience to build up an empirical understanding across a range of weather conditions.

One aspect ports are concerned about is the under-keel clearance implications of these unfamiliar vessels. These uncertainties, along with the growing acceptance of the limitations associated with the traditional static under-keel clearance (UKC) rules and the use of subjective personal judgment, have encouraged ports to seek better ways to manage UKC risks. Traditional static UKC rules can be unsafe, the challenge is to know when.

While there are advanced systems such as DUKC® that can manage all aspects of UKC advice for a port, such highly advanced and bespoke systems may not meet the needs of ports with simpler requirements. Recent developments in technology now mean that there is a simpler option for ports seeking to reduce the uncertainty around sailing decisions.

2. EASY ACCESSIBILITY TO UKC CALCULATORS

The first step towards improving UKC management is to facilitate access to UKC calculators. PIANC publications like “Harbour Approach Channels Design Guidelines” have numerous examples of formulae developed by specialist researchers (Ref: Figure 1). While these publications are generally focussed on design and are targeted at the port design engineer, they obviously have broader applicability and can be used to assess operational UKC requirements. However, simple and efficient access to these formulae has been limited, with the descriptions hidden in manuals and applicability cases hard to decide on the fly.

Lack of easy access has resulted in some pilots coding simplistic formulae into computer spreadsheets. This approach has several flaws:

- Risk of calculation error (In formula)
- Risk of applying outside range of applicability
- Lack of information about the considerable range of formulae / uncertainty levels

To address these issues, online calculators are now available that allow pilots to simply apply the formulae to their port and proposed transit and obtain results immediately. To date, formulae for squat, wave response, wind heel, turning heel and stability have been made available.

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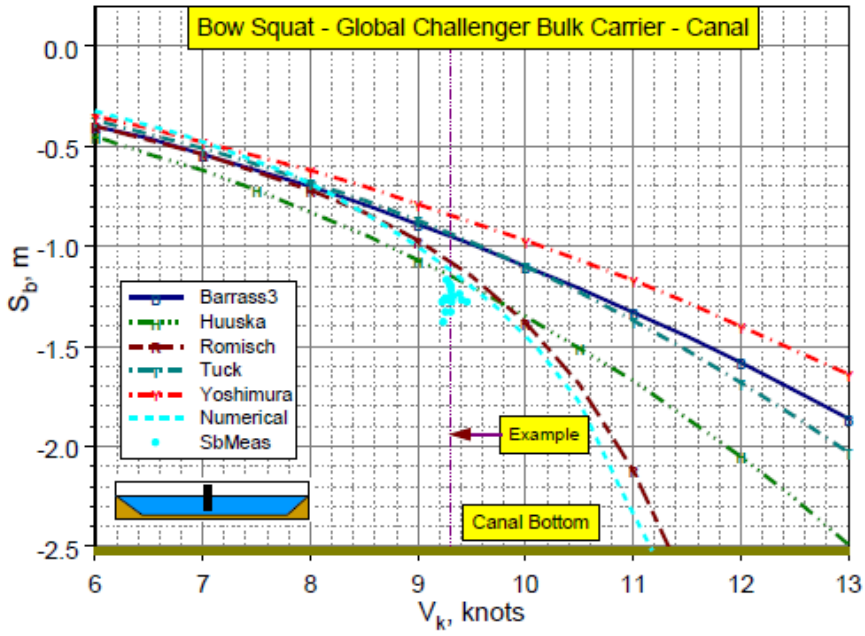

Figure D-13: Bow squat for Global Challenger Bulk Carrier, Panama Canal, L_{pp} = 216 m, B = 32.2 m, T = 11.7 m, C_B = 0.83, h = 14.2 m (h/T = 1.21), W = 152.4 m, W_{Top} = 206.4 m and n = 1.9

Figure 1: Variation in squat prediction. Source PIANC 2014

An additional advantage of having multiple formulae available is that it highlights the uncertainty associated with the formulae. For example, many empirical squat formulae are derived by fitting theoretical formulae to data measured in the field or in towing tank experiments. All of these approaches have inherent uncertainty often described in the original literature (Ref Figure 2). However, once these formulae are adopted in publications like PIANC, the details of the uncertainty are lost. A practitioner thus relying on a single formula without information about its uncertainty will psychologically start to give more credence to the result than may be warranted. However, when presented with a simple calculator that presents a series of seemingly equivalent formulae with different results, the same practitioner may more clearly appreciate the underlying uncertainties.

