Theme A: Case stories of recent ship collision accidents

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Theme A

Case Stories of Recent Ship Collision Accidents

Chairman

Professor W.C. Webster.

Professor Webster received his Ph.D. in Naval Architecture at the University of California, Berkeley. After 10 years in industry he returned to teach at Berkeley and is now chairman of the department of Naval Architecture & Offshore Engineering. Professor Webster has written several articles on ship collision and is a member of the National Academy of Sciences' Panel on Ship-Bridge Collision.

Technical Programme

The following papers were presented:

- T. Ishikawa, Y. Naoi, Japan
  Case Stories of Dolphin Accidents and Remedies.
  (Presented by Mr. T. Ishikawa)

- A. Mikkelsen, Denmark
  Ship Collisions with Danish Lighthouses.

- P. Laheld, Norway
  Statistics on Collision Accidents Involving Offshore Structures.

- A.G. Frandsen, Denmark
  Accidents Involving Bridges.

- P. Tambs-Lyche, Norway
  Vulnerability of Norwegian Bridges across Channels.

- T.R. Kuesel, U.S.A.
  Newport Bridge Collision.

Discussion and Comments

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Paper Title : Case Stories of Dolphin Accidents and Remedies.
Presented by: Mr. T. Ishikawa, Chuo Fukken Consultants, Japan
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Discussion by: Mr. J.H. Roderick Haswell, J.H.R. Haswell & Partners, Consulting Engineers, U.K.

I should be grateful to know the following:

1) What was the design speed of approach?

2) Were any estimates made of the actual speeds of impact of the respective vessels in the two incidents described in the paper?

3) What was the thickness of the cover of concrete to the main steel reinforcement?

In my opinion a reasonable design speed of approach should be not less than 9-inches per second (230 mm/sec). Further for coasters and other small vessels of up to approx. 2000-ton displacement the value should be doubled to at least 18-inches per second (460 mm/sec). The reason is that these small vessels are relatively more robust with respect to impact stresses involved, and the personnel concerned are inclined to handle them accordingly.

As far as cover of concrete to reinforcement is concerned I am convinced that for maritime structures the cover should be not less that 3-inches (80 mm) and up to 4-inches (100 mm) where severe sulphate and/or corrosion effects may be likely.

Answer by: Mr. T. Ishikawa & Mr. Y. Naoi

1) In Japan, usual design speeds of approach are 100-150 mm/sec. The dolphins concerned here were designed for the speed of 150 mm/sec.

2) Since actual data regarding the speeds of approach were not available, we could not know the exact speeds of the vessels in the incidents. Based on the analyses of the residual deformation of the Breasting Dolphin B-3, we estimated the speed of impact at 220 mm/sec with regard to this dolphin.

3) For maritime structures which are directly contiguous to sea water, Japanese criteria provide that the cover of concrete should not be less than 70 mm. The dolphins described in our paper were designed to have the thickness of the cover of concrete of 100 mm to the main steel reinforcement.

Discussion by: Mr. G. Woisin, Private Consultant, F.R.G.

To the paper given by Mr. Naoi and Mr. Ishikawa I want to add a question relating to the damaged sub-breasting dolphin; was there no need to restore an alignment with the two other undamaged breasting dolphins? But if so, how was this achieved without redeformation of the damaged piles?

Answer by: Mr. T. Ishikawa & Mr. Y. Naoi

In consideration of the safety of berthing operation of vessels and the stability of vessels mooring to the dolphins, we presumed that the alignment of the sea berth should be restored correctly. We therefore restored the line with additional reinforced concrete to the original top concrete decks.

Paper Title : Ship Collision with Danish Lighthouses.
Presented by: Mr. A. Mikkelsen, Administration of Navigation and Hydrography, Denmark.

Comment by: Mr. Gerhard Woisin, Private Consultant, F.R.G.

Relative to Mr. Mikkelsen's paper on small lighthouses I found particularly worthy of remark:

The viewpoint of designing the lighthouses to lessen damage to a ship in collision as far as possible, to protect not only the ship but also the ecological environment, should be introduced also in other cases of possible collisions, e.g., in case of protection measures to bridge piers. I could imagine for instance to avoid damages to the submerged part of a ship's hull by placing the protective structures, which in case of collision would be destructive to the ship's hull, above the waterline.

