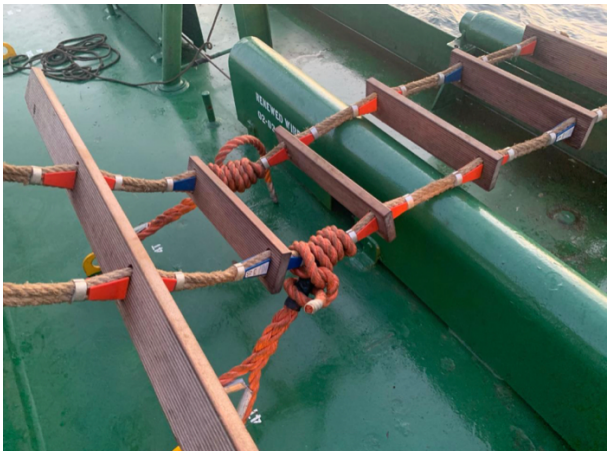
MMSI Year 1 - Research

Securing Methods of Pilot Ladders

An Inventory



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Cover Picture: Pilot ladder secured at intermediate length.
By Capt. Gary Clay

Abstract

Due to the length of the pilot ladder, in relation to the ship's freeboard, it is often necessary to secure the pilot ladder at intermediate length. In this work, an analysis is made of the various securing methods in use, as well as the legal system surrounding the securing of pilot ladders. It is identified that no formal requirements are in place dealing with the securing of pilot ladders at intermediate length. An analysis is made of the annual IMPA safety campaign in this respect, while data from other reporting schemes are identified as well. The results of a recent load test study are identified. Using an online survey, an inventory is then made of the distribution of the securing methods of pilot ladders in use, worldwide. Together with the outcome of the load test study, it is then concluded that the majority of pilot ladders secured at intermediate length have problems with regards to breaking strength, or problems with the potential damage to the integrity of the pilot ladder. Recommendations are made for further research and initiatives to solve this industry wide problem.

Foreword

During the last year I have been in contact with many maritime pilots, as well as other professionals from the maritime industry on the subject of pilot ladder safety. This research is a logical follow-up to Capt. Troy Evans' research into the breaking strength of the securing methods of pilot ladders used onboard ships. *Identify the problem, quantify the problem, come up with innovative solutions* is what is being taught during the Master in Maritime Shipping Innovation course of which this research is a part.

The results of this research may be a small step in the solution of the industry wide problem of "pilot ladder unsafety". I want to thank all maritime pilots from around the world who have contributed to the online survey, making this research project possible.

Rotterdam, January 2021,

Herman Broers

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1. Introduction

The profession of maritime pilots dates back hundreds of years, when local seamen and fishermen boarded ships, in order to advice the ship's master how to enter ports or estuaries and navigate dangerous coastal waters. The way pilots board ships has not changed much during this time. The modern pilot still uses the good old pilot ladder to embark and disembark ships, sometimes in combination with the ships' accommodation ladder.

Climbing the pilot ladder is a critical process. When accidents happen, there can be injuries, even deaths. Regulations regarding the way in which pilot ladders are to be secured on deck are general in nature and do not take the loading condition of the ship into account.

Many methods of securing can be identified, some considered better than others by pilots for various reasons. Recently, an investigation was published into the breaking strengths of various securing methods used (Evans, 2020). Without going into the question which securing method is better than others, it is now useful to inventory which securing methods are used in practice.

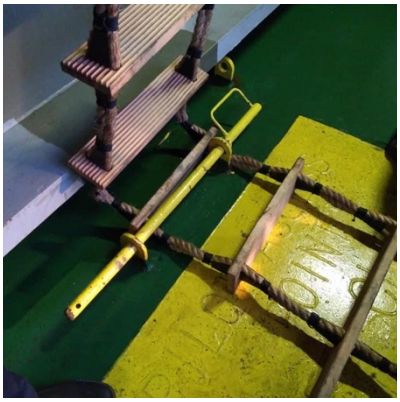
2. Orientation

Securing methods of pilot ladders in practice

The varying loading conditions of ships do not allow for the pilot ladder to be suspended at the correct height above the water, whilst using the top end of the ladder to secure it. In most cases pilot ladders are secured at "intermediate length". According to Vallance, P.38 (Vallance, 2018) "a worrying trend" is observed in the way pilot ladders are suspended from parts of the ship or ladder which are not suitable for this purpose.

Shackles (1)

Railing (2)



Steel bar (3)

Deck Tongue (4)

Spreader (5)

Non designated strongpoint (6)

Fig 1. Securing methods. From Facebook group #dangerousladders, by various authors, 2020, retrieved on December 1, 2020, from:https://www.facebook.com/groups/831768026997774/

The above securing methods are deemed problematic by pilots, since the solid parts of the ladder are used to carry the weight of the ladder (1 thru 5) or non-designated strong points are used to secure the ladder to (6)

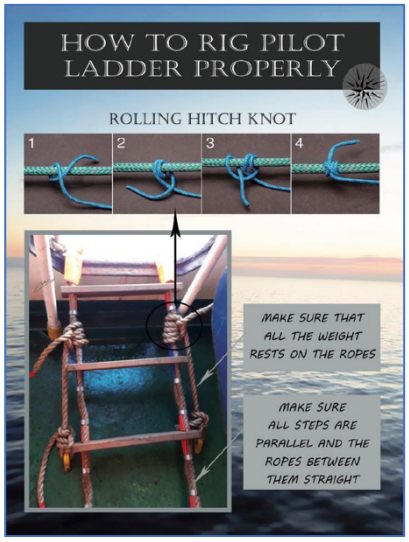


Figure 2: The rolling hitch method to secure a pilot ladder. From "Error Enforcing Conditions and Deficiencies" by Chirp Maritime, 2019, Retrieved on January 16, 2021 from: https://pilotladdersafety.com

An alternative method of securing is the rolling hitch knot which does not put any weight on the wooden parts of the ladder but instead uses the side ropes to transfer the weight of the ladder to the ship's deck. (Chirp maritime, 2019)

Regulations

From a regulatory perspective, legislation regarding the use pilot ladder is very special. When working aloft "on shore", requirements apply to the use of fall protection, scaffolding, fall arrestors and personal protective equipment. There are no such requirements for the use of pilot

ladders. Instead, there is a set of general regulations, guidelines, standards and a procedural framework.

