Master Thesis in Marine Technology -2013
The Efficiency of a Mewis Duct in Waves

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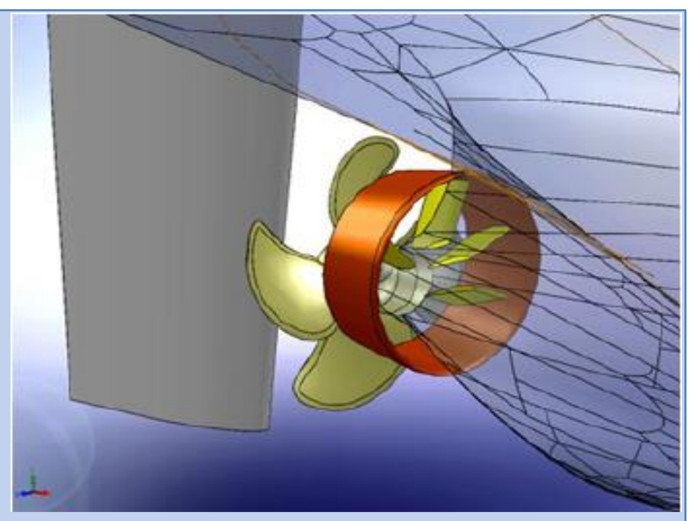
Problem:
The so-called Mewis Duct [1] has been found to improve the propulsion of high block coefficient, single-screw vessels, and a power-saving in the order of 5% have been reported. Model tests have only been performed in still water, and performed full scale trials have been unable to show conclusive results. It has therefore been questioned whether the duct has the same benefit in waves.

Introduction
The Mewis Duct [1] is an energy saving device placed in front of the propeller, and is built up by two components to target individual loss factors behind the hull to reduce energy loss:

- A wake-equalizing duct for equalization of the flow created by the hull towards the propeller
- Pre-swirl fins to generate a swirl in the flow in the opposite direction of the propeller to reduce the rotational losses
- The duct to propeller radii is also optimized to create a higher loading at the inner radii of the propeller area to reduce the hub-vortices.

Changes in the wake field and the thrust deduction in waves has been confirmed by model tests [2]. These are important factors to the Mewis Duct [1] and is expected to be important. Because of that and the fact that full scale trials have given inconclusive results, more work is required in order to verify if there is an effect in waves.

Method:
In order to investigate the efficiency of the Mewis Duct [1] in waves, propulsion tests in the large towing tank at MARINTEK was conducted with and without the duct fitted. The picture on the right show the arrangement of the Mewis Duct and is taken from [3].



A «load-varying» self-propulsion test method [4] was used both in still water, regular and irregular waves. At least two propeller revolution settings are used in each condition to obtain the load variation and the loading at the self propulsion point is obtained by interpolation. 7 regular waves with a wave length to ship length ratio from 0,6-1,5 was applied.

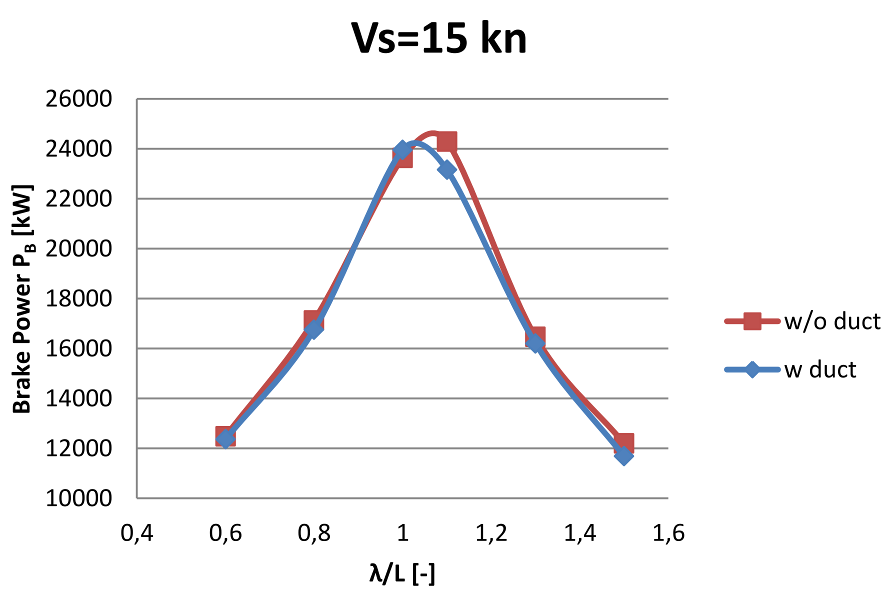
Measurements of thrust, torque and propeller revolutions was registered and used in combination with an open water diagram to calculate propulsive factors, propulsive efficiency and brake power.

