COMPARATIVE ANALYSIS BETWEEN TWO STANDARDS TCVN 5574:2018 AND TCVN 5574:2012

Part 2: Comparison of materials in two quality standards

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ABSTRACT

In the new standard TCVN 5574:2018, replacing TCVN 5574:2012, there are significant changes in structure, materials and calculation methods compared with the old version TCVN 5574:2012. The standard TCVN 5574-18 has approached EC2 and ACI standards to increase international integration, and it has also changed the perspective of computational modeling, converted from stress model to strain model. This article analyzes and compares two standards to highlight new points, helping designers to distinguish easily and conveniently apply TCVN 5574:2018 in practice. To achieve the goal, the authors organize into five main contents as follows: Part 1: Some general notes; Part 2: Comparison of materials in two quality standards; Part 3: Comparison of calculation methods in two quality standards; Part 4: Evaluation method and analysis of results.

Keyword: *TCVN 5574:2018, TCVN 5574:2012, Reinforced concrete, Standard, Strain model*

1. INTRODUCTION

The design standards of reinforced concrete structures of countries around the world are often updated and changed regularly. The period for updating and modifying is usually about every 3 years and renewal about every 10 years. The current standard for the design of concrete and reinforced concrete structures TCVN 5574:2018 [2] took effect from December 10, 2018, and replaces the old version of TCVN 5574:2012 [1]. TCVN 5574:2012 [1] was published in 2012. It has been moved from TCXDVN 356:2005 [3] and had been retained in its entirety, only renamed. Furthermore, TCXDVN 356:2005 is translated from the Russian standard SNIP 2.03.01-84 which was made more than 30 years ago. Thus, we had used too old standards compared with the progress of science and technology in the world. This problem had caused many inadequacies in the design process. Standard [1] stipulates the use of steels (such as CI, C-II, C-III...) according to the old standards before, so it is not linked with the new standards of Vietnam. as standard on current reinforcement steel, or prestressed steel (pre-stressed): TCVN 1651:2008 [4], TCVN 6284:1997 [5, 6, 7], TCVN 6288:1997 [8].

Therefore, to update new information in the field of design of concrete and reinforced concrete structures, standard [1] has been replaced by TCVN 5574:2018 [2]. This standard has been written mainly based on the Russian standard SP 63.13330.2012. With this approach, it will not cause much confusion in teaching and designing practice. In this new standard [2], it has many new points that deserve attention: the calculation perspective is changed from the stress model to the strain model (accepting the flat section assumption), calculating Puncture math and other new points are presented below.

2. MAIN CONTENT

The term "nonlinear strain model" is a computational model that takes into account the elastic-plastic properties of concrete in compression tension. Therefore, the relationship between stress and strain is not linear (constant), but linear for each segment; Replace the word "endurance grade" with "strength grade"; The limit applies to concrete with strength grades up to B100; Substitute the values of the working condition coefficient, conversion factor, and reliability factor (steel, concrete, load) so that the calculated strength of concrete is reduced; More types of reinforcement with different origins and features; The calculated intensity value is reduced. Both reinforcement and concrete use a confidence (safety) factor of 1.15, instead of multiple values as before. This problem facilitates the design as well as reduces confusion in use.

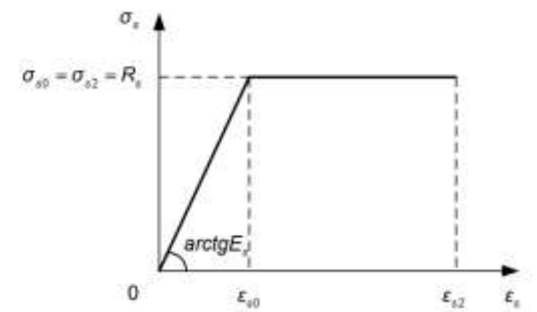
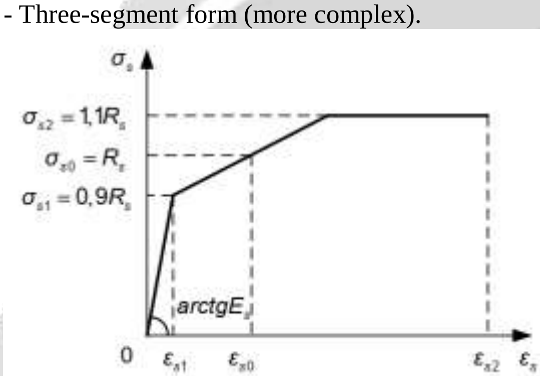
However, this factor is higher for reinforcements that have yield strength (the old standard was from 1.05 to 1.07) and lower for reinforcements that have yield strength. convention (the old standard was 1.2). This problem makes the calculated strength of reinforcement lower than actual reinforcement with yield strength and higher than that of reinforcement with conventional yield strength;

The values of the strain characteristics are significantly variable. The new standard [2], it uses strain diagrams of concrete and reinforcement for nonlinear calculations. The calculation according to the limited internal force, clearly specifies the deformation values (including limited deformation) of concrete and steel.