Figure 3. The Chain of regulations for pilot ladders.

The main regulations in the field of pilot ladders can be found in:

1. Solas convention CH V Reg 23: Regulations regarding Pilot Transfer Arrangements (International convention for the safety of life at sea (SOLAS), 1974, 1974)
2. IMO Resolution 1045(27). These are the technical guidelines pertaining to the above mentioned Solas convention. (Pilot transfer arrangements, 2011)
3. IMO/ IPMA Wheelhouse poster
4. ISO 799-1. The industry standard for pilot ladders. (International Organization for Standardisation, 2019)
5. International Safety Management code (ISM Code). (The international safety management (ISM) code, 1998)

1: Solas Ch.V reg 23 is the umbrella legislation in this context. The purpose of this legislation is set out in Article 2: 2.1. "All arrangements used for pilot transfer shall efficiently fulfil their purpose of enabling pilots to embark and disembark safely." Since 2012, the pilot transfer arrangements and all pilot transfer arrangements of a ship's safety equipment have been maintained, inspected and recorded as such (International convention for the safety of life at sea (SOLAS), 1974, 1974)

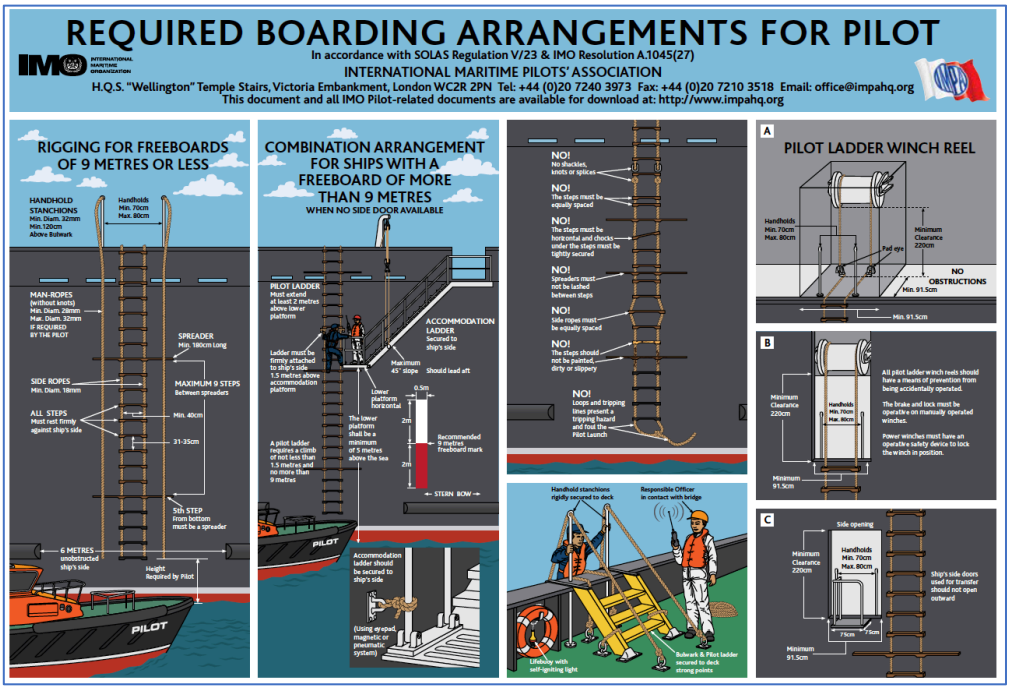


Figure 4. IMO / IMPA Wheelhouse poster. From "Pilot ladder poster" by IMPA,2020, Retrieved on January 16, 2021, from https://impahq.org/downloads.php

2/3: IMO-resolution A.1045 is the technical elaboration of SOLAS legislation. It provides guidelines for the use of the pilot ladder, the combination ladder and the pilot ladder winch. In IMO 1045, and on the wheelhouse poster that goes with it, no reference is made to the question how to deal with a pilot ladder which is attached at intermediate length. The close-up below shows that the securing method shown only takes a pilot ladder that hangs overboard over the entire length into account (IMO & IMPA, 2018)

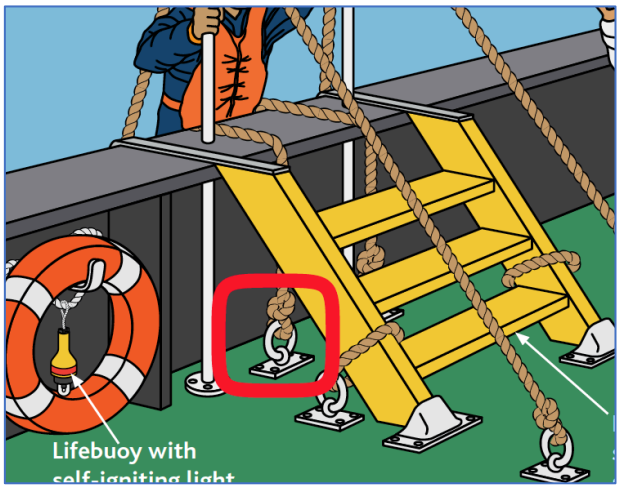


Figure 5: Close up of Wheelhouse poster. From "Pilot ladder poster" by IMPA,2020, Retrieved on January 16, 2021, from https://impahq.org/downloads.php

4: ISO 799-1 deals with the technical requirements of the pilot ladders. From IMO 1045 reference is made to these standards regarding construction requirements. This document also describes the testing procedures for pilot ladders. (International Organization for Standardisation, 2019)

5: In the ISM-code and the related Ship Management System the procedures that should lead to safe ship management are documented. This includes the procedures regarding the maintenance and inspection of safety equipment, of which pilot ladders are a part. (The international safety management(The international safety management (ISM) code, 1998)

When considering this legislation, it is noticeable that virtually everything in the field of pilot ladders has been regulated in detail, however the method of securing pilot ladders at intermediate length on deck is not regulated or mentioned.

Research and Literature

There are initiatives by pilot organizations aimed at increasing pilot ladder safety. For example, the International Maritime Pilot Association (IMPA) has been campaigning for years to improve safety around the use of pilot ladders. (International Maritime Pilots Association, 2014)Every year, a survey is conducted among pilots worldwide, to report unsafe pilot ladders by means of a survey. The results of the IMPA safety campaign 2019 show a total of over 12% non-compliant pilot ladders.

