THE SOLUTION OF THE ALGORITHM FOR SOLVING THE DIMENSIONAL CHAINS DURING THE DESIGNING COURSE

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***ABSTRACT**: The methodology of solving the designing problems and calculus formulas dependent upon the way of showing the sourcing data and the required results of the calculus. The given operative dimensional chain is made up of three primary constitutive elements, respectively of the closing element. When solving the designing problem the rated size of the determinative element shall be circled and checked up, without exceeding the limit values of the calculus of the closing element, since they are its regulating values. As a result solving the size chain nthe rated value of the constitutive element shall be found out. At such a rated value, the closing element shall be made up within the regulating limits of the reserve on the lower, respectively upper limits. If the reserve on the tolerance of the closing element ist else than zero, then the output of the actual values of the closing elements on the settled limits cannot be avoided. If the reserve on the tolerance of the closing element ist equal withn zero, then the rounding off of the rated determined value of this chain could not be possible.*

KEYWORDS: dimensional chain, errors, calculus, method.

1. INTRODUCTION

The methodology of solving the designing problems and calculus formulas dependent upon the way of showing the sourcing data and the required results of the calculus.

The given operative dimensional chain (**fig.1**) is made up of three primary constitutive elements A1, A2 and A3, respectively of the closing element AR. The elements A1 and A2 are the ultimately known size; they have limit deviations and the known rated size.

The element A3 should be determined by its given limit deviations, as the rated size is unknown. For the closing element AR are given both the limit and source value in the given example shall be considered to be the limit value. When solving the designing problem the rated size of the determinative element A3 shall be circled and checked up, without exceeding the limit values of the calculus of the closing element AR, since they are its regulating values.

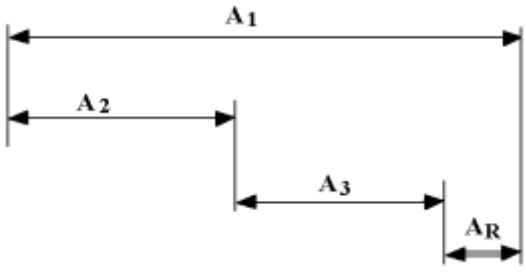

Fig.1. Example of dimensional chain settled while designing and checking up.

2. SHOWING THE ALGORITHM FOR SOLVING THE DIMENSIONAL CHAINS DURING THE DESIGNING COURSE

Determining the half of the tolerance field of the closing element:

a). minimum and maximum method: $\frac{\omega_R}{2} = \sum_{i=1}^{m-1} |\xi_i| \frac{\omega_i}{2}$

b). probability method (statistic): $\frac{\omega_R}{2} = k_R \sqrt{\sum_{i=1}^{m-1} \xi_i^2 \lambda_i^2 \left(\frac{\omega_i}{2}\right)^2}$

Determining the reserve on the tolerance of the closing element: $\omega = T_{\max R} - T_{\min R} - 2\left(\frac{\omega_R}{2}\right)$

The condition $\omega \geq 0$ shall be cheked up.

The determination of calculated average value if the source is represented by this value:

minimum: $A_{med\,R} = A_{\min R} + \frac{\omega_R}{2}$; maximum: $A_{med\,R} = A_{\max R} - \frac{\omega_R}{2}$;

average: $A_{med\,R} = \frac{A_{\min R} + A_{\max R}}{2}$

Determining the average value of the element with rated sought (determined) size:

$$A_{med\,(\det)} = \left(A_{med\,R} - \sum_{i=1}^{n-1} \xi_i A_{med\,(i)} \right) \frac{2}{\xi_{\det.}}$$

Determining the rated value of the element with sought rated size:

$$A_{\det} = A_{med\,(\det)} + \frac{\omega_{\det}}{2} - EI_{\det} = A_{med\,(\det)} - T_{med.\det}$$

Routing off the actual value writing the correct value of the rated size.

Determining the size of the applied correction: $K = A_3 - A_{3\det}$

Correcting the average value of the sought element: $A_{3cor} = A_{3med} + K$

Correcting the average value of the closing element: $A_{medRc} = A_{medR} + \xi_{\det} K$

Determining the minimum value of the closing element: $A_{\min Rc} = A_{medRc} - \frac{\omega_R}{2}$

Determining the actual maximum value of the closing element: $A_{\min Rc} = A_{medRc} + \frac{\omega_R}{2}$

Determining the reserve (deficit) for the lower limit value of the closing element: $RI = A_{\min Rc} - A_{\min R}$

Determining the reserve (deficit) for the upper limit value of the closing element:
$RS = A_{\max Rc} - A_{\max R}$

3. CASE STUDY

A. Data of problem: We are going to take into account the size chain shown in fig.2 featured by the following:

$A_1 = 50_0^{+0.2}$ mm; $A_2 = 30_{-0,5}^{+0,5}$ mm; $A_3 = 30_{-0,4}^{+0,2}$ mm şi A_R is minimum 0,15...2,05mm.

