Methodology for determining the spatial position of the ship's shaft line

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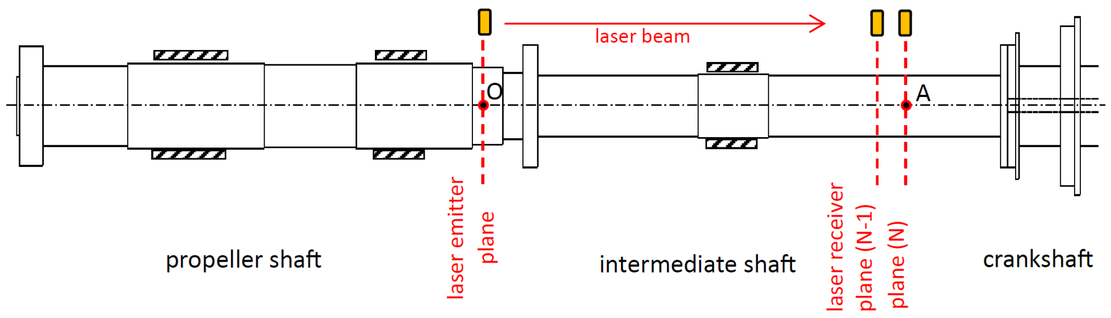
The aim of the article is to achieve a reliable assessment of the spatial position of the shaft line without the need to dock the ship and dismantle the shaft line.

The task set by the authors is related to the development of a methodology for measuring the spatial position (vertical and horizontal) of the shaft line using an optical laser system.

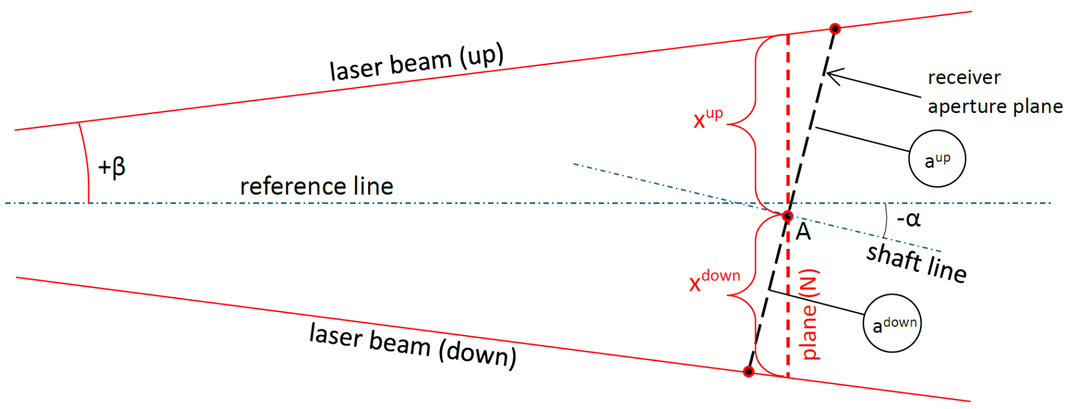
The method can be used in the absence of information about the set alignment of the shaft line by the manufacturer, i.e. for identification of the current alignment parameters of the shaft line.

Methodology for assessing the spatial position of the shaft line using an optical laser system

- position of emitter is determined (on tail shaft)
- a section of the intermediate shaft is selected (plane N)
- an auxiliary plane (plane N-1) is selected
- measurements are carried out in the vertical (UP-DOWN) and horizontal (PS-SB) planes



After the measurement data is filled in a software application, in order to determine the spatial position of point A, the data is transformed according to the proposed geometric scheme and formulas:



The angles α and β are calculated as the difference in readings between plane (N-1) and plane (N):

$$\alpha = \frac{1}{2}\left(\tan^{-1}\left(\frac{a_{n-1}^{down} - a_{n}^{down}}{d}\right) - \tan^{-1}\left(\frac{a_{n-1}^{up} - a_{n}^{up}}{d}\right)\right)$$

$$\beta = \frac{1}{2}\left(\tan^{-1}\left(\frac{a_{n-1}^{down} - a_{n}^{down}}{d}\right) + \tan^{-1}\left(\frac{a_{n-1}^{up} - a_{n}^{up}}{d}\right)\right)$$

The values for x^{up} and x^{down} are calculated according to formulas:

$$x^{up} = a^{up}\left(\frac{\sin(90 - \alpha - \beta)}{\sin(90 + \beta)}\right)$$

$$x^{down} = a^{down}\left(\frac{\sin(90 - \alpha - \beta)}{\sin(90 + \beta)}\right)$$

The position of point A relative to the zero line is determined by formula:

$$A = \frac{x^{down} - x^{up}}{2}$$

Conclusion

The proposed method can be used in the absence of information about the set alignment of the shaft line by the manufacturer, i.e. for identification of the current alignment parameters of the shaft line.

The proposed methodology is sensitive if the shaft line has residual deformation (bending).

The method can be used to determine the deformed line of ship shaft lines, if applied in n-number of sections.

The proposed method does not provide information about the contact of the shaft journal with the bearing shell in the measurement plane. It is recommended that the proposed methodology be accompanied by the jack-test method for full disclosure of the technical condition of the shaft line.

29 JUNE - 3 JULY
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