COUNTRY	TOTAL RETURNS	COMPLIANT	NON COMPLIANT	NON COMPLIANT AS %
Africa	43	31	12	27.91
Asia / Oceania	886	769	117	13.21
Europe	1743	1466	277	15.89
Middle East	4	2	2	50.00
North America	209	173	36	17.22
South America	1340	1241	99	7.39
TOTAL	**4225**	**3682**	**543**	**12.85**

Figure 6. Results of the IMPA Safety Campaign 2019. From "IMPA Safety Campaign 2019" by IMPA,2019, Retrieved on January 16, 2021, from https://www.impahq.org/safety_campaigns.php

During the campaign (International Maritime Pilots Association, 2020), detected defects are broken down into categories that are reported. This distinguishes between defects in the use of pilot ladders, and pilot ladders in combination with accommodation ladders. The method of securing is not specified in the reports.

DEFECTS OF PILOT LADDER	TOTAL	AS %
Not against ship's hull	51	11.02
Steps not of suitable material	5	1.08
Poorly rigged retrieval line	67	14.47
Steps broken	11	2.38
Steps not equally spaced	22	4.75
Pilot Ladder more than 9 metres	8	1.73
Steps dirty/slippery	16	3.46
Sideropes not of suitable material	12	2.59
Pilot Ladder too far forward/Aft	14	3.02
Steps painted	6	1.3
Incorrect step fittings	17	3.67
No bulwark ladder	5	1.08
Steps not horizontal	79	17.06
Other	150	32.4
TOTAL	**463**	

COMBINATION DEFECTS	TOTAL	AS %
Accommodation Ladder not leading aft	2	1.29
Lower platform stanchions / rail incorrect rigged	15	9.68
Accommodation ladder too steep (>45 degrees)	9	5.81
Pilot Ladder not attached 1-5m above Accommodation Ladder	35	22.58
Lower platform not horizontal	18	11.61
Ladder(s) not secured to ship's side	38	24.52
Lower platform less than 5 metres above the sea	21	13.55
Other	17	10.97
TOTAL	**155**	

Figure 7. Defects on pilot ladders. From "IMPA Safety Campaign 2019" by IMPA,2019, Retrieved on January 16, 2021, from https://www.impahq.org/safety_campaigns.php

When looking into the reported non compliances of pilot ladders secured on bulwark or deck, it is very clear that in 72% of the observed non compliances, pilots consider them "not properly secured". The sharp upward trend of this figure may be caused by the increased awareness of maritime pilots in this area.

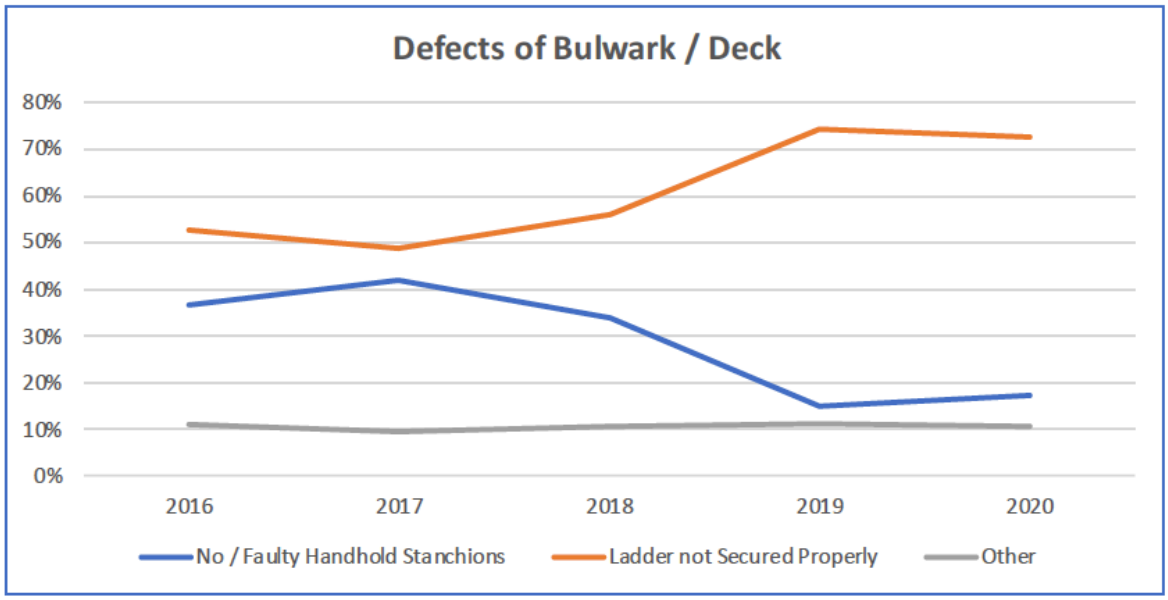


Figure 8. Analysis of Defects of Bulwark/Deck of IMPA Safety Survey 2016-2020. From: "Impa Safety Campaign Analysis" by Broers, H., 2020, Retrieved on January 16, 2021 from https://pilotladdersafety.com/impa-safety-campaign-analysis-2016-2020/

CHIRP Maritime, an independent UK organization dedicated to collecting data relating to accidents in the maritime domain, in 2019 reported 34% of the pilot ladders had problems with ropes, d-shackles or securing rods. In this report, this percentage is not broken down or specified by the securing method used. (Chirp Maritime, 2019)

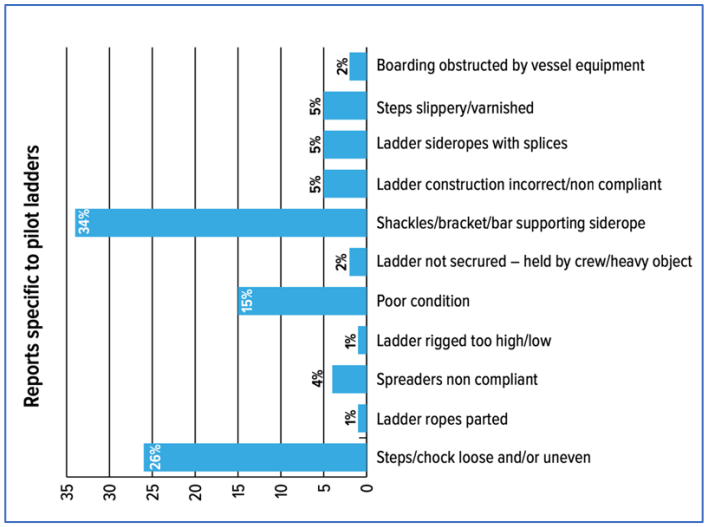


Figure 9. Defects to Pilot Ladders. From: "2019 Analysis of pilot ladder failings" by Chirp maritime, 2019, Retrieved on January 16, 2021 from https://www.chirpmaritime.org/wp-content/uploads/2020/06/2020-05-29-Pilot-Ladder-Analysis-2019.pdf

In this 2019 report, CHIRP confirms that there is no (SOLAS) regulation regarding the securing of pilot ladders (Chirp Maritime, 2019)

In October 2020, a report (Evans, 2020)was published in which the results of several load tests of pilot ladders have been reported. In these tests, not only the ropes, but also the steps and spreaders of various pilot ladder have been tested in combination with a number of securing methods at intermediate length.

