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Discussion and Comments

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Paper Title : Design Assumptions and Influence on Design of Offshore Structures
Presented by: Mr. B. Røland, Det Norske Veritas, Norway.

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Discussion by: Mr. Kurt Eriksson, VBB/SWECO, Sweden

1) Design for ship impact should be done for

   a) operating vessels (supply brates etc.). Characteristic values are given and ultimate limit state is considered, and

   b) for other ships (general traffic, tankers) deterministic values should not apply. A spectrum of events are considered (applies for all accidental loads) and probabilities of occurrance are estimated.

2) In limit state of progressive collapse is considered real damage may occur. Limit state of progressive collapse should be separated from ultimate limit state. They are different in nature. The resistance of the structure for progressive collapse is assessed and the accumulated probability for events which will cause progressive collapse is established.

3) The accumulated probability and the consequences of total collapse are given as criteria.

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

Referring to the introducting paper by Dr. Fjeld I would like to point out firstly a small mistake in fig. 1 and in the text: in the rule of thumb for the maximal impact force exerted by ship bows flattened the force is proportional with the square root of the deadweight.

With reference to fig. 4, which is due to /15/ (not /14/), I want to mention that it was taken from the first one of the 12 model tests conducted in Hamburg, and even though it is only a simplified sketch derived from some measuring record of the deceleration of the striking mass. Therefore, one should not overrate it. (Actually it was from a test in which side and bow model were penetrated simultaneously.)

In my opinion on the other hand from statical tests or calculations, as presented in figures 5 to 8, the first peak value of the impact force delivered by the kinetic impact is not reproduced properly.

To fig. 5 and 8 for a broadside impact of a drifting ship to a rigid cylinder I want to add that in my opinion this is tremendously overestimated. I am convinced this error yields from the calculation assumption resp. testing arrangement with the longitudinal structural elements, including the side shell, fully clamped at the nearest webframes or transversal bulkheads, or close to them. In the model test conducted in Hamburg we avoided this, in my opinion inadmissible, idealization by a special 'bending girder' simulating the proper boundary conditions of the ship hull to the side model. One result of these tests was the refined modification to the Minorsky formula mentioned by Dr. Fjeld. I wonder whether Det norske Veritas has made some comparison of this formula with their published calculations, based on Rosenblatt's method.

Answer by: Dr. Svein Fjeld.

The design philosophy suggested by Dr. Eriksson seems to match the one laid down in e.g. Veritas rules and advocated in the paper. The only difference seems to be that operating vessel impact should be given in two levels:

a) A given operating impact checked in the ultimate limit state.

b) An accidental impact estimated to have a probability of exceedance less than 10-4/year checked in the progressive collapse limit state.

The lacking square root pointed out by Dr. Woisin is a sheer printing error, the curve of fig. 1 is correct.

The curves 5-8 are based on model tests and computer analyses with somewhat simplified boundary conditions. These introduce somewhat overestimated resistance and energy absorption for a given indentation. The curves are produced to achieve a basic for practical design. As the deviations are to the safe side the curves are considered feasible for this purpose.

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

Being a member of the editing committee of the FIP Recommendations to be updated at the end of the present month, I would like to ensure both Mr. Røland (presenting the paper of Dr. Fjeld) and Mr. Eriksson, that I'll take into account their concern in connection with the final edition.

Paper Title : Design Assumptions and Influence on Design of Bridges
Presented by: Dr. B. Højlund Rasmussen, B. Højlund Rasmussen Consulting Engineers, Denmark

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Discussion by: Dr.techn. Claës Dyrbye, Department of Structural Engineering, Technical University of Denmark

In the contribution by Dr. Højlund Rasmussen like in many other contributions, the importance of knowing the probability of the occurrence of some specified collision event is stated. We may be in a position to find this probability for the near future - say 10 years. But bridges are supposed to have a lifetime of 50-100 years, and as collisions are due to man-made actions, they cannot be foreseen with any reasonable confidence. It corresponds to a situation, where people in the thirties should have made estimates about todays traffic at sea.