I also found it of interest that, despite the aim of minimizing damage to the ramming vessel, in 4 of the 10 accidents reported the colliding ship was damaged so heavily that it lost its seaworthiness or even went aground due to leakage. I trust it should be possible in future by a modified design to decrease this damage ratio.

Paper Title : Accidents Involving Bridges
Presented by: Mr. A.G. Frandsen, Cowiconsult, Consulting Engineers and Planners AS, Denmark.

Oral presentation by Mr. A.G. Frandsen:

In my paper I gave a summarized systematic account of 22 serious accidents from the period 1960 to 1982.

My definition of a serious accident was, that it interrupts the bridge traffic for a period. The investigation did not comprise so-called near accidents, mainly because this group of accidents is much less well-defined than the group of serious accidents. Are there any comments on this?

My paper is now one year old. It states that the annual rate of serious accidents is 1.5. How many serious accidents did actually happen since I wrote my paper?

I found two cases: one in Thailand reported by the Bangkok Post September 24, 1982 and another one in Tacoma, Washington, U.S.A., reported by Engineering News Record, April 7, 1983. None of these accidents were severe, but they still belong to the group of serious accidents according to my definition. Is anybody here aware of other serious accidents from the last year?

In my paper I mentioned the data sources used, and I raised the question: how complete is my list of serious accidents, appendix A? I should be glad to have comments on this.

I have had a communication regarding data sources from Dr. Aldwinckle of Lloyds Register of Shipping. He mentions that Lloyds has a very large database on ship performances and ship damages. This database includes the damages to ship from ship-to-ship collision and from ship-to-non-navigable items, such as bridges. This database is accessible, but it does not contain all the information we expect. For instance, the ship speed at impact is seldom found. If anybody present has experience in retrieving information on ship-to-bridge collisions from the database of Lloyds Register of Shipping, or from similar databases, I should welcome comments on this.

I should also like to have comments on the scheme given in appendix B for structuring the data from an accident.

Furthermore, comments on my suggestion in the concluding remarks in the paper are welcome. I stated that there is a need for a complete and reliable database for information on serious collision accidents, and I raised the question if such a database could be managed by an independant international body like IABSE?

I made this presentation of my paper short. I preferred to ask some questions to the audience and to save the time for discussion and comments.

Discussion by: Professor William C. Webster, University of California, U.S.A.

I would like to suggest that the quantity, the underkeel clearance, be included as a parameter in the proposed data base. The reasons for this inclusion are twofold. First, the maneuverability of a ship changes very dramatically as the underkeel clearance becomes small. Second, the nature of the hydrodynamic forces changes with underkeel clearance. For instance, the transverse added mass can increase by a factor of ten between the deep sea situation and that in shallow water.

Discussion by: Dr. P.A. Frieze and Mr. E. Samuelides, Dept. of Naval Arch. & Ocean Eng. Univ. of Glasgow, U.K.

This was given in response to a request for experience of Lloyds Register of Shipping Records.

An investigation into the possible services of data concerning real ship collision cases was performed by Glasgow University during April 1983. The records held by both Lloyds Register of Shipping (LRS) and the International Maritime Organisation (IMO) were considered. It was found that the data held by LRS would provide the better basis for the information sought.

The following points can be made about the LRS data:

1) LRS records collisions involving only ships which are registered with LRS;

2) Extensive details of the plating and stiffeners requiring replacement are available;

3) No formal report includes information concerning the velocities of the ships at the time of collision;

4) The displacements of the ships at the time of the collision are not given directly but are sometimes estimated;

5) Inspection of the ships does not necessarily occur immediately after collision;

6) Drawings of the ships are available from LRS. Unfortunately few collision incidents involve ships which are both registered with LRS.

Despite these limitations, the data provides a reasonable starting point but other sources are necessary in order to obtain a complete record of any particular collision.

Discussion by: Dr. John S. Gardenier, U.S. Coast Guard, U.S.A.

