# Using experience to assess required tug power

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## Introduction

The optimum use of tugs can have different interpretations depending on the economic priorities of the parties involved. The shipowner for example may want the fastest operations which in turn may lead to stronger tugs, the port on the other hand may not have the repeated use for very large tugs so that the owners cannot recover their investment. So the answer is a balance which is appropriate to the operating environment in the port concerned.

The experience of the shiphandler is, however, always a crucial factor when deciding on the appropriate use of tugs. This experience factor is essential to answer the questions of how many tugs are needed and what tug power is required? The importance of the experience factor is not always taken into consideration, and this article emphasises this important factor.

## Why we should take heed to the experience factor?

The basic reason is the trend in the use of ever stronger tugs and the related important aspect of the difficulty in assessing how much tug power is really needed to handle ships safely in a port. The latter is also important for port authorities to be aware of when assigning ships what tug assistance should be used. A proper assessment of the tug power needed is important for large ships and particularly for ships with a large windage, such as container vessels, car carriers and LNG carriers, whose number and wind area increases continuously.

The trend towards the use of more powerful tugs and the difficulty in assessing the tug power really needed will also have its effect on ports under construction and ports with a small financial budget. While a professional assessment of the situation, taking into account the local available experience, may result in a more realistic and economical tug use and tug fleet, it should be well noted that the larger the shiphandler's experience the better the results will be. This also means that for a port, training of shiphandlers, pilots and captains, by capable instructors with the right practical experience is a major factor of importance as well.

## The present situation and its consequences

As mentioned above, in many ports a tendency can be observed towards ever stronger and often ever more complicated tugs. Tug power increases continuously and tugs with a bollard pull of 70 tons can be found already in a number of ports or are under construction, while harbour tugs with a bollard pull of 100-120 tons are already considered. No port is the same and tug requirements differ from port to port. However, in general more powerful tugs mean larger investments and higher costs.

The dimensions of tugs change. Ever stronger engines can be installed in ever smaller tug hulls. An extreme example is the so called compact tug: Tugs, often with azimuth thrusters, with a length over all of about 24m and a bollard pull of up to approximately 70 tons. The small, very manoeuvrable and powerful tugs are a welcome development as space in ports is often limited and high power is sometimes needed.

Photos: Captain Henk Hensen FNI

Bulk carrier "Western Island" (l.o.a.181.5 m) on the Surinam River, proceeding to Paranam and when moored alongside the jetty.

Replacing a number of smaller tugs by a more powerful tug could produce savings for a tug fleet owner due to the smaller tug fleet and savings on tug crews. However, the availability of stronger tugs does not automatically mean that ships will use less tugs. Ships normally using one or two tugs will, when using more powerful tugs, still use one or two tugs. Even ships using, for instance, four tugs on arrival generally use the same number of tugs when even more powerful tugs become available. An example is given below. In such cases the towing company made a large investment, but ships are more or less using the same number of tugs and may pay the same tug dues.

Reducing the number of tugs because of the introduction of more powerful units may have consequences for a port. A reduced availability of tugs may cause problems in case of severe weather conditions or in case of peaks in shipping traffic.

The introduction of more powerful tugs may in certain cases indeed result in a reduction of the number of tugs used per ship, for instance from four to two units. This has the consequence that an additional risk is introduced. The reason is as follows: In case the ship is assisted by four tugs and one tug has a break down, there are still three tugs left to assist, which is, in most cases, sufficient to handle the ship safely. In cases where the ship is assisted by two powerful tugs, and one tug has a breakdown, safe handling of the ship becomes problematic with just one tug.

Tugs should, furthermore, be suitable for the size of ship. This means that small ships should preferably be handled by small tugs. Smooth and gentle handling of small ships with powerful tugs is more difficult and bollards and fairleads of small ships are not strong enough for the forces that can be delivered by the powerful tug.

The latter is already a problem for large ships when handled by the present powerful tugs of 60 – 70 tons bollard pull. Several complaints regarding damaged bollards and fairleads have already been reported.

It is clear that although the development of safe and capable tugs should continue, following blindly the trend towards stronger tugs is not the way it should be done, although the fact that shiphandlers gradually get used to the larger tug power is a factor not to be underestimated.