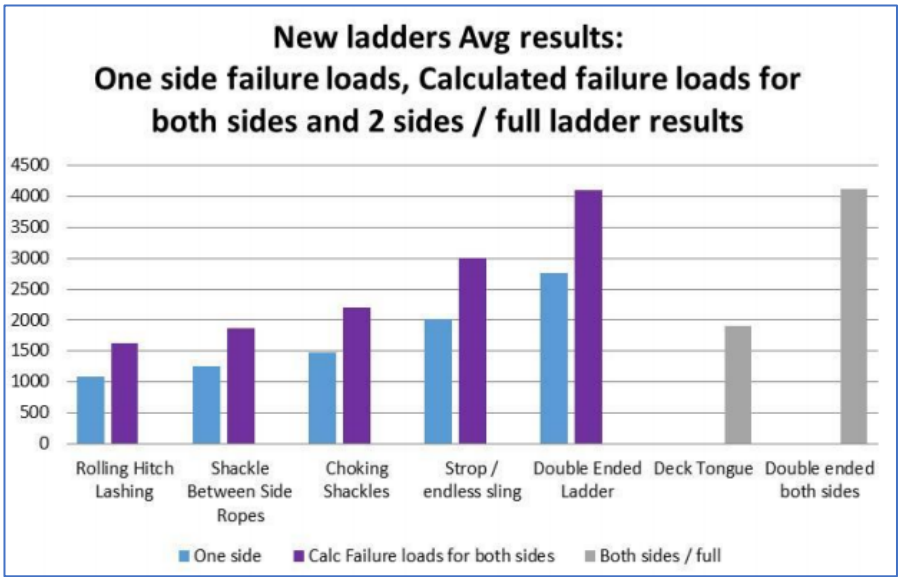


Figure 10. Test results of load tests on pilot ladders. From "Strength of pilot ladders and intermediate securing of pilot ladders" by Evans, Troy, 2020, Retrieved on December 1, 2020 from: https://underway.nz

This report shows that the breaking strength of the pilot ladder is strongly influenced by the method of securing used. This investigation has not established the distribution of the different securing methods are used on board ships.

The IMPA confirmed by e-mail that 12 pilots have died in accidents involving pilot ladders since 2006. It is not known whether these accidents are related to the way in which the pilot ladders are secured on board ships. IMPA does not hold statistics on pilot ladder incidents.

My own observations on board ships confirm the fact that many securing methods are in use, in which I wonder to what extent the methods used are safe for the pilot ladder system.

3. Research question and definition of concepts

There is no legislation on how to pilot ladders should be secured at intermediate length. No data is available on which securing methods are in use and how frequent they are used on board ships.

Now that the strength of a number of securing methods is known, it is useful to investigate which securing methods are in use and how frequently they are applied for a number of reasons:

- Knowledge of this can be used to raise awareness in the profession on confirmation of pilot ladders.
- Knowledge of this can be used to draw attention to
    - The fact that certain securing methods in use are weak.
    - The fact that there is no regulation in this area.
- Knowledge of this could be a starting point for further research, for example by looking into innovative ways of securing of pilot ladders at intermediate length on ships.

During the survey, it is also useful to check whether there are differences between the various ship types and sailing areas (continents) in order to raise awareness among local and international pilot organizations and authorities in these areas.

Objective

The objective of the research is to gain insight into the different methods of securing of pilot ladders, by means of a survey amongst maritime pilots.

Research question

What is the distribution of securing methods of pilot ladders on intermediate length on board ships?

Sub-questions

- Which securing methods are used?
- What is the distribution of the different securing methods?
- What is the distribution of securing methods per ship type?
- What is the distribution of securing methods per sailing area (continent)?

Definition

Securing at intermediate length: securing of a pilot ladder to the deck of a ship that does not use the top end of the ladder for securing.

4. Methodology

Research strategy and design

Since there was no data available at the time of the research, a field research was designed to collect data. In this case, descriptive examination was done since it examined how often the present situation occurred and the distribution of different securing methods. Since there was no intervention in the present situation but only data was collected, it clearly was a survey study. The research focused on obtaining and analysing quantitative data on the securing methods of pilot ladders. A limited number of securing methods were identified before the survey. However, unknown methods that were reported during the survey were included in the study as well.

Due to the international nature of the regulations, it was useful to involve maritime pilots from around the world in this survey. They are involved with pilot ladders of various kinds and types on a daily basis and should be familiar with requirements regarding pilot ladder safety. They were alerted to this survey by means of social media, LinkedIn and direct mail contact. The survey focussed on pilot ladders (research units) with maritime pilots as respondents.

The online tool used was google forms. Later on, a survey monkey questionnaire was added with an identical survey-form because it became apparent that some respondents were unable or unwilling to make a google account for the purpose of this survey.

The research units were the pilot ladders which have been secured at intermediate length during the duration of the survey. A random sample was taken to answer the main- and sub questions.

Given the practical feasibility and the short lead time of the study, both an oral survey (interview) and a written survey (postal addresses are not known) were not deemed practical. A survey has therefore been chosen by means of an online questionnaire in order to obtain the required data on pilot ladders collected by pilots. It's a cheap, fast, standardized way to collect a lot of data. By standardising the questionnaire, the data obtained could be easily analysed. By means of a semi-open question, both known and unknown confirmation methods were reported.

For every pilot ladder observed during his shift, the respondents were asked to fill in a report. In the standardised questionnaire, half-open questions identified the seven most common modes of securing. Multiple answers per observation were possible. There was also room for reporting unknown securing methods, by describing them and uploading photos. By means of a multiple-choice question, the ship type and the continent in which the observation took place were reported as well.

