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Reliance on Tensile Strength for Cast-in-Situ Wall-to-Wall Joints

Résistance à la traction des joints clavés de parois coulées sur place

Tragfähigkeit von Fugen in Ortbetonwänden

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SUMMARY

The paper considers theoretical and practical problems concerning an estimation of the complete concrete tensile deformation diagram in the analysis of the load bearing capacity of keyed joints of cast-in-situ exterior and interior walls.

RÉSUMÉ

Cet article prend en considération les problèmes théoriques et pratiques d'une appréciation concernant le diagramme complet traction-déformation du béton, et ceci, dans le contexte de l'analyse de la capacité portante de joints clavés, appartenant à des parois intérieures et extérieures coulées sur place.

ZUSAMMENFASSUNG

Im Aufsatz wird das theoretische und praktische Problem der Bewertung des vollständigen Dehnungsdiagramms des Betons in der Tragfähigkeitsberechnung der Monolithverzahnung der Aussen- und Innenwände besprochen.

The connections of intersection walls constructed both of cast--in-situ concrete of different nature and class (Fig. 1) and of precast concrete members can be provided by using keyed joints. The cross-shaped and wavy dividing closures of asbestos cement sheets provided a rational solution ensuring technologically simple connections between walls of buildings and constructions. A remarkable cohesion of these sheets with concrete is characteristic. Therefore it is expedient to use new types of joints for connections of cast-in-situ exterior lightweigt and interior heavy concrete walls of buildings.

The experimental laboratory and site data indicate the necessity of new types joints with the division closures. The keyed joints of concrete walls lead to the economy and increase in both tolerable rigidity of the connections and stiffness of multi-storey buildings subjected to shear forces. Such forces are generated by horizontal wind or seismic actions, non-symmetrical vertical loading, shrinkage deformations, temperature gradient etc.

Shear carrying capacity of keyed joints depends on mechanical properties of wall concrete in tension. The shear strength of a key system belonging to one of wall connection members is closely related to the possibility of a redistribution of shear stresses both in a single key and among the connection keys.

Twenty four full-scale specimens of exterior and interior wall connections were tested to investigate the behavior of concrete keys and to establish a cracking resistance (a load rating) and a failure strength of keyed joints.

The shear capacity of keyed wall-to-wall joints can be determined by the following equation derived from a test analysis and modelling data

$$R = nR_1 (1 - tg\alpha / tg\beta) + A_s f_y tg\alpha. \qquad (1)$$

Here n - the number of keys in weaker wall member; R_1 - shear strength of a single key; $tg\alpha$ - coefficient taking into account the shape of a crack surface and the position of a crack direction angle; $tg\beta$ - coefficient characterizing the key slope angle and the contract surface between asbestos cement sheet and concrete; A_s - cross-sectional area of horizontal reinforcing bars; f_y - steel yield strength.

The shear strength of a concrete key

$$R_1 = \varkappa A_c f_v , \qquad (2)$$

where $\varkappa$ - coefficient which helps to evaluate the influence of crack location on the cross-sectional area A_c of shear key; f_v - concrete shear strength.

The value of the strength f_v can be calculated on the basis of the empirical equation

$$f_v = \xi_v \sqrt{f_c f_{ct}} , \qquad (3)$$

where ξ_v = 0,7 for heavy and ξ_v = 0,5 for lightweight concrete;

