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SUBJECT Supplementary Report on Deck Stresses Surrounding a Turret Opening

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NAVAL RESEARCH LABORATORY

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NAVY DEPARTMENT

BUREAU OF ENGINEERING

Supplementary Report on Deck Stresses Surrounding a Turret Opening

NAVAL RESEARCH LABORATORY
ANACOSTIA STATION
WASHINGTON, D.C.

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ABSTRACT

The present report of deck stresses near a turret opening is supplementary to Reports H-1442 and H-1493.

The barbette of Report No. H-1442 was rigidly cemented to the deck plate throughout its circumference, and of Report No. H-1493 was attached by a slightly flexible angle plate for 30 degrees fore and aft of the center line of the barbette. The two stress patterns were radically different.

For the present study, attachment was made by the slightly flexible method of Report No. H-1493 for the entire circumference of the barbette. The results were in close agreement with those of Report No. H-1493, but showed high compression of the deck plate near the diagonal axes of the turret.

The measurements of all three reports are consistent and applicable to steel structures built by the design of any of the three celluloid models.

INTRODUCTION

(a) Authorization

1. This study was authorized by Bureau of Construction and Repair confidential letter NP14-6(RP) of 17 November 1937.

(b) Scope of the Problem

2. The object of this investigation was to find why two different measurements of the deck stresses near a turret opening as reported in H-1442 and H-1493 had shown such radically different results.

CONCLUSIONS

(a) The rigid cementing of the celluloid deck plate directly to the celluloid barbette, the method of attachment used for Report H-1442, resulted in high torques between the barbette and deck when the deck was placed in tension. These torques built up a large transverse compression or -Q stress near the center line of the barbette and gave large P-Q values shown in Plates 8 and 9 of Report H-1442.

(b) The more flexible angle attachment used for the H-1493 report gave complete transfer of forces between deck and barbette, but transmitted practically no torque. This resulted in the large positive value of Q as shown by Plate 9 of Report H-1493 and the accompanying low value of P-Q.

(c) The present investigation showed that the stress distribution of Report H-1493 was not changed in any important detail by extension of the angle attachment for the full circumference of the barbette.

EXPERIMENTAL METHODS AND RESULTS

(a) Model Used

3. The free barbette in turret 2 of the model used in Report H-1493 was attached to the deck as shown for turret 1 except that attachment extended around the entire circumference of the barbette. The loading conditions were the same as for that report.

(b) Description of the Plates

4. Plate 1 shows the stress maps for the deck about turret 2 under tension with the barbette flexibly attached over the entire circumference.

5. Plate 2 shows values of P, Q and P-Q in the deck along the transverse center line of turret 2 and at the circumference of the barbette. The solid lines give measured or calculated results

while the broken lines give estimated results. Points where Q=0 on the circumference are measured.

(c) Comparison with Previous Reports

6. A comparison of the P-Q map with the P-Q maps for turret 1 in Report H-1493, Plates 4 and 8, shows very similar patterns, but the measurements of the present report are about 20 per cent lower. This would be expected because of the wider section of the deck which is 28 feet for turret 2, but only 21 feet for turret 1.

7. The maximum shear of 170 per cent shown about 40 degrees forward of the mid-section for turret 2 may be compared with the 170 per cent shown to the right for turret 1 in Plate 4, or the 200 per cent shown both right and left in Plate 8.

8. The isoclinics and stress flow lines of Plate 1 likewise show a general pattern similar to that shown for turret 1 in Plates 3 and 7 of Report H-1493. It is to be noted that whereas measurements on turret 1 show the zero isoclinic foreward of the center line, turret 2 shows this isoclinic definitely aft of the center. This slight difference in stress distribution probably results from the difference in the deck pattern between turrets 1 and 2 rather than to the methods of attachment between deck and barbette.

9. The Q values for turret 2 show in Plate 2 high negative values not shown for turret 1 in Plates 5 and 9. Deck forces near the center line of the ship transferred to the barbette distort it to produce these high Q compressions. They are thus an indication of the extent to which the barbette is taking up deck load.

10. The high value of P stress near the barbette and on the center line of the turret indicate that the barbette at this point is carrying a stress of 110 per cent of the load on a deck free of openings.

SUGGESTIONS

11. It is believed the non-torque producing attachment of the present study and of Report H-1493 gives results applicable to steel providing the method of attachment for the steel structure shows a comparable flexibility. The method of attaching the celluloid deck to the celluloid barbette for report H-1442 allowed torques to be transmitted from the barbette to the deck plating. Similar torques are not present in the steel structure; therefore, the measurements of Report H-1442 are not applicable to the ordinary steel, barbette, deck structure. They would be applicable to a steel structure if the method of attachment of barbette to deck was the same as that used for the celluloid models.

