ТЕОРЕТИЧНІ ОСНОВИ БУДІВНИЦТВА. НОВІТНІ ТЕХНОЛОГІЇ, КОНСТРУКЦІЇ ТА МАТЕРІАЛИ ДЛЯ БУДІВНИЦТВА, РЕКОНСТРУКЦІЇ ТА ВІДНОВЛЕННЯ БУДІВЕЛЬ І СПОРУД

UDC 624.014

COMPARISON OF CALCULATION AND SELECTION RESULTS OF THROUGH COMPOSITE CROSS-SECTION OF A CENTRALLY COMPRESSED FREESTANDING COLUMN ACCORDING TO UKRAINIAN AND EUROPEAN STANDARDS

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Problem statement. Design of metal structures in Ukraine until 01.07.2013 was done according to national normative documents only. However, after this date, it became legal to design and calculate metal structures according to European norms − Eurocode 3 "Design of metal structures" [1].

In the realities of today, due to the processes of active European integration of Ukraine, there is a necessity to correct the current construction normative documents and adapt them to the European standard. To do this, it is important to identify the differences and details in the calculation algorithms of both normative documents, and to analyse the differences in the results of calculations. This is what determines the relevance of this research topic [4].

The subject of our study is a comparison of the results of calculation and selection of through composite cross-section of a centrally compressed freestanding column according to DBN B.2.6-198:2014 "Steel structures. Design standards" and EN 1993-1-1 Eurocode 3: Design of steel structures − Part 1-1: General rules and regulations of buildings.

Research aim. The purpose of the research is to perform calculation and selection of through composite cross-section of a freestanding centrally compressed column according to DBN B.2.6-198:2014 and EN 1993-1-1, and to compare the results of calculations and cross-sections selection. And also, compare the results obtained with the results of similar comparison of continuous I-beam columns [4].

Research results. For the calculation the following initial data were taken: Freestanding centrally compressed column of 6 m height, vertical constant force 1000 kN, the force from its own weight is taken into account. The column is made of steel grade St3Gsp, which corresponds to steel C255 according to Ukrainian norms and S235 according to European norms. Column cross-sections consist of two channels with parallel edges of the flanges, the distance between the profiles was taken as two profile widths. The lattice consists of 10mm thick plates, 150mm wide with a step of 450mm. The scheme of the column is shown in Fig. 1.

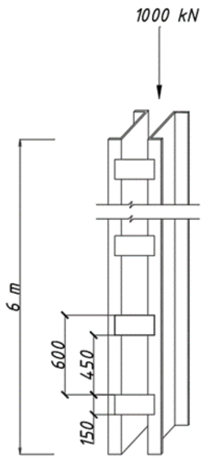
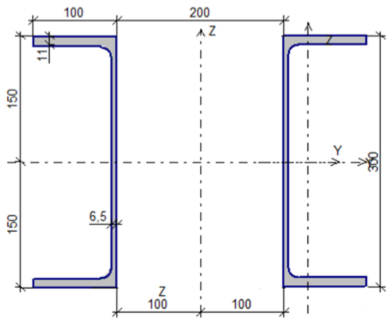
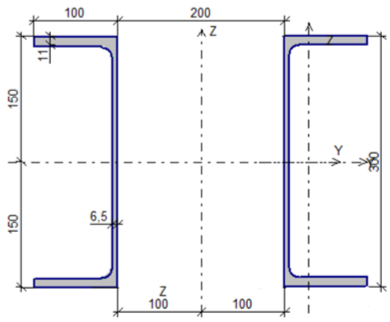


Fig. 1. Structural scheme of the column

The calculation was performed using SCAD Office Kristall 21.1.1.1.1 software. As a result of the calculation, we received the following results [2; 3]:

- Results of cross section selection:

<table>
<tr><th>DBN B.2.6-198:2014</th><th>EN 1993-1-1</th></tr>
<tr><td>
</td><td>
</td></tr>
<tr><td>Channel with parallel flanges 30П</td><td>Channel with parallel flanges 30П</td></tr>
</table>

- Calculation results with selected cross sections:

According to DBN B.2.6-198:2014

Check		Factor	
Overall stability of a bar under axial compression in XOY	Sec.8.1.3, 8.1.5	0,662	
Overall stability of a bar under axial compression in XOZ	Sec.8.1.3, 8.1.5	0,656	
Resistance of a batten to the shear force	Sec.8.2.7, 8.2.8	0,226	
Strength of chord under bending moment Mz	Sec.9.2.1	0,309	
Strength of chord under combined action of axial force and bending moments, no plasticity	Sec.10.1.1	0,94	
Stability of chord under compression in XOY plane	Sec.8.1.3	0,65	
Stability of chord under compression in XOZ plane	Sec.8.1.3	0,685	
Stability of chord in the moment Mz plane under eccentric compression	Sec.10.2.8	0,837	
Stability of chord in out of the moment Mz plane under eccentric compression	Sec.10.2.4, 10.2.5, 10.2.8	0,685	
Limit slenderness in XOY plane	Sec.13.4.1	0,141	
Limit slenderness in XOZ plane	Sec.13.4.1	0,127	

Utilisation factor – 0,94.

- According to EN 1993-1-1

Check	Factor	
Plastic resistance to longitudinal compression	0,882	
General loss of stability with respect to Y axis	0,914	
General loss of stability with respect to Z axis	0,885	
Shear strength with respect to Y axis	0,882	
Resistance to buckling under action of (N,My,Mz)	0,914	

Utilisation factor – 0,914.

Conclusion. According to the results of calculations it can be seen that the geometrical characteristics of both cross-sections are the same, but in calculation according to DBN B.2.6-198:2014 a bit higher value of utilisation factor was obtained compared to the results of calculation according to EN 1993-1-1.

However, when comparing the calculations of similar columns with a solid cross-section, the results were completely opposite: the result of the calculation according to the Ukrainian norms showed a lower value of the utilisation factor and a smaller size of the required cross-section compared to the European norms. And also, the calculation of the through-column was followed by a much more number of checks to calculate the utilisation factor [4].

Based on this, we can conclude that on the calculation of the through composite cross-section according to the Ukrainian norms, clarifying information about the degree of responsibility of the structure and other coefficients affect the increase of the final value, relative to the result of the calculation according to European norms, in contrast to the calculation of the column with a solid cross-section. This may indicate that the use of columns with a solid cross-section is more common in Ukraine [4].

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