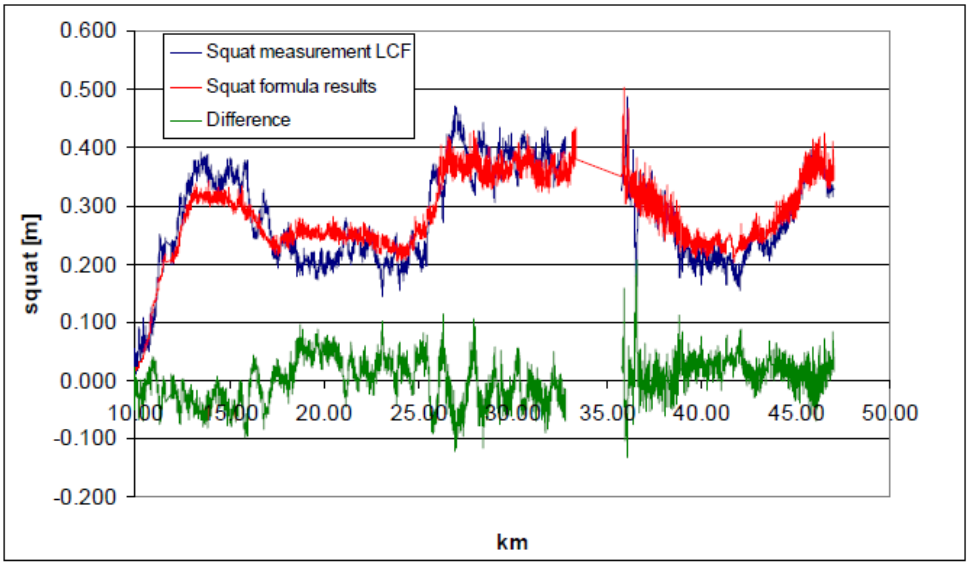

Figure 2: Uncertainty in squat measurement. Source Laupichler and Wandelt (2009)

3. READY ACCESS TO ENVIRONMENTAL OBSERVATIONS AND FORECASTS

Environmental information is as important as the underlying equations driving the UKC calculations. Real-time weather data such a tide gauges, wind sensors or wave buoys, are required to obtain a complete picture of the conditions in the port's region. The lack of such equipment is often a limitation in UKC risk management for many harbours around the world. Previously, access to this type of data was limited by cost, but in the past few years a series of light weight wave measurement devices (Ref Figure 3) have entered the market with the potential to make access to real-time wave data much more accessible to ports with cost constraints.

Figure 3: Light weight wave measurement devices. Source spoondrift.co

In addition to instantaneous environment monitoring, the path to improved safety during vessel transits requires an appropriate understanding of the future weather conditions. Safety and operability planning are now made possible by modern technology developments, enabling port-specific high-resolution

weather forecasting to be delivered anywhere in the world. Ports worldwide can now benefit from 7-day high resolution forecasts accessible through an online subscription system.

Bridging the gap from the past, and a port's traditional static UKC management rules; the present through real-time monitoring systems; and the future accessed through state-of-the-art forecasting solutions and UKC predictions, PortWeather provides a unique decision-support platform empowering all port users.

4. **USER EXPERIENCE**

Ultimately the successes of a simplified approach to operationalise UKC calculations depends on how the users respond. To date, feedback has been positive with many ports and pilots responding well to the ability to be more involved within the UKC decision making. We are working with a number of ports interested in the technology to streamline the use of the online UKC calculators and make them more efficient for daily professional use. Indeed, some pilots in New Zealand have begun to adopt these techniques into their operations, using the calculators and forecasted environmental conditions to assess the UKC prior to undertaking a transit.

5. **SUMMARY**

The lack of easy access to UKC calculators and limited access to environmental information has meant that ports have relied on personal judgement and simplistic static UKC rules. Based on such limited information these rules tend to be either unnecessarily conservative or occasionally risky. However, with freely available web-deployed UKC calculators and subscription services offering high resolution environmental forecasts for ports around the world, port users can now make much better-informed operational decisions.

6. **REFERENCES**

PIANC (2014), Report No.121, Harbour Approach Channels Design Guidelines, PIANC, Brussels. ISBN 978-2-87223-210-9

Laupichler and Wandelt, (2009), Comparison of CFD Results with Experimental Squat Data, 3rd Squat-Workshop 2009 - Nautical Aspects of Ship Dynamics - Elsfleth (Germany)