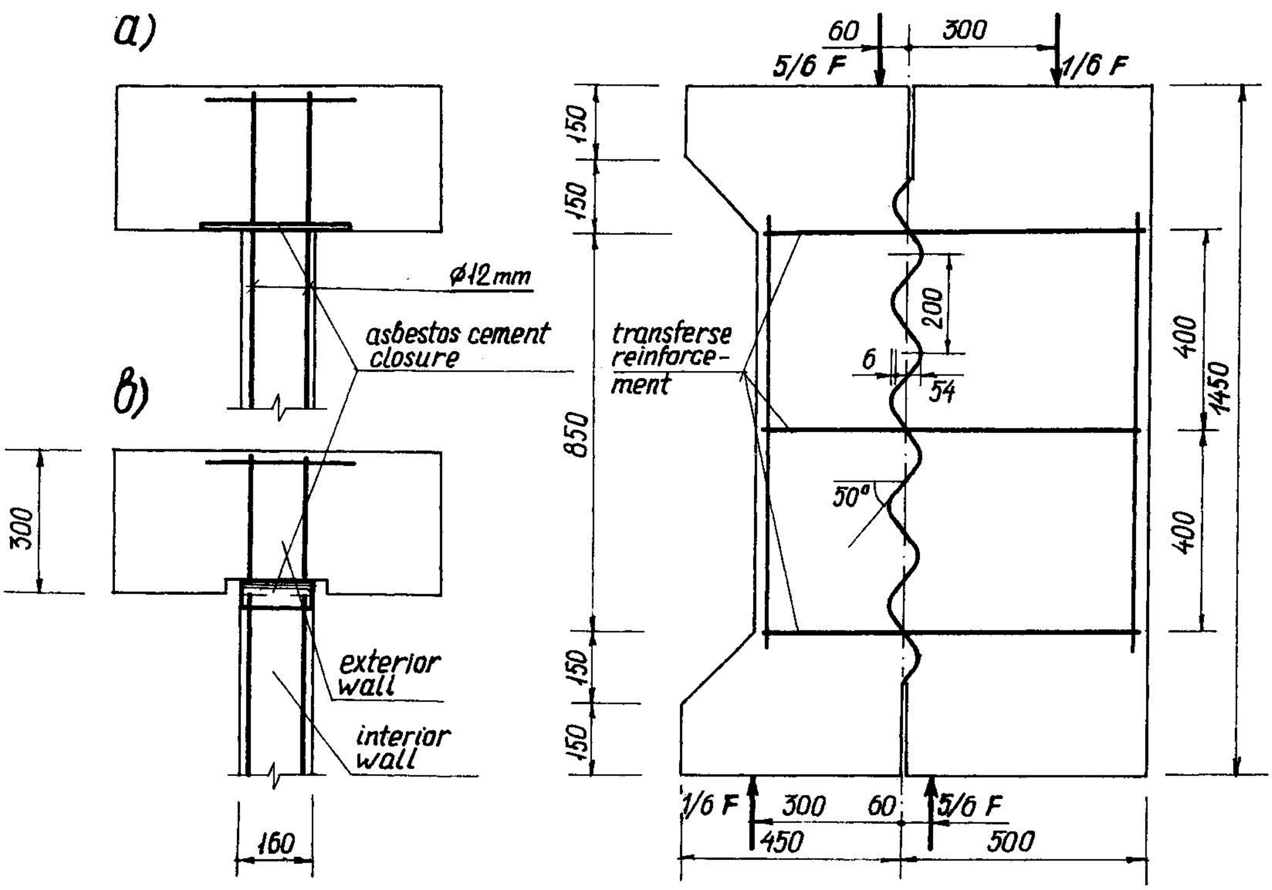


Fig. 1. Test specimens and test loading diagram of plain (a) and keyed (b) joints (dimensions in mm)

