UDC 691.87

MODELLING OF TERMINAL CONNECTORS FOR TESTING AND OBTAINING PRESTRESSING FRP REINFORCEMENT

EGOR ZIABKIN, DMITRIY SHABANOV
Polotsk State University, Belarus

The article presents the possibility of using terminal connectors with wedge grips. To determine the load-carrying capacity of the wedge grips, it is necessary to calculate the drag force on the surface between the FRP reinforcement and the slip. As a result, the friction force on the contact surface is supplemented with the drag force generated by plastic shear strain of the pipe body.

Modern views on the use of non-metallic reinforcement gained greater resonance, i.e, used in conjunction with metal designs. However, their physical and mechanical properties are much better. To expand the applications of composite nonmetallic reinforcement and a detailed study of its joint work with concrete it is advisable to continue research and test various structures, the use of non-metallic reinforcement in prestressed concrete structures.

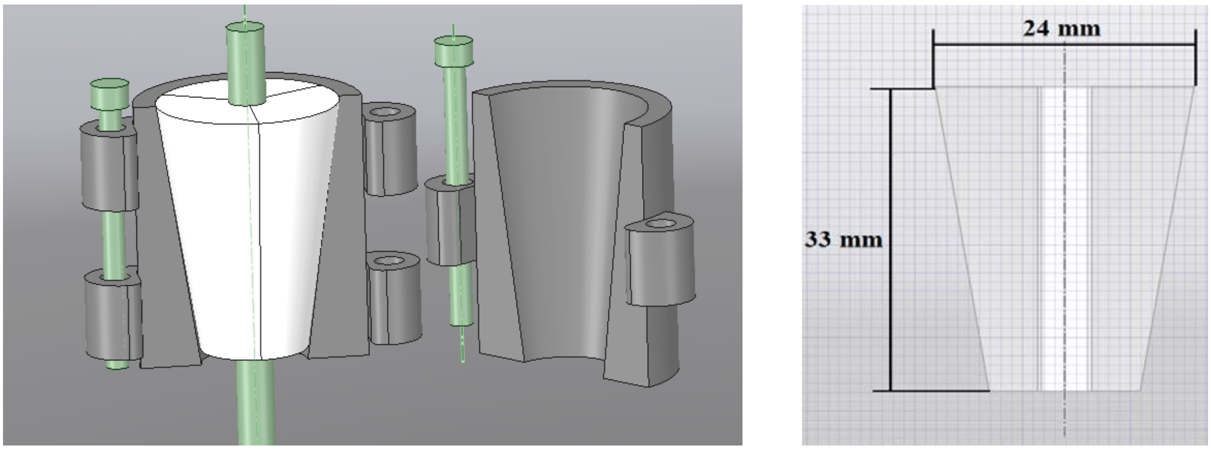

Fig. 1. Model of terminal connectors and dimensions
of wedges executed in the software ANSYS SpaceClaim

A wedge clamp is used in devices where it is necessary to obtain a significant clamping force or change its direction. They allow to increase and change the direction of the transmitted force. To provide a restraining force, the surface of the wedge (Fig. 1) device must create the necessary resistance force on the contact surface resulting from the plastic deformation of the composite reinforcement when it moves relative to the wedges, which complements the frictional force.

Elastic and plastic analytic solutions. At the initial stage ($h \to 0$) of indentation of a wedge punch with a flat base, solution of the linear elastic problem of punch pressure with a rectangular base on half space [4, 5] can be used:

$$F = \frac{E}{1-v^2} \cdot \frac{\sqrt{wl}}{m} h \tag{1}$$

where *E=210 GPa* is Young's modulus, *v=0.3* is Poisson's ratio, *w=0.024 m*. is the truncated wedge base width, *l=0.033 m.* is the truncated wedge base length, *m* is the parameter determined as the ratio of the base sides *(if l /w=1.375 m = 0.95, Fig. 2)*. Eq. (1) was derived by generalization of the solution of the Boussinesq problem on the action of a normal concentrated force on the surface of elastic half-space. It should be noted that solution (1) was derived based on the assumptions of infinitesimal mechanics, where small strains are assumed and the differences between the actual and reference configurations are neglected. In this case, the form of the wedge side face is not crucial, only the truncated wedge base sizes are essential. The solution is true for very weak indentation forces only and, therefore, for shallow penetration depths ($h \to 0$), when the plastic zone and contact on the side wedge faces may be neglected. When solution (1) was derived, it was assumed that contact pressure was evenly distributed, there was no friction and h was assumed as the average displacement value under the punch. Such conditions are not crucial as the difference from the solution for the rigid punch (constant displacements and variable contact pressures) is about 8% [4].

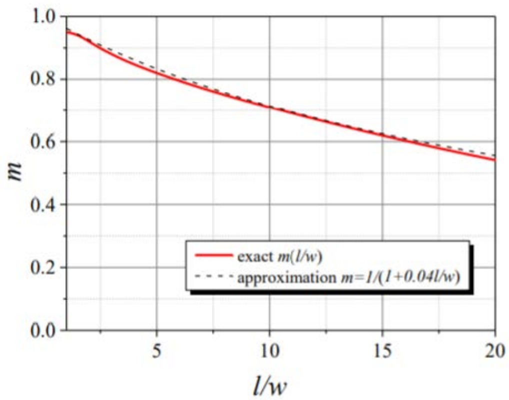

Figure 2. [3]. Parameter m in Eq. (1) vs. base side ratio l/w=1.375

$$F = \frac{210 \cdot 10^6}{1 - 0.3^2} \cdot \frac{\sqrt{24 \cdot 33}}{0.95} h = 6836N$$

A simplified analytical model was proposed to determine the indentation force of non-ideal (truncated) wedge punch with symmetrically sloped sides (20^0).

REFERENCES

1. Kim, W. Metal flow in wedge indentation of V- and W-shaped tools / W. Kim, K. Kawai, H. Koyama // Journal of Materials Processing Technology. – 2007. – №. 1(189). – P. 392–400.
2. Effects of blade tip geometry on cutting characteristics of lead alloy sheet subjected to wedge indentation / P. Mitsomwang [et al.] // Key Engineering Materials. – 2017. – Vol. 719. – P. 137–141.
3. Modeling of indentation and slip of wedge punch / A.S. Semenov [et al.] // Magazine of Civil Engineering. – 2017. – № 6. – P. 78–101.
4. S.P. Timoshenko Theory of Elasticity / S.P. Timoshenko, J.N. Goodier. – 3 ed. – McGraw-Hill, New York. 1970. – 519 p.
5. Schleicher, F. Die Verteilung der Bodenpressungen unter starren Gründungskorpern" (Distribution of Soil Pressures Under Rigid Foundation Bodies) / F. Schleicher // Der Bauingenieur. – 1933. – Vol. 14. – P. 242–245.