Validity and reliability

The questionnaire was accompanied by a reader explaining the purpose of the survey to the respondent. (See annex 1)

By sending photographs of the seven known securing methods, it is ensured that there can be no misunderstanding about the method used in answering the main question. (See annex 2)

Both the reader and the questionnaire were tested for language errors and functionality by a maritime pilot from New Zealand. The functionality of the questionnaire was checked by testing it myself in the month prior to the study.

There are around 8,000 pilots worldwide who make about 250 trips per person per year (Estimate according to national Dutch figures). This equates to about 38,000 trips a week. At a turnaround time of the three-week survey, there is a conservatively estimated number of trips of 100,000, the population. A confidence level of 95% and a margin of error of 5% were used, because this is the standard. (Noorhoff, 2017)

Formula: $n = (z/m)^2 * p\ (1-p)$

p = *0,50 (the result is unknown in advance)*
z = *z-value of reliability level = 1.96 for 95% reliability*
m = *required margin of error = 5% = 0,05*

⇨ *n = 384; The minimum sample size is 384.*

The survey was held from December 4th, 2020 until December 31st, 2020. During this time several reminders were sent out to maritime pilots from all over the world. A total number of 486 observations were eventually obtained during this period.

Data-Analysis

The data has been be analysed in Excel, generating overviews of the distribution of securing methods, ship types and sailing areas.

In SPSS, Pearson's tests have been used to test whether there is a significant relationship between securing method, the ship's type and the continent of the observations. (See Annexes 3 and 4)

5. Results

1. Observations by geographical area

A total number of 486 observations was obtained during the survey from all 5 different regions in the world. The majority of observations was returned from Europe (78%). The relatively small number of observations outside Europe posed the questions as to the global representativeness of the survey. The total distribution of securing methods in use does not differ a lot between Europe and the total observations. (Figure 10)

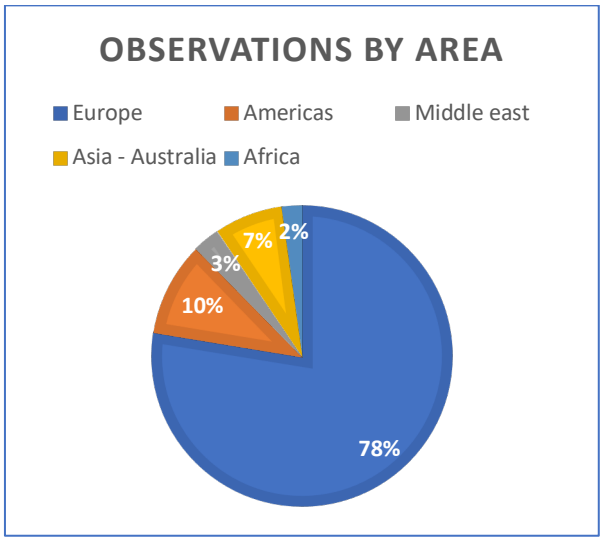


Figure 11. Graph observations by Area

	Area	#	%
1	Europe	377	78%
2	Americas	49	10%
3	Middle east	14	3%
4	Asia - Australia	36	7%
5	Africa	10	2%
	Total	486	

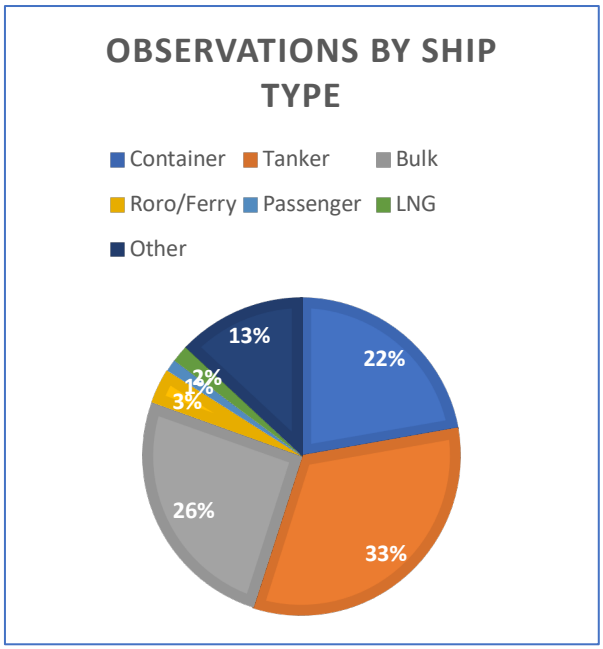
Table 1. Table observations by area

Securing method by geopraghical area (%)						
	Europe	Americas	Middle east	Asia - Australia	Africa	Total
Rolling Hitch	33,7%	16,3%	28,6%	27,8%	20,0%	31%
Shackles	49,9%	57,1%	42,9%	63,9%	60,0%	52%
Steel bar	3,7%	10,2%	0,0%	0,0%	0,0%	4%
Deck tongue	2,7%	4,1%	14,3%	0,0%	0,0%	3%
Railing	4,2%	8,2%	14,3%	2,8%	0,0%	5%
Spreader	2,1%	0,0%	0,0%	0,0%	20,0%	2%
ND Strong pt	3,7%	4,1%	0,0%	5,6%	0,0%	4%
Other	0,0%	0,0%	0,0%	0,0%	0,0%	0%
Total	100,0%	100,0%	100,0%	100,0%	100,0%	100%

Table 2. Table of observed securing methods by geographical area (%)

2. Observations by ship-type

The number of observations by ship type show that most observations were made on tankers (33%), bulk carriers (26%) and container ships (22%).



