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TRANSFORMING SOURCE DATA INTO AVERAGE VALUES AND SOLVING THE VERIFICATION ISSUE FOR DIMENSIONS CHAINS

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Abstract: This work presents a method of solving verification problems and at the process dimensional analysis of technological design allowing establishing whether the features of closing elements, operative extension values are known for the drawing sizes, which cannot be achieved directly, at design.

1. INTRODUCTOTY NOTIONS

Solving the verification problems for the process dimensional analysis of technological design allows establishing whether the features of closing elements, operative extension values are known for the drawing sizes, which cannot be achieved directly, at design.

For calculating and establishing verification source data, the problem of calculating operative technological chains coincides with the reverse problem of chains calculation. The solving methodology for the design and verifications problems and calculation formulas depend on the presentation form of data sources and calculus results.

When solving the verification problem we will have to start from the given values of the component elements and calculate limit values of the closing element and compare with the regulating limit values. If the calculated values are higher than the established limits, if needed, the probability of this event shall be calculated (or the fault probability).

2. ALGORITHM FOR SOLVING DIMENSION CHAINS AT VERIFICATION

Establishing have of the tolerance field of the closing element by:

- Minimum and maximum method:

$$\frac{\omega_R}{2} = \sum_{i=1}^{m-1} \left|\xi_i\right| \frac{\omega_i}{2} \tag{1}$$

- Possibility method:

$$\frac{\omega_R}{2} = k_R \sqrt{\sum_{i=1}^{m-1} \xi_i^2 \lambda_i^2 \left(\frac{\omega_i}{2}\right)^2} \tag{2}$$

1. Establishing the average real value of the closing element:

$$A_{medRc} = \sum_{i=1}^{n} \xi_{(i)} A_{med(i)} \tag{3}$$

2. Establishing the minimum real value of the closing element:

$$A_{\min Rc} = A_{medRc} - \frac{\omega_R}{2} \tag{4}$$

3. Establishing the maximum real value of the closing element:

$$A_{\max Rc} = A_{medRc} + \frac{\omega_R}{2} \tag{5}$$

4. Establishing the reserve (fault) for the inferior limit value of the closing element:
$$RI = A_{\min Rc} - A_{\min R} \tag{6}$$
5. Establishing the reserve (fault) for the superior limit value of the closing element:
$$RS = A_{\max Rc} - A_{\max R} \tag{7}$$
6. Establishing the displacement of the real average value of the closing element:
$$e = A_{medRc} - \frac{A_{\max R} + A_{\max R}}{2} \tag{8}$$
7. Establishing the values output periodicity of the closing element on the inferior regulating value:
$$P_{EI} = \Phi\left(T_R \frac{A_{\min R} - A_{medRc}}{\frac{\omega_R}{2}} \right) \tag{9}$$
8. Establishing the values output periodicity of the closing element on the superior regulating value:
$$P_{EI} = \Phi\left(T_R \frac{A_{medRc} - A_{\max R}}{\frac{\omega_R}{2}} \right) \tag{10}$$
9. Establishing the values output periodicity of the closing element on the limit regulating value:
$$P_0 = P_{EI} + P_{ES} \tag{11}$$

Observation:

a. RI and RS reserves calculation and displacement is made only for the elements with limit regulation values.
b. *P_0, P_{EI} and P_{ES}* periodicities are calculated only for the closing elements with limit regulation values. Calculated forms are given for the case when periodicity method is used for calculating chains, and the closing elements have a normal distribution rule.
c. At the distribution of the closing element according to the equal periodicity and Simson (equilateral and isosceles triangle laws) P_{EI} and P_{ES} periodicity is calculated after the relations 1.9, 1.10 and 1.11.

3. CASE STUDY

For studying the verification problem we consider the operative dimensional chain (fig. 1.1) which consists of three component elements A_1, A_2, A_3 and the closing element A_g. For all the component elements we know the nominal dimensions and limit faults, the A_1, A, are definitive dimensions and A_3 - is the intermediary operative dimension. At the A_g closing element limit values are regulated.