The selected method of calculus is the maximum and minimum methods.

B. We have to make the change of soursing data: $A_1 = 50_0^{+0.2}$ mm and $A_{3-0,4}^{+0,2}$ mm.

C. The calculus of the size chain shall be carried out, the rated value of the element A3 of the size chain shall be found out:

C1. Determining the half of the tolerance field of the closing element by the minimum and maximum method: $\frac{\omega_R}{2} = \sum_{i=1}^{m-1} |\xi_i| \frac{\omega_i}{2} = 0,1 + 0,5 + 0,3 = 0,9$ mm

C2. Determining the reserve on the tolerance of the closing element:

$$\omega_R = A_{\max R} - A_{\min R} - 2\left(\frac{\omega_R}{2}\right) = 2,05 - 0,15 - 1,8 = 0,1 \text{ mm}$$

C3. The condition $\omega \geq 0$ shall be cheked up.

C4. The determination of calculated average value if the source is represented by this value: $A_{med\,R} = A_{\min R} + \frac{\omega_R}{2} = 0,15 + 0,9 = 1,05$ mm

C5. Determining the average value of the element with sought rated value:

$$A_{3\,\text{med}} = \left(A_{\text{med R}} - \sum_{i=1}^{n-1} \xi_i A_{\text{med (i)}}\right) \frac{1}{\xi_{\text{det.}}} = (1,05 - 50,1 + 30)\frac{1}{-1} = 19,05 \text{ mm}$$

C6. Determining the rated value of the element with sought rated size:

$$A_{3\text{det}} = A_{3med} + \frac{\omega_{\text{det}}}{2} - ES_{\text{det}} = 19,05 + \frac{0,6}{2} - 0,2 = 19,15 \text{ mm}$$

C7. Routing off the actual value writing the correct value of the rated size: A3 = 19,1 mm

C8. Determining the size of the applied correction:

$$K = A_3 - A_{3\text{det}} = 19,1 - 19,15 = -0,05 \text{ mm}$$

C9. Correcting the average value of the sought element:

$$A_{3cor} = A_{3med} + K = 19,05 + (-0,05) = 19,00 \text{ mm}$$

C10. Correcting the average value of the closing element:

$$A_{medRc} = A_{medR} + \xi_{\text{det}} K = 1,05 + 0,05 = 1,1 \text{ mm}$$

C11. Determining the minimum value of the closing element:

$$A_{\min Rc} = A_{medRc} - \frac{\omega_R}{2} = 1,1 - 0,9 = 0,2 \text{ mm}$$

C12. Determining the actual maximum value of the closing element:

$$A_{\min Rc} = A_{medRc} + \frac{\omega_R}{2} = 1{,}1 + 0{,}9 = 2{,}0 \text{ mm}$$

C13. Determining the reserve (deficit) for the lower limit value of the closing element:

$$RI = A_{\min Rc} - A_{\min R} = 0{,}2 - 0{,}15 = 0{,}05 \text{ mm}$$

C14. Determining the reserve (deficit) for the upper limit value of the closing element:

$$RS = A_{\max Rc} - A_{\max R} = 2{,}05 - 2 = 0{,}05 \text{ mm}$$

4. CONCLUSIONS

As a result solving the size chain the rated value of the constitutive element A3=19,1[mm] shall be found out. At such a rated value, the closing element AR shall be made up within the regulating limits of the reserve 0,05 [mm] on the lower, respectively upper limits.

If $\omega_R < 0$, then the output of the actual values of the closing elements on the settled limits cannot be avoided.

If $\omega_R = 0$, then the rounding off of the rated determined value of this chain could not be possible.

Broadly speaking, the following conditions shall be observed:

- for the chain with the source (first) minimum or maximum given value of the closing element: $\omega_R - K_{\max} \geq 0$;
- for the chain with the source (first) average given value of the closing element $\omega - 2K_{\max} \geq 0$ (Kmax making up the highest value of the possible correction for the rated rounding off operation).

When the rounding off is not necessary, the steps 7 and 14 shat't be carried out. The size of the K correction is found out in formulas with the sign got while calculating under the step 8.

Getting the negative values of the reserve RI and RS means the prove of the out put of the actual values of the closing element on the settled limits.

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