# STRESS-STRAIN STATE OF HIGH-STRENGTH STEEL REINFORCEMENT

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***Annotation.***
The article discusses the possibility of evaluating and comparing the physical, mechanical and deformative properties of steel reinforcement for widespread use in construction.
***Key words*:**Reinforcing steel, deformability, physical and mechanical properties.
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The relevance of the problem of evaluating the physical, mechanical and deformative properties of steel reinforcement for different classes of periodic profile. This is due to the need to derive the qualities of metallurgical industrial enterprises for the CIS countries [1,2,3,4].

The main purpose of this study is to test the stress-strain state of rod steel, fiberglass and various classes of reinforcement under short-term load action.

To achieve this goal , the following tasks were solved during the study:

-development of methodology and production of prototypes, steel fittings of classes A240, A500c, A600c, SPA

--conducting tests of samples with a short-term load before destruction.

-analysis of the experimental data obtained and comparison with standard calculation methods.

To assess the physical and mechanical properties of the reinforcement, prototypes were made and tensile tests were carried out.

Table 1 - General characteristics according to GOST[5,6,7]

<table>
<tr><td>№ п/п</td><td>Characteristicsofthereinforcement</td><td colspan="4">Steel fittings GOST 5781-82 GOST 52544-2006 Fiberglass fittings TU 2296-001-60722703-2010</td><td>Steel fittings GOST 5781-82 GOST 52544-2006 Fiberglass fittings TU 2296-001-60722703-2010</td></tr>
<tr><td rowspan="4">1</td><td rowspan="4">Mechanical characteristics under tension, σ,N/〖mm〗^2</td><td>класс</td><td>σ_B</td><td>σ_T</td><td>σ_P</td><td rowspan="4">1300</td></tr>
<tr><td>A240</td><td>373</td><td>235</td><td>225</td></tr>
<tr><td>A500</td><td>633,6</td><td>390</td><td>355</td></tr>
<tr><td>A600</td><td>883</td><td>390</td><td>510</td></tr>
<tr><td>2</td><td>Elongation, e_P,%</td><td colspan="2">A240, A500<br>A600</td><td colspan="2">6,7,6</td><td>2,2</td></tr>
<tr><td>3</td><td>Modulus of elasticity, E_S, N/〖mm〗^2 (Hpa)</td><td colspan="4">200000 (200)</td><td>55000 (55)</td></tr>
<tr><td>4</td><td>Density, g/〖cm〗^3</td><td colspan="4">7,85</td><td>1,9</td></tr>
<tr><td>5</td><td>Corrosionresistance</td><td colspan="4">Corrosion-resistantStainlessmaterial</td><td>Corrosion-resistantStainlessmaterial</td></tr>
<tr><td>6</td><td>Ratio</td><td colspan="4">13-15</td><td>9-12</td></tr>
</table>

| | | | |
|---|---|---|---|
| 7 | Coefficient of thermal conductivity, W/(m*K) | 46 | 0,35 |
| 8 | ElectricalProperties | Electrically Conductive Non-Electrically Conductive Is a dielectric | Electrically Conductive Non-Electrically Conductive Is a dielectric |
| 9 | Magneticproperties | DiamagnetMagneticCore | DiamagnetMagneticCore |
| 10 | Durability | In accordance with building codes, the predicted durability is at least 80 years | In accordance with building codes, the predicted durability is at least 80 years |

To assess the physical and mechanical properties of valves of different classes, they were carried out on an instron 1000HDX testing machine and simultaneously measured stresses and elongation by an extensometer sensor.