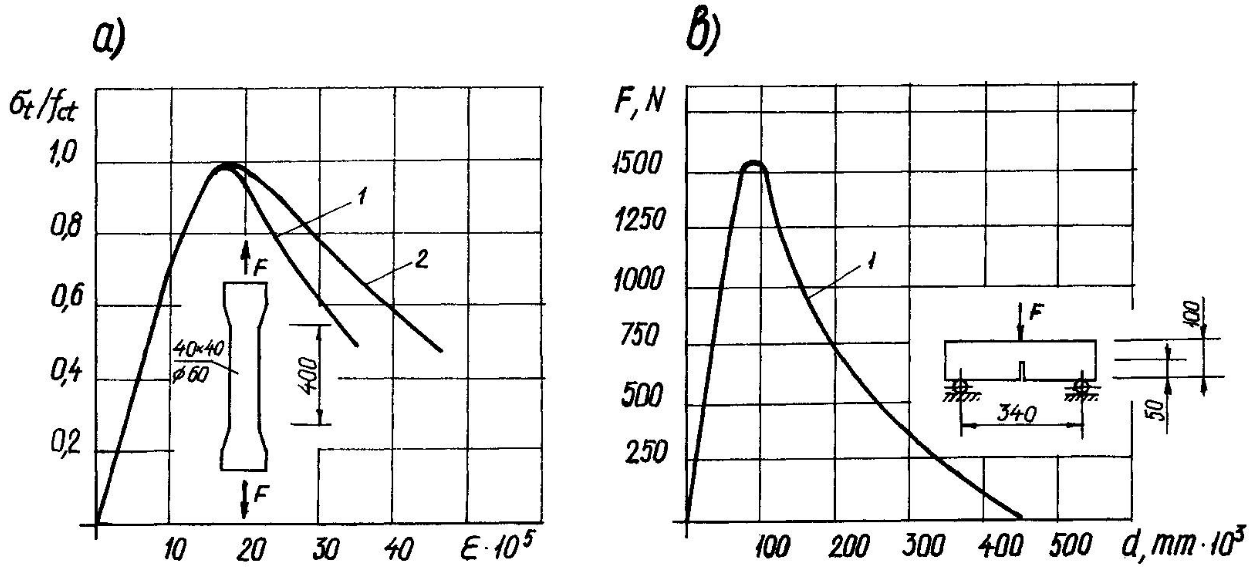


Fig. 2. A tensile (a) and a stable bending (b) tests of concrete (1) and reinforced concrete (2) specimens

f_c and f_{ct} - concrete compressive and tensile strength, respectively.

According to the theory of plasticity [1] the shear strength of concrete can be assumed as

$$f_v = \sqrt{\frac{\nu_{ct}}{\nu_c} f_c f_{ct} \left(\nu_c - 4\frac{\nu_{ct}}{\nu_c}\frac{f_{ct}}{f_c}\right)} , \qquad (4)$$

where ν_{ct} and ν_c - are the so called effectiveness factors for concrete in tension and compression, respectively.

The values of factors ν_{ct} and ν_c can be obtained by using the stress-deformation curves not only with ascending but also with descending branches, i.e. with the help of intensity of released energy of tensile concrete in fracture G_1 .

A non-linearity of the post-peak curve contributes substantially to the toughness and ductility of tensile concrete. An investigation of fracture mechanism of tensile concrete gives a possibility to understand the behavior of keyed joints in shear. Moreover, it helps to conceive the indispensable conditions leading to instantaneous cracking and collapsing of the keyed joints.

A tensile stress concentration in concrete due to internal cracking is noticed. If concrete is a sufficiently tough material the stress concentration does not lead to a sudden brittle failure of a single key and to a decrease of carrying capacity of wall-to--wall joints. It may be explained by the fact that the toughness property helps to absorb the released energy of cracking concrete. Owing to it a distribution of load effects occurs in the key system.

Twenty test sets were used to investigate the main mechanical and energetical properties of tensile loaded concrete C15...C20. Both notched and un-notched tensile and bending specimens were tested to study the tension behavior of concrete (Fig. 2).

According to the recommendation [2] the failure mechanism of tensile concrete may be described by two parameters (Table 1). The critical coefficient of stress intensity

$$k_1 = \sqrt{\pi \ell}\; f(\varsigma) , \qquad (5)$$

where $f(\varsigma)$ - function, characterizing a specimen configuration and loading technique.

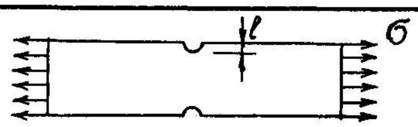
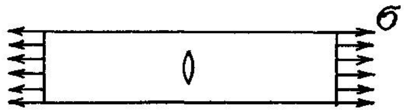
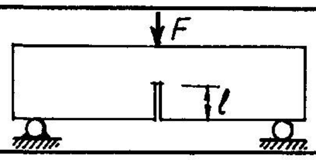
The intensity of released energy may be evaluated by the equation

$$G_1 = k_1^2 / E_c , \qquad (6)$$

where k_1 - coefficient by (5); E_c - modulus of elasticity of concrete. The intensity G_1 by (6) allows to calculate the values of factors ν_{ct} , ν_c and concrete shear strength f_v by (4) more accurately.

Table 1

Parameters of fracture criterion of concrete in tension

Loading technique	Loading diagram	k_1, $MN/m^{3/2}$	G_1, N/m
Centric tension		1,02	52
Centric tension		1,19	62,8
Three point bending		1,08	51,6

REFERENCES

1. Nielsen M.P. Limit Analysis and Concrete Plasticity. Prentice-Hall, Inc., Englewood Cliffs. New Jersey, 07632. 1982. 420 pp.
2. Siratory M., Miosy T., Macusita Ch., Vytchislitelnaia technika razrushenia. Moskva. Mir. 1986. 336 pp.

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