Nevertheless, the type of tugs, the required number of tugs and the required bollard pull should be determined in a professional way, based on the local situation, including the local available

shiphandler's experience. A number of ports do carry out careful studies to determine what the required type and bollard pull of new tugs should be, taking into account pilots' experience.

## Is shiphandler's experience indeed so important?

Shiphandler's experience is indeed an essential factor for the tug assistance needed. This can be demonstrated by a few practical examples.

1. During a long lasting strike in the port of Rotterdam a number of years ago, many vessels that normally used tugs still did enter and leave the port, such as general cargo vessels, containerships (up to approximately 200-225 metre in length, even those without bow thruster), bulk carriers and tankers. The ships had to be moored alongside river jetties, manoeuvred into relatively narrow basins situated along a river with currents and be berthed there, etc., all without tug assistance. The longer the strike lasted, the more seemed to be possible, because the experience of the pilots was building up. Specific measures and regulations between the harbour authority, mooring men and berth supervisors were agreed upon, enlarging the possibilities of safe arrivals and departures without tug assistance.
2. Pilots bring bulk carriers, without a bow thruster, with a length up to approximately 225 metres over the Suriname River to Paranam where the ships are turned on the river, where the width is only a little more than the maximum ship's length, and then moored alongside the jetty in a safe and professional way, all without the use of tugs. In most other ports these ships will normally use tugs.
3. General cargo vessels, bulk carriers (not tankers) and passenger vessels up to a length of nearly 230 metres, that might use tugs in other ports, often enter the port of Willemstad in the Caribbean without tug assistance. These ships, when coming from sea, proceed through the narrow entrance towards the berths and moor safely alongside their berth without tugs. (During certain periods of the year there is even a rather strong cross current just before the port entrance).
4. The world's largest bulk carriers and tankers are coming to Rotterdam. One has been coming already for almost 20 years. This ship has a deadweight of 365,000 tons and a draft on arrival of 74 feet. To be sure that the available tugs were strong enough to handle this large deep-draft bulk carrier, initially simulations were carried out, resulting in the conclusion that the ship could safely be handled by 4 x 30 tons tugs! During several years the ship was indeed handled on arrival by four tugs with a total bollard pull of 120 – 140 tons. It worked well with these relatively low powered tugs.

Due to the availability of more powerful tugs, the ship is nowadays still handled by four tugs, but with a total bollard pull of approximately 220 – 240 tons. This is up to 100% more tug power, while nothing has changed to the ship or berth, and conditions have not changed dramatically. Although, with a total tug power of only 120 tons, margins are smaller, manoeuvring procedures are stricter and it requires more from a pilot's experience, which includes the pilot's knowledge of the capabilities and limitations of the assisting tugs.

A minimum width of the fairway or harbour basin might be an argument for stronger tugs. When, however, bringing ships into a drydock or lock, manoeuvring width and length is minimal and ships generally enter or leave the drydock or lock with the available tugs without problems. Apart from the need for proper tug assistance, a very important factor in such cases is also the correct manoeuvring procedures and the right experience of pilots, and of tug masters.

Photo: courtesy Bergesen d.y. ASA

Bulk carrier "Berge Stahl" with 74 feet draft assisted by four tugs of KOTUG, Rotterdam, with a bollard pull between 53 and 76 tons.

The above examples show that even for rather large ships tugs are not always used or needed and if tugs are used the total bollard pull applied can vary significantly. They show furthermore, what an important role experience can play, which should also include a proper knowledge of the capabilities and limitations of the attending tugs. On the other hand, it will be clear that if shiphandler's experience is at a low level, it will place high demands on tug assistance.

It will be understood that certain circumstances, e.g. specific berth locations or conditions, may require maximum input from tugs, while ship manoeuvres should, of course, be possible when using only ship's manoeuvring devices, anchor and mooring equipment for arrival or departure manoeuvres.

It is not so simple to determine how much tug power is really needed taking into account a shiphandler's experience. The crucial question is how to quantify the shiphandler's experience in terms of the required tug power.

## Different situations for assessment of required tug power

Whether more tugs are needed in a port or the available minimum tug assistance is sufficient, can be assessed by a desk study and a simulator study, taking into account the local experience of pilots and, if applicable, of tug masters.