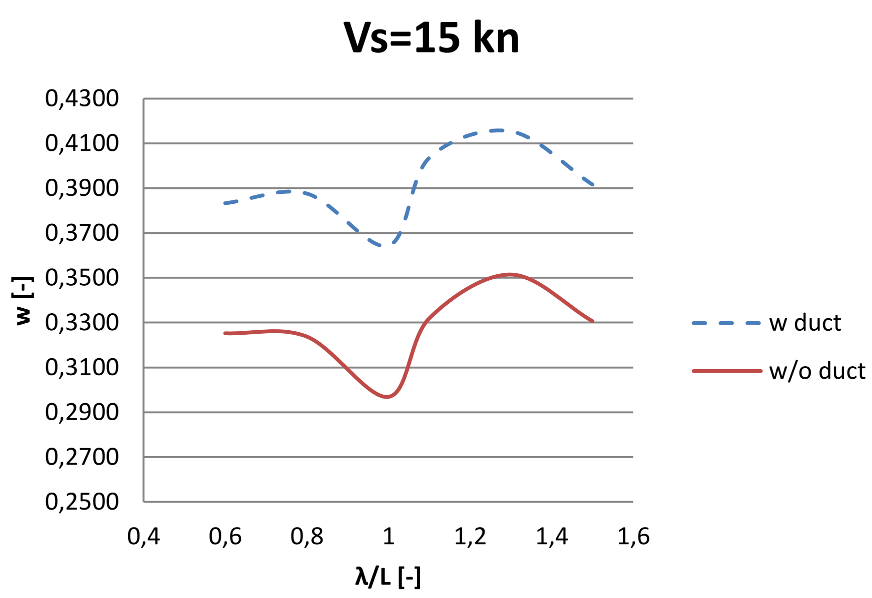
In addition analysis of the thrust deduction and effective wake with and without the Mewis Duct [1] in different wave conditions have been followd through, as well as motion analysis in the form of pitch and heave RAO plots have been worked out.

Uncertainty analysis of the measured and calculated values have allso been an important part of the work.

Results:
Results so far indicates that the relative differences with and without the Mewis Duct [1] fitted does not change drastically in waves compared to still water measurements. The figures below shows examples of the calculated brake power and the effective wake in waves, and illustrates the differences with and without the duct. λ/L is the wave length to ship length ratio.

Results of measured and calculated values indicates a relative high uncertainty compared to the expected efficiency gain in the order of 5%. Ideally more time should be spent in the model tank to provide enough information for a certain conclusion regarding the efficiency in waves.





References:
[1] Mewis, F. (2009). "A Novel Power-Saving Device for Full-Form Vessels", Mewis Ship Hydrodynamics (MSH), Dresden, Germany.
[2] Nakamura, S. and Naito, S. (1975). "Propulsive Performance of a Container Ship in Waves", J.S.N.A., Kansai, Japan.
[3] Mewis, F. and Guiard, T. (2011). "Mewis Duct® – New Developments, Solutions and Conclusions", Second International Symposium on Marine Propulsors smp'11, Hamburg, Germany.
[4] Holtrop, J. (2001). "Extrapolation of propulsion tests for ships with appendages and complex propulsors", Marine Technology, Vol. 38, No. 3:p. 145–157.

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