Near-accidents are not now collected because there is no system to do so. In the U.S., there is a system for reporting near accidents. Reporting persons have immunity and their identities are protected. The system is administered by a third party which assures the report is complete. They contact the reporter by phone to do this. The name of the person and vessel are removed before data is passed to the regulatory agency. The reports are more frank and believable than most accident reports, because of the legal forces affecting the latter cases.

Routine annual analyses of near miss data should be augmented by special reports when specific patterns of problem or solution are noted.

Discussion by: Professor John Kemp, City of London Polytecnic, U.K.

In answer to the query concerning the use of Lloyds data, I can say that we have had considerable experience of using this in compiling a file of data concerning collisions between ships. The information published by Lloyds varies in that some casualties are reported quite fully but others are reported very sparely. We have therefore used Lloyds data simply as starting point to identify that a collision has taken place and have then attempted to obtain further information, from national or local sources, and from records of law firms and insurance interests. There is a problem that people concerned with casualties are unwilling to release data while legal proceedings are in progress and this means that information concerning a collision may not be available until perhaps two or three years after the event. Nevertheless, we have been able to collect detail such as the classes, the speeds and the courses of about 50% of ships involved in collisions worldwide up to two or three years ago. Similar methods could be employed in the collections of data concerning collisions between ships and bridges or fixed structures but the effort required should not be underestimated.

Discussion by: Mr. G. Woisin, Private Consultant, F.R.G.

To the check list established by Mr. Frandsen I would propose the addition of the ship´s speed, mass, draught, angle and point of impact both relative to bridge and to ship, and in the case of damage to ship tanks whether filled with water, oil or void, etc.

The list of serious accidents should not,in future be limited to cases in which bridge traffic has been interrupted for a period, that is, to cases with serious consequences to the bridges.

There are two different aims for the collection of data of real collisions which in my view are not clearly kept apart:

Firstly, the collection of data for actual statistical purposes, within clearly defined limits of time, area etc., where the number of elements must then be complete or a genuine random sample found to be representative.

Secondly, the collection of - because of certain interesting viewpoints -arbitrarily selected collision cases with the purpose of the verification or creation of empirical or semi-empirical methods of the prediction of mechanical damages, as e.g. the wellknown Minorsky-method. (The Minorsky-method is not a statistically gained one as is sometimes supposed). To prove mechanical methods we need a collection of several individual cases of collisions with data as reliable and as comprehensive for the individual case as possible. This would not yield statistics as likewise a collection of data of collision model tests would not do.

Discussion by: Professor Thürlimann, President of IABSE, Switzerland.

Answers to the question of a data base managed by IABSE:

1) IABSE is willing to manage a data base on ship-bridge collisions. Computer facilities are available.

2) Reporting (e.g. Appendix B of Frandsen´s paper) should be made on a standard form to allow easy entrance into computer data base.

3) Reporting network should be conceived, i.e. contact agency in major countries.

4) IABSE would publish periodically short reports.

5) Data base would be accessible to interested parties.

Answer by: Mr. A.G. Frandsen.

Dr. Gardenier´s remarks on near-accidents are very interesting and the U.S. System for reporting these accidents should be globally applied.

There were no comments on the completeness of the list of serious accidents in my paper. The comprehensive remarks, however, made by Dr. Frieze and Mr. Samuelides and by professor Kemp, on experience gained by the use of Lloyds data vill be very valuable for the future work of collecting ship-to-bridge collision data.

The suggestions made by Professor Webster and by Mr. Woisin concerning parameters to be included in the checklist (appendix B in my paper) should be followed. The corresponding information should be included in the description of the accidents whenever possible.

Finally, I want to thank professor Thürlimann for the support he has given the idea of creating a "Ship Collision Database" under the auspices of IABSE.

Paper Title : Newport Bridge Collision
Presented by: Mr. T.R. Kuesel, Parsons, Brinckerhoff, Quade & Douglas, Inc., U.S.A.

Discussion by: Mr. Bejon Panthaky, Hindustan Construction Co. Ltd., India

The piers are shown to be supported on 512 steel H. Piles. While the piles can transmit the vertical force to the ground, whether they are good enough for transmitting large horizontal forces acting at the top of piles arising out of ship impact, particular as the section modulus in y direction of the joist columns would be quite less.