Discussion by: Mr. R. Sexsmith, Buckland & Taylor, Canada

In response to comments on probabilities becoming obsolete in the long term:

Probabilities can have a number of different meanings. One useful one is to use them as weighting functions on degree of belief of a responsible decision maker. They are not necessarily frequencies or statistically based. They represent the best judgement at the time.

<u>Answer</u> by: Dr. B. Højlund Rasmussen

The remarks from Dr. Claes Dyrbye point out that the determination of the probability for a given collision becomes more and more difficult, the farther out in the future the eventual collision will be placed. This is undeniable.

We cannot, however, treat the problems of ship collisions without dealing with probabilities, which, as Mr. R. Sexsmitt correctly remarks, represent the best possible judgement at the time of construction or immediately after.

The relative vulnerability of the single elements of the bridge compared to each other will probably change less in time than the absolute vulnerability of the bridge. It is the opinion of the author that the proposed method for establishing design assumptions results in a reasonable distribution of the resources used for protecting the bridge against ship collisions.

The extent of these resources depend on the risk level we wish to obtain. This risk level is extremely difficult to define, but it must naturally as far as possible be determined with regard to a prognosis for the development of the navigation at the site of the bridge.

Paper Title: Ship Collision with the Tokyo Bay Crossing Bridge-Tunnel
Presented by: Mr. K. Wada, Oriental Consultants, Japan.

<u>Discussion</u> by: Dr. L.C. Zaleski, C.G. Doris, France

We have heard an exciting report. A great bridge will be born in a new future. But why have you chosen a tunnel concept in the central part of the crossing thus involving complicated and expensive transition facilities through two man-made islands? A lot of collision protection systems of bridges have been presented this morning, four of them by Japanese engineers. Why not apply them, to make possible a bridge solution across the whole bay. Furthermore, offshore type rigid piers, I suggested some years ago, could provide a safety redundancy. Is there still time possibly to consider an alternative in your feasibility study?

<u>Answer</u> by: Mr. Y. Wasa & Mr. Oshitari.

Major reasons not to adopt bridges through the whole length of the crossing are as follows:

- A passage of 3.5km clear width is required at the middle of the proposed route according to the agreement between shipping authorities concerned and crossing project authorities.
- Large scale bridges are very difficult on the aspect of securing earthquake-resistance due to the soft sea bed of more than 50m thick.
- There are restrictions on air space at Haneda Airport near the project site.

Thus, immersed tunnel and two man-made islands are essential in this project.

Pier type presented in the preliminary paper is not final. We will make further studies on other alternative types such as Open Caisson Foundation and Under Water Footing Foundation, and moreover on the related collision protection systems.

For your reference, outline of this project have been presented by Mr. S. Ando in the publication of '82 English edition annual report of "Civil Engineering in Japan" by the Japan Society of Civil Engineers.

Paper Title : Ship Collision and the Faroe Bridges
Presented by: Mr. A.O. Jensen, Christiani & Nielsen A/S, Denmark.

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

It was a pleasure to note the characteristics of the risk analysis with the Faroe Bridges.

The authors have treated separately the likelihood of ship impacts and the severity of those impacts. The impacts were estimated relative to ship passage. The general tendencies seem consistent with our empirical studies of ship oil spills, where the accidents are distributed with the negative binomial distribution and the severities with a lognormal or inverted gamma. It is important to recognize that most impacts are small, but the design concern must be with the rare, major impact.

Answer by: Mr. A.O. Jensen.

We are encouraged to note that one of our principal assumptions: that the distribution with respect to inherent collision force, that is the size and speed, of the ships that collide with a bridge pier during a certain time period is the same as the distribution of the ships that pass between the bridge piers during the same period, is consistant with empirical studies of events of a similar nature.