[redacted]

12. High compression values of Q near the diagonal radius of the turret show poor strength design for the barbette, deck structure. The fore and aft component of the Q stress in this region must be added to the total fore and aft load of the deck. It is probable that this compression adds about 5 per cent to the total deck load under tension. If the deck in its original attachment to the barbette were pre-stressed in this region by a tension, the total strength of the deck could be increased by about 5 per cent.

13. Perhaps a more important aspect of the high compression values for Q on the diagonal axis of the turret is the probability that sometime the turret guns will be fired trained about 40° fore or aft and the deck will be required to absorb recoil forces at a time when it is already under a high compressive force. For such a condition, pre-stressing the deck might easily add 50 per cent to its ability to absorb recoil shocks.

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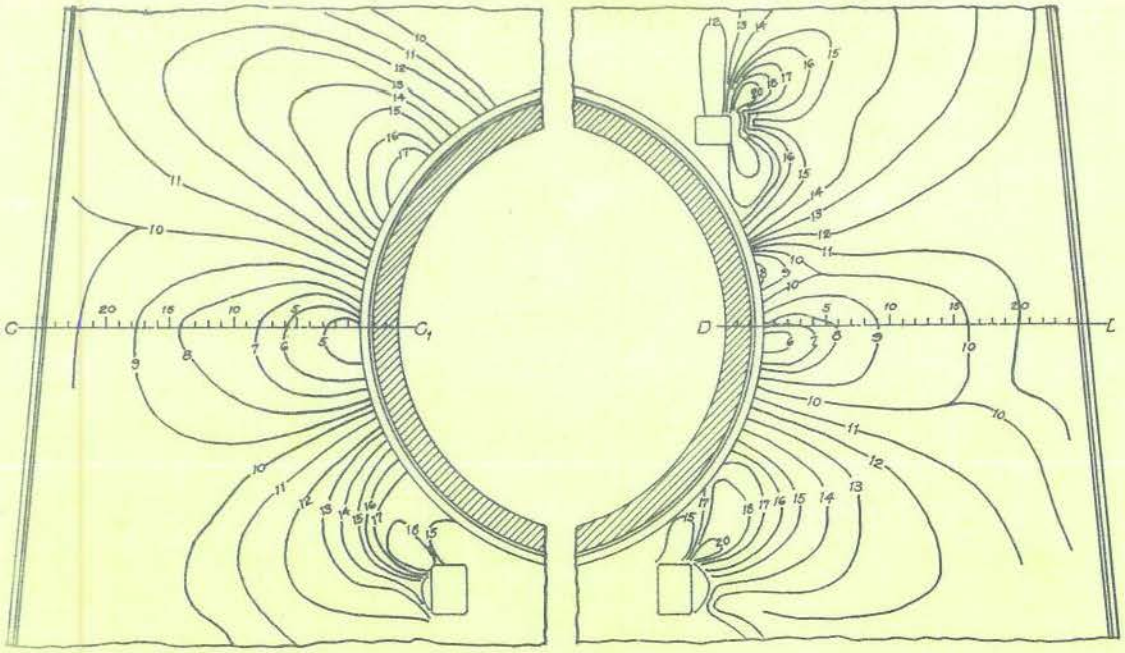
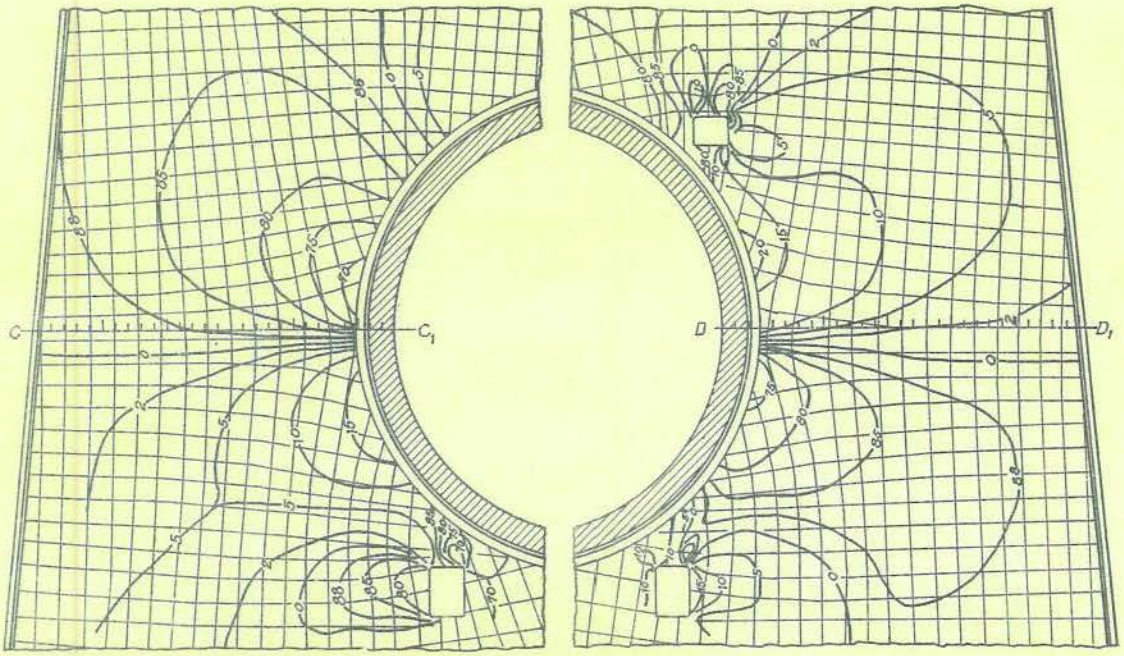
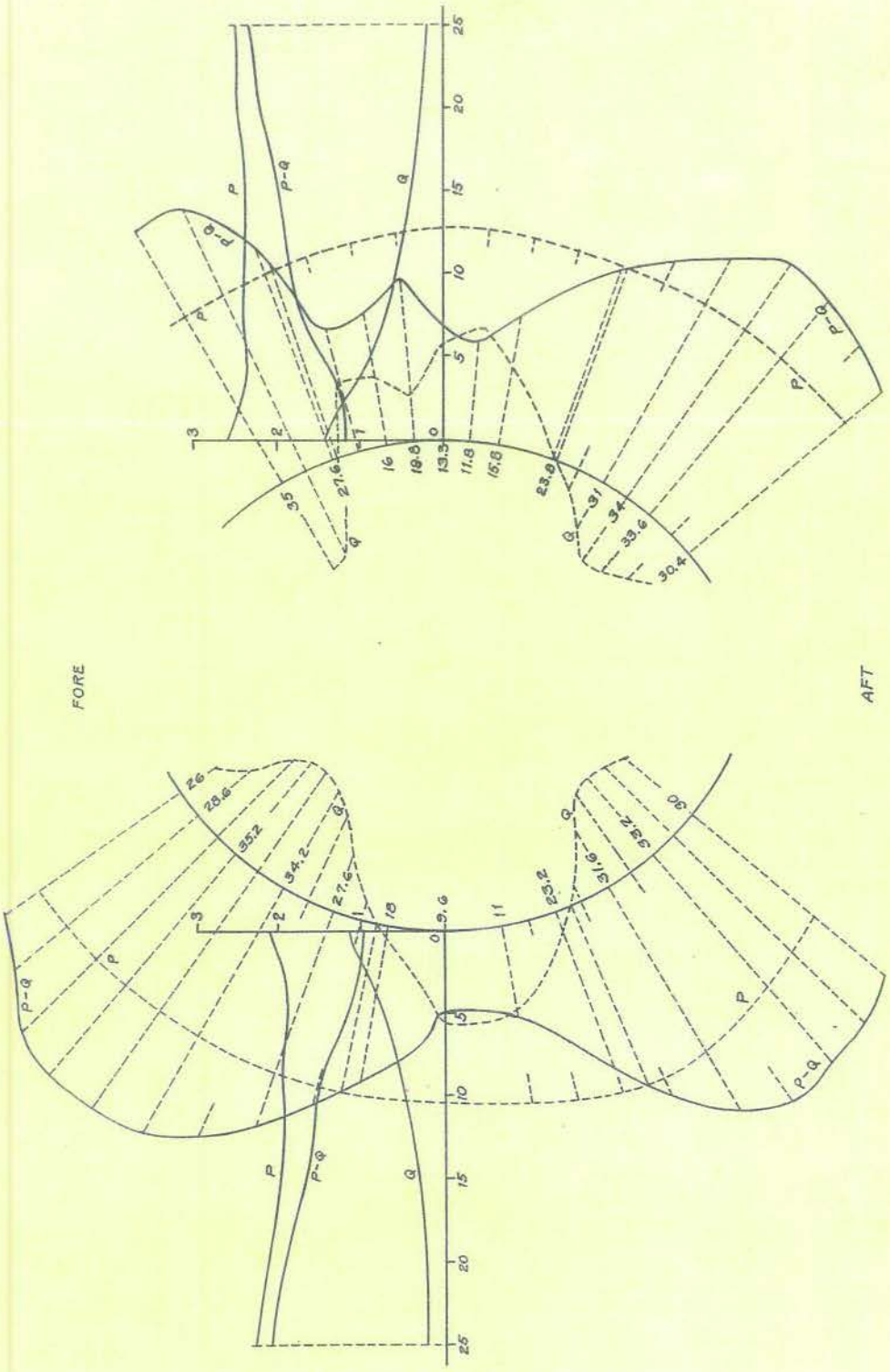


P-Q MAP



ISOCLINICS AND FORCE LINE FLOW MAP
BARBETTE-COMPLETE ATTACHMENT.

PLATE 1



SCALE PLAT OF P, Q AND P-Q VALUES.
BARBETTE WITH COMPLETE ATTACHMENT

PLATE 2