Instead of piles perhaps a caission would have proved to be structurally superior or economical too. In case of caissions the large mass would be available and that too at a low elevation instead of present design where the mass of pier is at a higher elevation.

Discussion by: Mr. G. Woisin, Private Consultant, F.R.G.

The collision case paper given by Mr. Kuesel is a valuable supplement to Mr. Frandsen´s introductory paper giving some figures of the average impact force. This value is very important to compare it with similar model tests, in view of possible scale effects, and with calculation methods. The oil tanker was on full draught which means the fore-peak tank will have been empty. Ballast water in this tank, according to my experience with model tests conducted some years ago in Hamburg, would have increased the average impact force considerably. Also according to these model tests a cylindrically shaped instead of a bulbous bow could have increased the average impact force substantially (see also my discussion of Mr. Minorsky´s paper).

I hope for some more reports like Mr. Kuesel´s one on rather lucky collisions of ships with bridges in the near future, to improve load assumptions for bridge piers.

Please, can an idea be given on the exactness of the speed estimation, e.g., whether ±.5 or ±1 or even ±2 knots?

Answer by: Mr. T. R. Kuesel.

The resistance of the piles to large horizontal forces arising out of ship impact was assured by dredging out the top eight meters of the Bay bottom soils, so that the piles are laterally supported entirely by dense sand deposits of glacial origin. Proof of the adequacy of this concept is that the pier withstood a collision force estimated at 6,000 tons without any lateral displacement.

Although a caisson might be economical in other economic conditions, a comparative study of several alternative foundation designs demonstrated that the hollow shell form with structural tremie concrete was the best choice for that time and location. The center of mass to the combined pier and superstructure is slightly below the water level, so the ship impact created relatively little overturning moment.

Although the question of hydrodynamic energy associated with shallow underkeel clearance deserves further investigation, in the case of the Newport Bridge the water depth was 29 meters and the line of the collision force was closely parallel to the longitudinal axis of the ship, so the added hydrodynamic mass was not significant.

It was not intended to imply that the Newport Bridge collision represented a maximum case, and Mr. Woisin's comments on variations in ship characteristics that might easily have increased the impact force are worthy of note. The estimation of ship speed at the time of collision is subjective. The ship was proceeding in dense fog at about five knots when the bow lookout signaled that the pier was dead ahead. The ship captain called for hard left rudder and full speed ahead in an attempt to gain steerageway, but there was not sufficient distance to affect the course of the ship apreciably. The official Coast Guard report of the accident estimates that the speed was "between five and eight knots". It seems likely that the estimate of six knots is accurate within 10%.

General Comments to theme A: Case stories of Recent Ship Collision Accidents.

Comment by: Dr. David J. Ball, Simon Engineering Labs. Univ. of Manchester, U.K.

The authors have made reference to channel conditions and impact energies. I suggest that even if the velocities of impact are known, the quantification of forces and energies is not easily found. We do not know enough about the hydrodynamic energies, which are a function of the structural load/deflection characteristics and that of the ship structure and in addition the underkeel clearance. If a ship is turning at the moment of impact or is drifting, the hydrodynamic energy may be so large in shallow water that the total energy of impact may be many times the kinetic energy.

Comment by: Dr. L.C. Zaleski, C.G. Doris, France

With respect to the two papers presented on lighthouses and offshore structures respectively, I would like to insist on the fundamental differences existing between design philosophies of the structures described. When a ligthouse is conceived having in mind the integrity of the ship in case of collision, an offshore structure is designed to ensure first the safety of the platform. The reason for this difference appears evident: The basic purpose of a ligthouse is actually the safety of navigation, furthermore damage to a ligthouse, if any, would involve less risk to the environment, and in general no risk to human life, as heavy damage to a ship could do. Inversely, an offshore platform, if damaged, may present a source of oil pollution, of human losses, and, last but not least, of production disturbances and of subsequent economical problems. I agree nevertheless, all necessary measures to protect the safety of the ship in a case of collision with an offshore structure should also be foreseen in the design of such a structure.