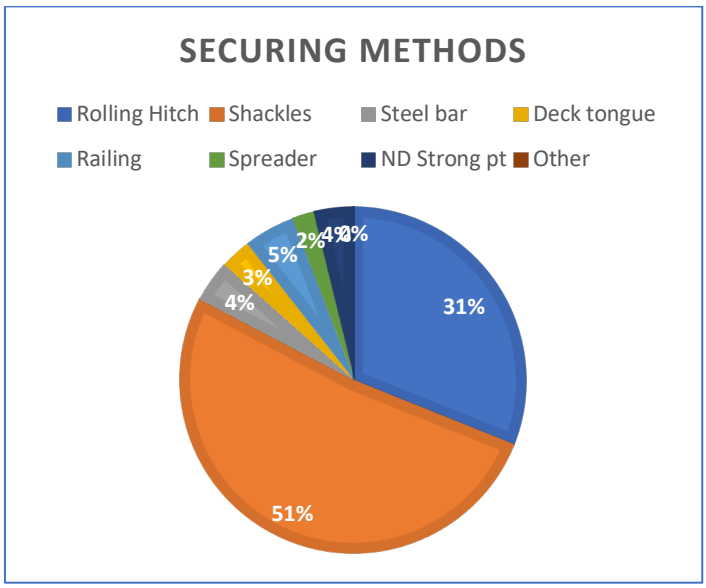
	Typeschip	#	%
1	Container	108	22%
2	Tanker	159	33%
3	Bulk	124	26%
4	Roro/Ferry	17	3%
5	Passenger	6	1%
6	LNG	9	2%
7	Other	63	13%
	Total	486	

Figure 12. Graph observations by ship-type

Table 3. Table observations by Ship-type

3. Observations of securing methods in use

The most frequently used securing method found in use was the D-shackle method (52%), whereby D shackles are used over the side ropes to secure the pilot ladder. The rolling hitch knot as a securing method was found in 31% of the cases. No "other" securing methods were observed during the survey.



	Method	#	%
1	Rolling Hitch	151	31%
2	Shackles	251	52%
3	Steel bar	19	4%
4	Deck tongue	14	3%
5	Railing	23	5%
6	Spreader	10	2%
7	ND Strong pt	18	4%
8	Other	0	0%
	Total	486	

Figure 13. Graph securing methods

Table 4. Table securing methods

Relationship between securing method and geographical area

The Pearson correlation test showed there was a no strong positive correlation between securing method and geographical area, $r = 0.034$, $n = 486$, $p = 0.453$ (See annex 3)

Relationship between securing method and ship type

The Pearson correlation test however showed there was a no strong positive correlation between the securing method and ship type, $r = 0.090$, $n = 486$, $p = 0.048$ (See annex 4)

6. Conclusions

It has been shown that a majority (51%) of pilot ladders is secured by means of D-shackles, when secured at intermediate length. Previous research (Evans, 2020) has proven that this method has only about 50% of the strength of the pilot ladder when secured at full length ("double ended ladder"), or by means of the "endless-sling" method.

The rolling hitch knot is used in 31% of the observations. When used correctly, this method is rated at only 39% of the strength of the ladder when secured at full length ("double ended ladder"), or by means of the "endless-sling" method.

There is no correlation between ship's types or geographical area and the securing methods in use. In other words, all identified methods are in use on all types of ships, worldwide.

The use of D-shackles as a securing method is a very easy, user-friendly securing method for the ship's crew. Also, many ships have been specifically designed to facilitate this method.

The use of a rolling hitch knot is the most used alternative to the D-shackle. The frequent use of this method is probably caused by the fact that it is being promoted by pilots around the world, in publications and on social media. It is considered the least harmful method of securing to the integrity of the pilot ladder.

The survey was intended to give a representative picture of the securing methods in use in various parts of the world. As a result of the limited response outside Europe that goal has not been achieved. The minimum sample size has however been reached.

7. Discussion

The two most frequently used methods of securing pilots at intermediate length are either demonstrably weaker than the total strength of the pilot ladder or are considered harmful to the integrity of the pilot ladder itself. There is no legislation or standard of a securing method which is both of equal strength of the ladder, and harmless for the ladder's structural integrity.

Without accident statistics it is hard to describe the present-day practice of securing pilot ladders at intermediate length as "unsafe". This research however shows that the most used methods of securing are not the most effective with regards to strength and the integrity of the pilot ladder.

The nature of the embarkation and disembarkation is a critical process, meaning that serious injury or fatalities are the likely outcome as the result of accidents involving pilot ladders.

The fact that there is no proven design for the securing of a pilot ladder at intermediate length in a safe, convenient manner calls for innovative solutions to the ever-present danger of breaking of failing pilot ladders.

8: Recommendations

This report should serve as a reminder to maritime pilots, legislator and other stakeholders in the maritime industry that an industry wide problem exists: the regulatory gap regarding pilot ladders which are secured at intermediate length. Much work needs to be done to improve this situation.

- The research conducted in this survey should be repeated regularly to identify trends and changes in the securing methods used for pilot ladders at intermediate length. IMPA could play an important role if they are willing to incorporate this research into their annual safety survey.
- A new innovative securing method for pilot ladders at intermediate length should be developed, Ideally, this process should involve ship designers, ship owners, pilot ladder manufacturers as well as maritime pilots. The design of the pilot ladder itself must be subject for reconsideration if needed.
- An industry standard should be developed regarding the securing of pilot ladders at intermediate length, involving all relevant stakeholders in the maritime industry.
- A global database on pilot ladder incidents, accidents and near-miss database should be developed in order to generate much needed management information which can be used to improve safety of pilot ladders in general.

9: Annexes

Annex 1: Reader with the online survey

Securing Methods at Intermediate Length of Pilot Ladders: An Inventory

Dear colleague,

As you are probably aware, there is a lot of legislation on pilot ladders. However, there is no legislation about the way the pilot ladder should be secured at intermediate length to the ship's deck. As a result, there are no statistics about this subject as well.

Pic: Securing at intermediate length

The purpose of his study is to get an insight into the distribution of the different methods of securing onboard ships that are used, by means of an online survey.

By gathering and analyzing data, I want to be able to answer the questions:

1. Which securing methods are in use for pilot ladder at intermediate length.
2. How is the distribution of the different types of securing methods of pilot ladders?

I want to ask you to participate in this survey by filling out the attached Google Forms survey form every time you board a ship in let's say a one- or two-week period. You can fill out a form for every ship you board or disembark. It is an anonymous survey, which runs in the month of December 2020. When you download the link under the button below to your mobile phone, you can use it as many times as needed. It will only take a minute per report. Please distribute this reader to as many fellow pilots as you are able to, the higher the number of reports from all over the world, the better it is.

The survey will be held during a 4-week period, from December 7th until January 4th, 2021.