We know:

$A_R = A_1 - A_2 - A_3$; $A_1 = 50^{+0,2}$ mm; $A_2 = 30 \pm 0,5$ mm, $A_3 = 19^{+0,2}_{-0,4}$ mm şi $A_R = 0,15....2,05$ mm.

Limit values of the closing element should be calculated and compared to the limit regulation values.

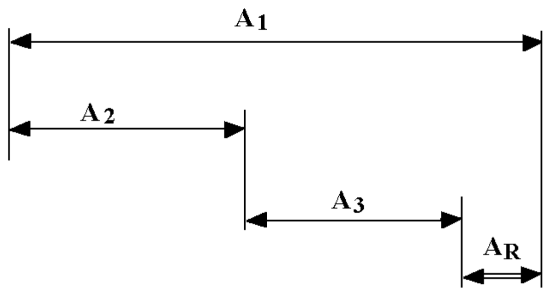

Fig. 1.1 Dimensions chain example at design and verification

The calculation values chosen are the maximum and minimum method.

A. Transforming the $A_1 = 50{,}1 \pm 0{,}1$ and $A_3 = 19 \pm 0{,}3$ elements:

B. Calculating the dimensions chain:

c1) Establishing the half of the tolerance field of the closing elements through the maximum and minimum method:

$$\frac{\omega_R}{2} = \sum_{i=1}^{m-1} |\xi_i| \frac{\omega_i}{2} = 0{,}1 + 0{,}5 + 0{,}3 = 0{,}9 \text{ mm} \tag{12}$$

c2) Establishing the average real value of the closing element:

$$A_{medRc} = \sum_{i=1}^{n} \xi_{(i)} A_{med(i)} = 1{,}05 + 0{,}05 = 1{,}1 \text{mm} \tag{13}$$

c3) Establishing the minimum real value of the closing element:

$$A_{\min Rc} = A_{medRc} - \frac{\omega_R}{2} = 1{,}1 - 0{,}9 = 0{,}2 \text{ mm} \tag{14}$$

c4) Establishing the maximum real value of the closing element:

$$A_{\min Rc} = A_{medRc} + \frac{\omega_R}{2} = 1{,}1 + 0{,}9 = 2{,}0 \text{ mm} \tag{15}$$

c5) Establishing the reserve (fault) for the inferior limit value of the closing element:

$$RI = A_{\min Rc} - A_{\min R} = 0{,}2 - 0{,}15 = 0{,}05 \text{ mm} \tag{16}$$

c6) Establishing the reserve (fault) for the superior limit value of the closing element:

$$RS = A_{\max Rc} - A_{\max R} = 2{,}05 - 2 = 0{,}05 \text{ mm} \tag{17}$$

c7) Establishing the displacement of the average real value of the closing element:

$$e = A_{medRc} - \frac{A_{\max R} + A_{\max R}}{2} = 1{,}1 - \frac{0{,}15 + 2{,}05}{2} = 0 \text{ mm} \tag{18}$$

The A_g closing element, after the calculation results indicate to equal 0,2…2,0 mm with reserves of 0,05mm on the superior and inferior limit, which proves that the limit values calculated of the closing element are in accordance with the limit regulation values.

4. CONCLUSIONS.

The calculation algorithm is hard, because it requires long achievement time, but with its help we can check whether the chain of dimensions presented and calculated at design is correct. This was made beginning with the transformation of A_1 and A_3 component elements, then minimum, average and maximum real value was established for the closing element, and finally reserves were established for the inferior and superior limit values. The result obtained after the present algorithm proves that the closing element calculated limit values are in accordance with the regulating limit values.

REFERENCES

[1] Dunaev, P.F.: Chains of dimensions, Technical Publishing House, Bucharest 1958
[2] Cîrţînă L.M., Ghimişi Şt., Luca L.Ş The solving the chains of dimensions bz the statistic methods, Proceeding of 3rd Zouth Simposium on Experimental Solid Mechanics, 2004, Poretta Terme, Italz.
[3] Militaru C., Cîrţînă L.M., Rădulescu C.: Researches about statistic developing a complex chain of dimensions, The International conference on advanced manufacturing technologies, Bucharest, 3÷4 November 2005, Ed.Romanian Academy.