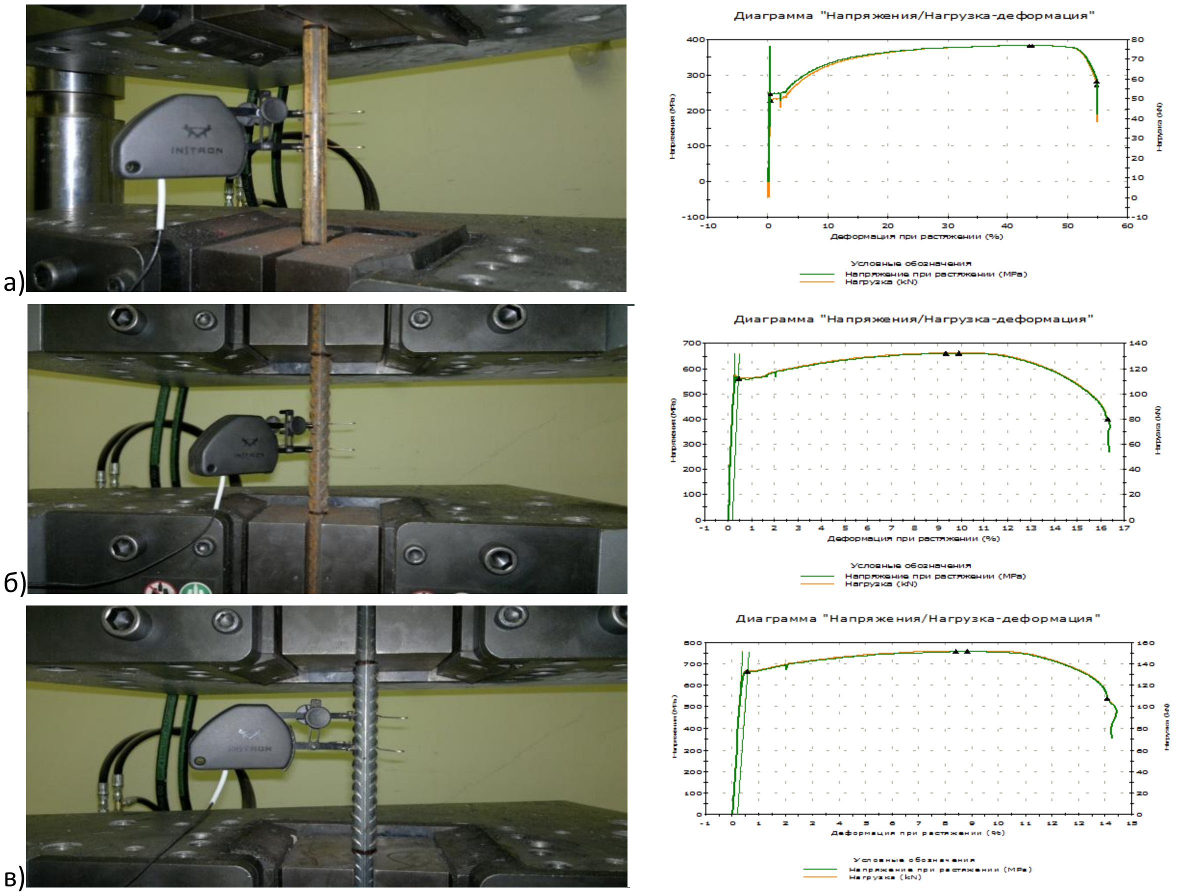


Figure 1 - (a.b.c). Reinforcement deformation diagram «$\sigma - \varepsilon$»

a) -a sample when testing steel reinforcement A240

b) -a sample when testing steel reinforcement A500C

c) -a sample when testing A600C steel reinforcement

Table 2 - characteristics of prototypes after testing

| | Samplelabel | Diameter(mm) | Cross-sectional area, mm^2 (mm^2) | Estimatedlength, mm | Lengthafterrupture, mm |
|---|---|---|---|---|---|
| 1 | A600c | 16,00 | 201,1 | 160,0 | 185,0 |
| 2 | A600c | 16,00 | 201,1 | 160,0 | 183,0 |
| 3 | A500c | 16,00 | 201,1 | 160,0 | 187,0 |
| 4 | A500c | 16,00 | 201,1 | 160,0 | 187,0 |
| 5 | A240 | 16,00 | 201,1 | 160,0 | 221,3 |
| 6 | A240 | 16,00 | 201,1 | 160,0 | 238,0 |

The combined diagram of deformation of samples Ø16 mm from reinforcing steels of classes A240; A500C and A600C used in the manufacture of prototypes is given.