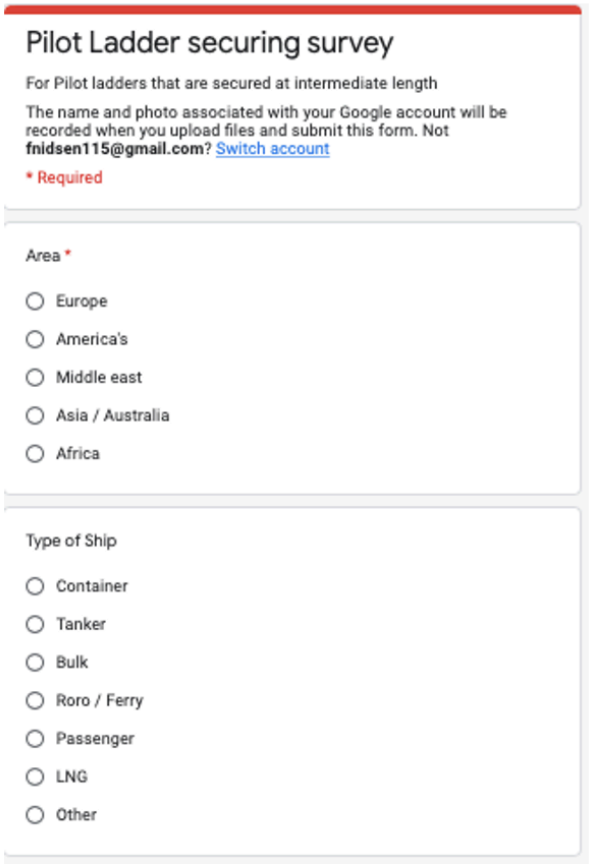
The results of the study will be published on the website **pilotladdersafety.com** in the beginning of 2021. I will also use the data for a Master in Maritime Innovation study at the Maritime College Willem Barentsz, The Netherlands. Every participant will receive his or her personal copy of the study. For this purpose, you can email me at: **info@pilotladdersafety.com** to leave your email address.

With the recent study into the breaking strength of various securing methods, and the outcome of this survey, we should be able to quantify the securing-issue of pilot ladders at intermediate length. Your input for this purpose is very important.

Thank you for taking part, I wish you many safe voyages in these challenging times, stay safe and healthy,

Very best regards,
Herman Broers
Maritime Pilot, Port of Rotterdam

Annex 2: Online Survey form



Pilot Ladder securing survey

For Pilot ladders that are secured at intermediate length

The name and photo associated with your Google account will be recorded when you upload files and submit this form. Not **fnidsen115@gmail.com**? Switch account

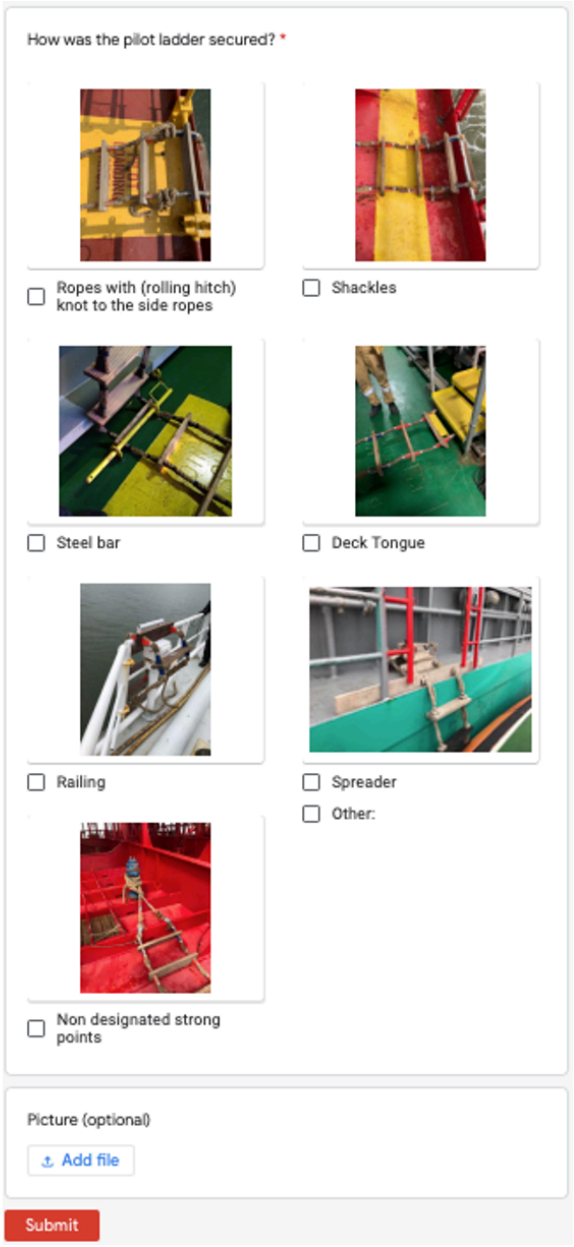
* Required

Area *

- Europe
- America's
- Middle east
- Asia / Australia
- Africa

Type of Ship

- Container
- Tanker
- Bulk
- Roro / Ferry
- Passenger
- LNG
- Other



How was the pilot ladder secured? *

- Ropes with (rolling hitch) knot to the side ropes
- Shackles
- Steel bar
- Deck Tongue
- Railing
- Spreader
- Other:
- Non designated strong points

Picture (optional)