For reinforcement, in the new standard [2], it is allowed to use curve charts, approximate actual strain charts of reinforcement, but it is recommended to use two-segment diagrams in preference. straight line (for reinforcement with actual yield strength) and a three-segment diagram (for reinforcement with conventional yield strength).

Table 2. Material comparison

Numerical order	TCVN 5574:2018	TCVN 5574:2012 (356-2005)
1	Strength grade of heavy concrete under compressive: B15; 20; 25; 30; 35; 40; 45; 50; 55; 60; 70; 80; 90; 100	Strength grade of heavy concrete under compressive: 20; 25; 30; 35; 40; 45; 50; 55; 60;
2	Strength grade of heavy concrete under tension: B0.8; 1.2; 1.6; 2; 2.4; 2.8; 3.2; 3.6; 4	Strength grade of heavy concrete under tension: B0.8; 1.2; 1.6; 2; 2.4; 2.8; 3.2
3	$R_{b,n}$; $R_{b,ser}$: Standard strength of concrete under compression; constant; regulated to B100	$R_{b,n}$; $R_{b,ser}$: Standard only specified up to B60
4	$R_{bt,n}$; $R_{bt,ser}$: Standard strength of concrete under tension: reduced value, specified up to B100.	$R_{bt,n}$; $R_{bt,ser}$: Standard only specified up to B60
5	R_b: Calculated strength of concrete under compression; unchanged, specified to B100.	R_b: Standard only specified up to B60
6	R_{bt}: Calculated strength of concrete under tension; value increases, specified to B100 .	R_{bt}: Standard only specified up to B60
7	The limit relative strain value of concrete is precisely determined. - when the load is short-term: ε_{bo} **= 0.002** – axial compression**;** ε_{bto} **= 0.001** – axial drag. - when the load is acting long-term, see table 9: values of ε_{bo}, ε_{bto} are higher in the case of short-term loads.	This value is not specified.
8	E_b – Initial elastic modulus of concrete in compression, up to B100 – Table lookup.	The E_s lookup table has up to B60 – the value is almost the same
9	$E_{b,t}$ – Initial elastic modulus of concrete in tension (lower value) $E_{b,\tau} = \frac{E_b}{1+\varphi_{b,cr}}$ (2)	$E_{b,t} = E_b$ (3)

	$\varphi_{b,cr}$: The creep coefficient of concrete (see Table 11, according to the average moisture content (40-70%)) $E_{b,t} < E_b$	
10	Strain diagram of concrete according to linear deformation model (new standard similar to EC2 and ACI 318). - Two-segment form (most common).  Figure 1. Diagram of two straight segments of concrete when compressed. - Three-segment form (more complex).  Figure 2. Diagram of three straight segments of concrete when compressed. - Curve chart format, including descending branch: precise but complex, purely theoretical, rarely used (see appendix table of standard 5574-12). In which: The relationships σ - ε are established according to each selected line segment, changing each short-term or long-term applied load - see details. - This strain chart is also assigned to different compressive and tensile concrete. - Used for complex cross-sections, when calculating: + Reinforced concrete structure according to the first limit state. + According to the formation of cracks or widening of perpendicular cracks. + Calculation of deformation when the section is not cracked.	The deformation chart of concrete is not specified.
11	Reinforcing steel is denoted differently from TCVN 1651-1-2008 and 1651-2-2018. - CB 240T: 240 (210) Mpa and belt reinforcement 170Mpa. - CB 300T và CB300V: 300 (260) Mpa and belt reinforcement 210 Mpa - CB 400V: 400 (350) Mpa and belt reinforcement 260 Mpa - Cáp 12.7 và 15.2 1550 (1350) mpa Thus, the calculated strength of ordinary reinforcement of all kinds will now be taken lower.	Ordinary steel reinforcement: CI, AI: 235 (225) Mpa CII, AII: 295 (280) Mpa CIII, AIII: 390 (355) Mpa Cable 12.7 and 15.2: 1500 (1250) Mpa

3. CONCLUSIONS

The design standard of concrete and reinforced concrete structures TCVN 5574-18 has gradually approached the EC2 standard and a little approach to ACI (ε_b = 0.003). It has changed the view of computational modeling and has moved from the stress model to the strain model. This model is recommended to be used as a priority for calculation according to limit states (first and second) for members subjected to bending moments and longitudinal forces. It still allows úing the limited internal force method for members with simple cross-sectional shapes such as rectangle, T, and I.

TCVN 5574-18 has added: how to calculate steel for floors and walls; The breakdown calculation allows to take into account the influence of bending moments in both directions, which is different from the previous standard which has not been taken into account. The calculation of local compression is still the same as the previous model, but the calculation formula is adjusted.

TCVN 5574-12 has not been detailed, even omitted, so it was confusing to apply. As it did not state the establishment of calculation equations for members with any symmetrical cross-section, the establishment of calculation equations for other common cross-sections.

4. ACKNOWLEDGEMENT

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5. REFERENCES

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