To answer the question how strong tugs should be or how much tug power is needed, assuming if tugs are considered to be necessary, two basic situations have to be considered:

- Where the mass of the vessel is the predominant factor such as with loaded tankers and bulk carriers, for which a rather large margin in required tug power is possible; and
- Where external forces (wind, current, wave forces) working on the ship are the governing factors which determines much more precisely the total tug power required.

A distinction should furthermore be made between the required tug power or bollard pull for:

- Handling ships that normally visit the port;
- Handling specific ships that are planned to visit the port, for instance large LNG carriers or container vessels, or for specific situations in the port; and
- The introduction of a new tug.

For nearly all these cases a well-equipped ship bridge simulator is an optimum tool to include along with the experience factor of the local shiphandler in determining the required tug power needed, while at the same time the experience of the local tug master can be taken into consideration.

For basic calculations and for daily operations, appropriate empirical formulae and formulae based on wind and current forces can be used to assess the total tug power required (for more detail please refer to *Tug Use in Port. A Practical Guide*. 2nd edition. Henk Hensen, and *Ship Bridge Simulators. A Project Handbook*. Henk Hensen).

## Conclusions

The intention of this article is not to argue against the introduction or the use of modern powerful tugs. On the contrary, they are often needed for safe and efficient handling of ships. It is a plead for a realistic, professional and practical approach to determine what is needed for a port with respect to harbour tugs.

- It has been shown that automatically following the trend of ever stronger tugs may have certain consequences for a port or a towing company;
- An important factor for what is really needed with respect to tug power (and tug type as well) is the experience of the local shiphandler, mostly the local pilots;
- The experience factor mentioned above may even lead to the conclusion for some ports or berths that no tugs are needed, taking into account, if necessary, certain limitations in regards to wind and currents;
- For more common situations, simple (empirical) formulae can be used to assess the required tug power for a ship or for certain operational environmental conditions;
- For specific situations in a port and/or for specific ships the only way to determine accurately how much tug power is needed or how strong tugs should be (and what tug type is needed) is by the use of a ship bridge simulator. This creates the possibility to quantify the shiphandler's experience in the results of required tug power in an optimum way, while the experience of local tug masters can be included in the simulations as well;
- The above often also applies for answering the question how strong a new tug should be for a certain port; and
- As experience is such an important factor, professional training of pilots, and tug masters, is crucial for safe and efficient shiphandling and tug use.

Of course, other factors may play a role in the choice of a tug as already indicated in the introduction. Safety or emergency regulations in a port may lead to additional requirements such as for escort operations; the market price of the tug may play a role, or tugs may be used for offshore activities as well. This all may lead to higher requirements than would be needed for normal harbour operations only.

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### ABOUT THE AUTHOR

Captain Henk Hensen is a Master Mariner and was a Port of Rotterdam pilot for 23 years. During his years as a pilot he was stationed at the Pilot Office of the Rotterdam Port Authority for five years. During that time he started the first simulator courses for harbour pilots and tug captains, and participated in many port studies, including simulator research.

Following his pilot career he continued to work as marine consultant on the nautical aspects of port studies, harbour tug advice and simulator training.

Projects have included pilot and tug captain simulator training courses, port entrance and port development studies, including port studies on simulators, amongst others for the ports of Rotterdam, Amsterdam as well as for other ports in the world.

Furthermore he has carried out and has been involved in various other nautical studies, such as nautical safety studies, tug performance studies for ship bridge simulators, studies for the development of LNG terminals, container terminals, mooring simulation studies, simulator studies for safe bridge passages, studies on safe and efficient harbour tug use, etc.

As an author he published the monograph "Manoeuvring Single Screw Vessels fitted with a Controllable Pitch Propeller in Confined Waters" (1994); the first and second edition of the book "Tug Use in Port" (1997, 2003); chapters of the book "The Nautical Institute on Pilotage and Ship Handling" (1990); chapters of the book "The Work of the Harbourmaster" (1998) and numerous articles in nautical magazines. Captain Hensen is a Fellow of the Nautical Institute, member of the International Federation of Shipmasters and of the Netherlands Institute of Navigation.

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