# STRESS STATE OF ELEMENTS IN THE COMPOSITION OF METALLIC BODIES OF CYLINDRICAL TANKS WITH EXTERNAL FRP REINFORCEMENT

Dziuba S.V., Ph.D., Associate Prof.; Korshak O.M., Ph.D., Associate Prof.;
Mikhailov O.O., applicant for Ph.D.
*(the department of metal, wood and plastic structures)*

Sequential consideration of the work of the steel shell of a cylindrical tank, having a radius $r$ and a thickness $t_s$, being under the action of the initial internal pressure $P'$ and than strengthened by transverse prestressed FRP elements with prestress $\sigma_{f0}$ and thickness $t_f$, continuously located along its height, experiencing a subsequent increase in pressure by an amount $\Delta P$, made it possible to obtain the values of the maximum hoop stresses, respectively, in the elements of FRP reinforcement and the steel wall

$$\sigma_f = \sigma_{f0} + \frac{m\left[N_{f(x,z)} + t_s E_s\left(\alpha_s \Delta T_{s2} - \alpha_f \Delta T_{f2}\right)\right]}{t_s + t_f m} ,$$

$$\sigma_s = \frac{P' \cdot r}{t_s} - \sigma_{f0}\frac{t_f}{t_s} + \frac{N_{s(x,z)} + t_f E_f\left(\alpha_f \Delta T_{f1} - \alpha_s \Delta T_{s1}\right)}{t_s + t_f m} .$$

The parameters of the conditional ring forces of a unit section, respectively, of the FRP reinforcement and steel layers of the wall, which occur when the internal pressure changes by an amount $\Delta P$ and determined taking into account the combined action of the ring and longitudinal stresses in the steel part of the structure, are

$$N_{f(x,z)} = \Delta P \cdot r(1 - \mu/2), \ N_{s(x,z)} = \Delta P \cdot r\left[1 + m\left(t_f / t_s\right)\left(\mu/2\right)\right].$$

Parameters determining the stress state: $E_s$ and $E_f$ – the modules of elasticity of steel and elements of FRP reinforcement; $m = E_f/E_s$ – the ratio of the elastic modules of the constituent layers of the wall; $\mu$ – Poisson's ratio of the material of the steel component of the tank wall; $\alpha_s$ and $\alpha_f$ – coefficients of linear thermal deformation of steel and a layer of FRP; $\Delta T_{s1}$ and $\Delta T_{f1}$ – the most critical temperature changes of the steel and FRP components of the shell, causing maximum additional stresses in the steel; $\Delta T_{s2}$ and $\Delta T_{f2}$ – the most critical changes in the temperatures of the steel and FRP components of the shell, causing the maximum additional stresses in the FRP.

## Література

1. Дзюба С.В., Стоянов В.В. Усиление стенок металлических цилиндрических резервуаров направленно-ориентированными фибро-пластиковыми материалами // Современные строительные конструкции из металла и древесины / Сб. науч. тр. ОГАСА. –Одеса: ОДАБА, 2015. –С. 66-78.