Образцы с 1 по 6

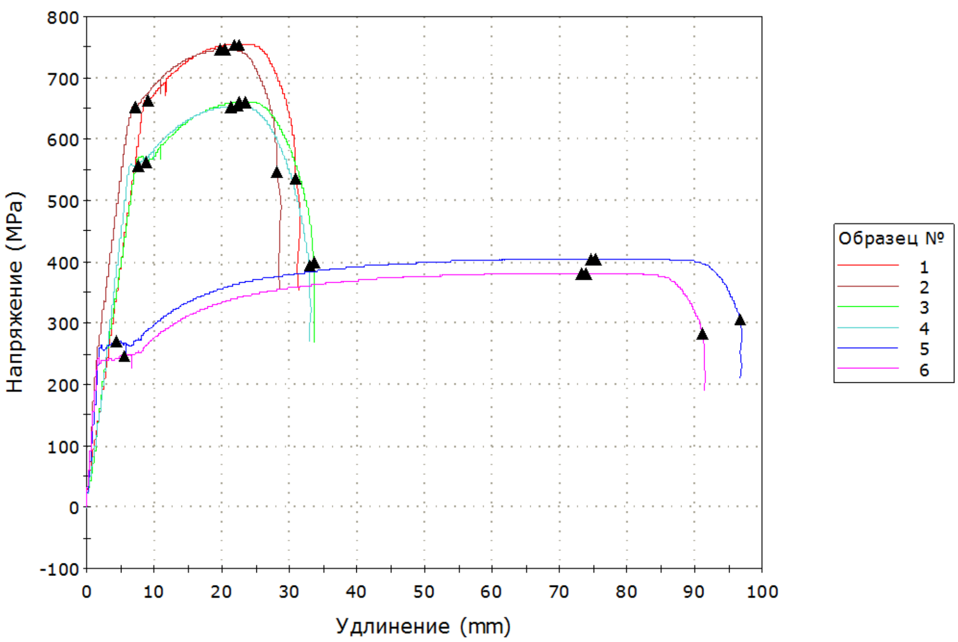


Figure 2 - Combined deformation diagram after testing for reinforcement classes A240, A500C and A600C

Table 3 - Results of tensile tests of prototypes

| | Yieldstrength(MPa) | Yieldstress(kN) | Maximumtensilestress (MPa) | Maximumload(kN) | Stress under destructive force (MPa) | Destructiveforce(kN) | Relativeelongation, (%) | Module (MPa) |
|---|---|---|---|---|---|---|---|---|
| 1 | 662,5 | 133,2 | 754,7 | 151,7 | 536,6 | 107,9 | 15,6 | 181595,82520 |
| 2 | 653,7 | 131,4 | 745,9 | 150,0 | 547,1 | 110,0 | 14,4 | 229177,09961 |
| 3 | 560,9 | 112,8 | 660,8 | 132,9 | 400,4 | 80,5 | 16,9 | 211272,90039 |
| 4 | 558,0 | 112,2 | 653,9 | 131,5 | 393,6 | 79,1 | 16,9 | 212089,50195 |
| 5 | 269,6 | 54,2 | 404,7 | 81,4 | 305,7 | 61,5 | 38,3 | 1937939,84375 |

| | Yieldstrength(MPa) | Yieldstress(kN) | Maximumtensilestress (MPa) | Maximumload(kN) | Stress under destructive force (MPa) | Destructiveforce(kN) | Relativeelongation, (%) | Module (MPa) |
|---|---|---|---|---|---|---|---|---|
| 6 | 245,9 | 49,4 | 381,9 | 76,8 | 282,3 | 56,8 | 48,8 | 211121,53320 |



**Conclusions:**

The magnitude of the ultimate deformations of the prototypes under the short - term action of the load was (1,57-1,90)* 〖10〗^(-3), which led to the achievement of the yield strength in valves of classes A240, A500C and A600C. The stresses in the fiberglass reinforcement (SPA) have not reached the elastic limit. Due to the low value of the elastic modulus of fiberglass (SPA) reinforcement, its effect on increasing the bearing capacity of compressed elements is insignificant. The experimental and calculated values of the destructive load of the prototypes showed good convergence of the results. The discrepancy between the experience of its calculation is 0.5 - 13%.

## REFERENCES

1. Popov K.N. Building materials and products. M. HSE 2002

2. Popov N.N., Zabegaev A.V. Design and calculation of reinforced concrete and stone structures. M. Higher School 1989

3. Mandrikov A.P. Examples of calculation of reinforced concrete structures. M. 2007 "Alyans"

4. Golovin N.G. "Strength and deflectivity of bending elements" Dissertation of the degree of Candidate of Technical Sciences p. 31

5. Hot-rolled steel for reinforcement. Reinforced concrete structures Technical specifications GOST 5781-82

6. Concrete and reinforced concrete structures. The main provisions of SNiP 52-01-2003

7. Interstate standard GOST 31938 – 2022 composite polymer reinforcement for reinforcement of concrete structures. Generaltechnicalconditions.