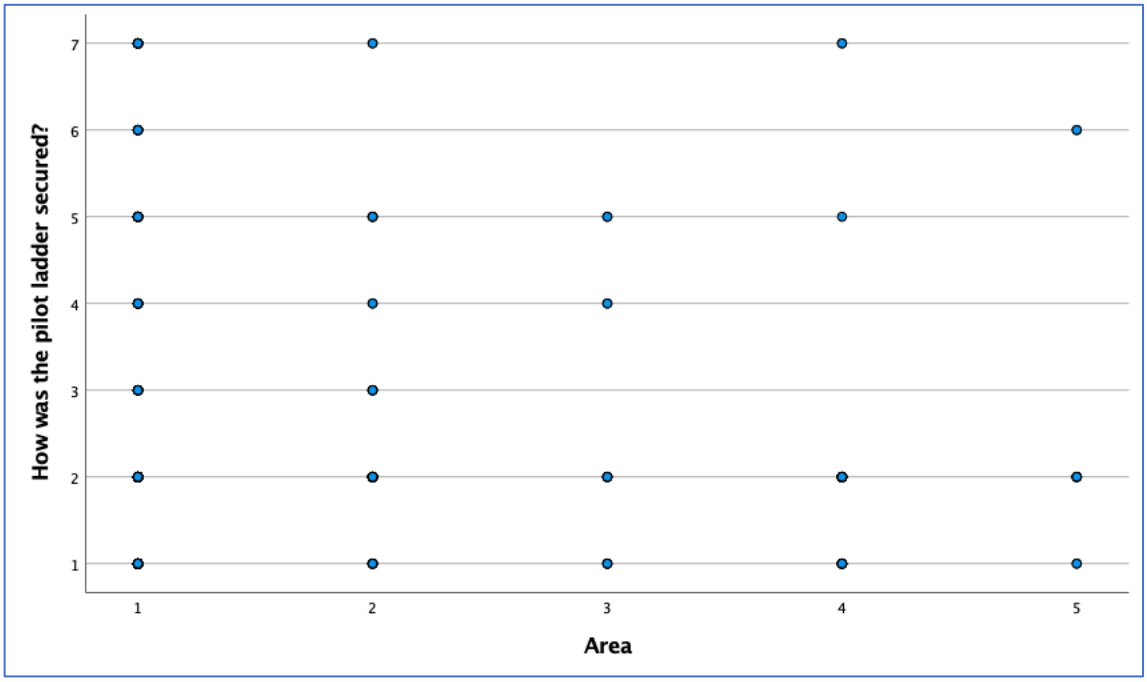
Add file

Submit

Annex 3: Pearson's test: Securing method – Geographical area

Correlations

		Area	How was the pilot ladder secured?
Area	Pearson Correlation	1	.034
	Sig. (2-tailed)		.453
	N	486	486
How was the pilot ladder secured?	Pearson Correlation	.034	1
	Sig. (2-tailed)	.453	
	N	486	486

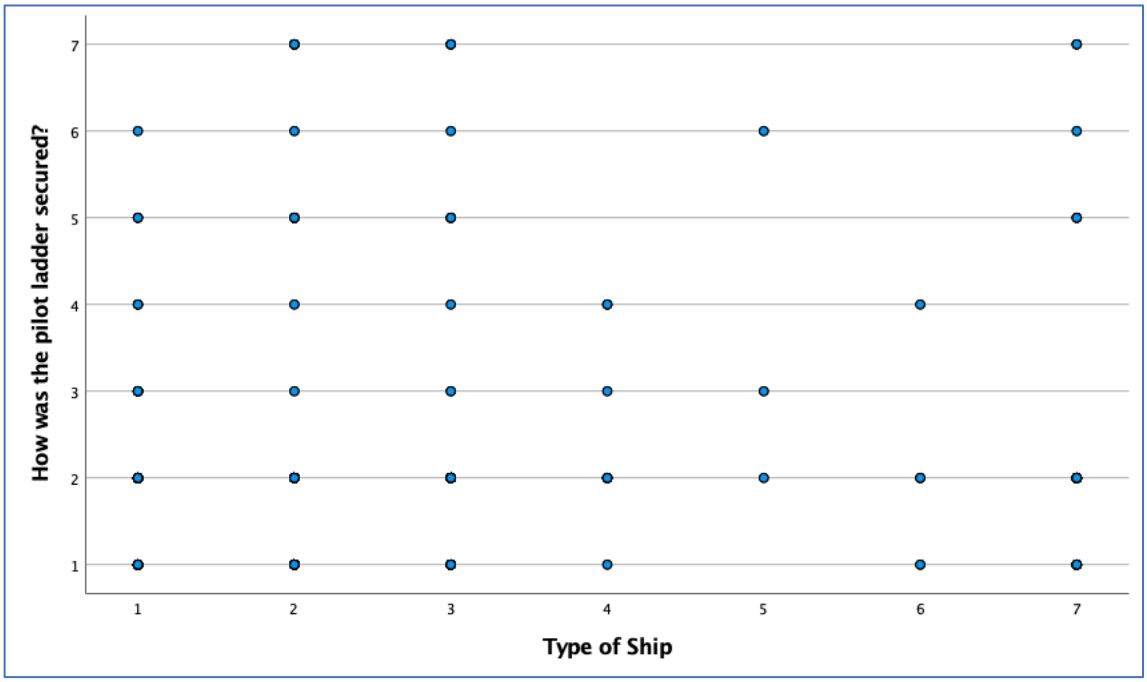


Annex 4: Pearson's Test: Securing method – Ship_type

Correlations

		Type of Ship	How was the pilot ladder secured?
Type of Ship	Pearson Correlation	1	.090*
	Sig. (2-tailed)		.048
	N	486	486
How was the pilot ladder secured?	Pearson Correlation	.090*	1
	Sig. (2-tailed)	.048	
	N	486	486

*. Correlation is significant at the 0.05 level (2-tailed).



10: References

References

Chirp Maritime. (2019). *2019 analysis of pilot ladder failings*. Chirp Maritime.

Chirp maritime. (2019). Pilot ladders – error enforcing conditions and deficiencies. *Chirp Maritime,* , https://www.chirpmaritime.org/wp-Final.pdf.

Evans, T. (2020). *Strength of pilot ladders and intermediate securing of pilot ladders.* (). Auckland, NZ: Troy Evans.

An investigation into actual strength of ladders and intermediate securing methods used.

IMO, & IMPA. (2018). Poster required boarding arrangements for pilot.(2) https://www.impahq.org/admin/resources/finalimpapladderposter.pdf

International convention for the safety of life at sea (SOLAS), 1974, 21-10-1974Cong. (1974). www.imo.org

International Maritime Pilots Association. (2014). *IMPA on pilotage* (1st ed.). Witherby.

International Maritime Pilots Association. (2020). *IMPA safety campaign 2019.* (). London, UK: IMPA. http://www.impahq.org

International Organization for Standardisation. (2019). *International standard 799-1 - ships and marine technology - pilot ladders - part 1*. International Organization for Standardisation.

The international safety management (ISM) code, 18Cong. (1998). www.imo.org

Noorhoff, B. V. (2017). *Basisboek methoden en technieken 2017 studentenwebsite.* Basisboek methoden en technieken 2017. https://basisboekmethodenentechnieken.prepzone.noordhoff.nl/

Pilot transfer arrangements, 27th sessionCong. (2011).

Vallance, K. (2018). *Pilot ladder manual* (advanced edition ed.). Witherby.