CALCULATION TABLE FOR OBLIQUE ECCENTRIC COMPRESSION COLUMN BY INTERACTIVE CHART METHOD

Part 2 - Principles of building interactive charts according to current Vietnamese standards

Han Thi Thuy Hang[1], Tong Thu Huong[2,*], Phan Thi Van Huyen[3]

[1,2] *Faculty of Civil and Environment, Thai Nguyen University of Technology, Vietnam*
[3] *Faculty of Fundamental Sciences, Thai Nguyen University of Technology, Vietnam*

ABSTRACT

Interactive diagrams have been widely used in countries around the world and have been included in design standards such as ACI-318, BS-8110. In Vietnam, recent studies have also mentioned the construction of interactive charts to design reinforced concrete columns. The article researches to set up an automatic calculation table to calculate reinforcement for rectangular columns subjected to oblique eccentric compression. The author team also built a calculation table to check the bearing capacity of columns by the interactive chart method. many calculation examples were also conducted to verify the proposed calculation table and compare it with the calculation theory and the existing reinforcement calculation program. The author organizes the implementation according to the five main contents consist of: Part 1-Methodological content; Part 2-Principles of building interactive charts according to current Vietnamese standards; Part 3- Method of calculating reinforcement area; Part 4-Simulate the system on specialized software; Part 5- Evaluate calculation results.

Keyword: *Interactive chart, oblique eccentric compression, rebar calculation, bearing capacity, reinforced concrete column.*

1. INTRODUCTION

Reinforced concrete column structures subject to simultaneous effects of longitudinal forces and bending moments in both directions of the section is very common in multi-story building construction. In frame structural systems, columns supporting load-bearing beams are members subjected to both bending moment and compressive force, often they are called eccentric compression members. The column members in the frame will receive the load from the floors above, they transmit this load to the floors below and the building foundation through the foundation structure. If these compression-bearing members are not capable of bearing forces at adverse locations, they can cause damage to the entire structure. Damaged columnar structure in a building can cause more damage to people and property than horizontal load-bearing structures such as beams and bars. So the design is often calculated with a higher level of safety. Failures due to the compressive or brittle failure are more abrupt than plastic failure.

A column subjected to oblique eccentric compression is a column that is simultaneously subjected to an axial compression force N and a bending moment in the two directions Mx, My taken for the major axes of the section. Currently, there are several methods of calculating oblique eccentric columns such as: The additive method introduced by Moran, the reinforcement is calculated separately from (N, Mx)và (N, My), then add the results, detailed in [1]; Method to convert oblique eccentricity to internal flat eccentric [2], Bresler's test method is based on the idea of failure side [3], the method introduced by Row and Paulay [8] is to use directly the interaction diagram

for rectangular cross-section subjected to oblique eccentric compression. Each graph contains four quadrants, each of which corresponds to a load application angle. When the actual load angle does not coincide with the load angle in the chart, it must be interpolated.

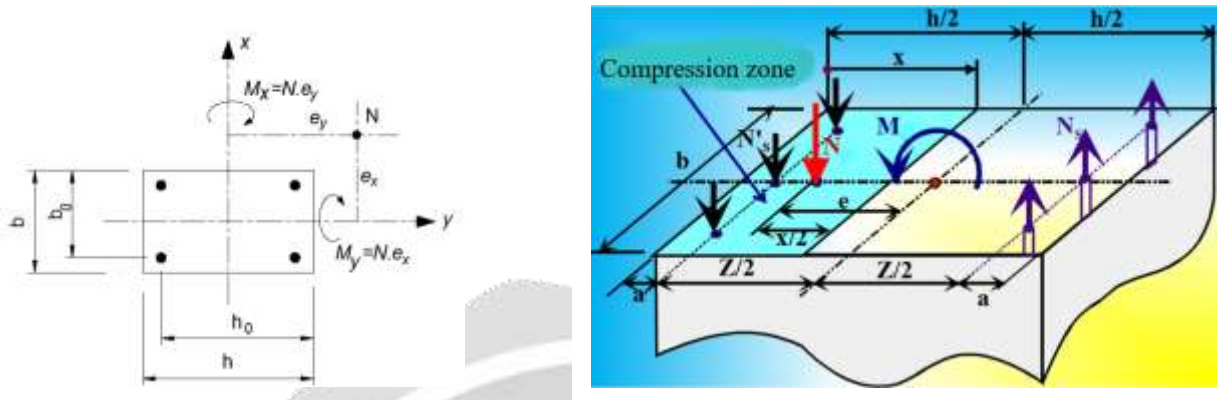

Figure 1. Cross-section of columns subjected to oblique eccentric compression

The internal force to calculate the column subjected to oblique eccentric compression is taken from the result of the load combination, in which it is necessary to pay attention to the following triples of internal forces (N, M_x, M_y):
+ N_{max} and M_x, M_y respectively
+ M_{ymax} and N, M_x respectively
+ M_x and M_y great value and N respectively.

2. METHODS OF IMPLEMENTATION

Assumptions: The compressive strength of concrete is conventionally defined as the compressive stress of concrete, equal to R_b and uniformly distributed over the compression zone of the section. Neglecting the behavior of tensile concrete, the flat section and reinforced concrete have the same strain at each position. The reinforcement is arranged evenly along the edges, the four corners of the column are all placed with steel.

$$N_u = R_b bx - \sum \sigma_{si} A_{si} \quad (1)$$

$$M_u = N_u \eta e_0 = R_b bx\left(\frac{h}{2} - \frac{x}{2}\right) + \sum \sigma_{si} A_{si} z_{si} \quad (2)$$

$$\sigma_{si} = \frac{\sigma_{sc,u}}{1 - \frac{\omega}{1,1}}\left(\frac{\omega}{\xi_i} - 1\right) \quad (3)$$

$$\xi_i = \frac{x}{h_{0i}} \quad (4)$$

In which: N_u - limiting compressive force, M_u - limiting moment in the plane containing side h, η - coefficient taking into account the effect of longitudinal bending, R_b - calculated compressive strength of concrete. σ_{scu} = 500 (MPa), ω = – 0,85 - 0,008Rb , h_{0i} is the distance from the centroid of the ith steel layer to the compression edge, if $\sigma_{si} < 0$ the i reinforcement layer is in compression, if $\sigma_{si} > 0$ the i reinforcement layer is in tension.

Calculation principles: Let parameter x change from 0 to h_o step by step 0.1.h_o.
For concrete: Calculate $N_b=R_b bh_o$ x and $M_b= R_b bh_o^2$ x***(1-***x***)****/2* with x=x/h_o,
For reinforcement in tension zone A_S: With the assumption that the tensile stress σ_s does not exceed R_S
herefore, when x (small): $\xi \le \xi_R$ then $\sigma_s = R_S$: Big eccentricity

when x (large): $\xi > \xi_R$ then $\sigma_s < R_S$: Small eccentricity until $\sigma_s = 0$ then switch to compressed $\sigma_s < \boldsymbol{0}$ we can consider it a very small eccentric state (or little). When $x=h_o$**:** $\xi = 1$: the reinforcement reaches the maximum compressive value $\sigma_s = -R_S$.

Compression zone types: When the compression zone limit line is on the top right point, the entire concrete is in tension, then it will fall into the case of eccentric tension. Thus, to ensure that the cross-section is subjected to eccentric compression, there are only 5 types of compression zones of concrete as shown below.

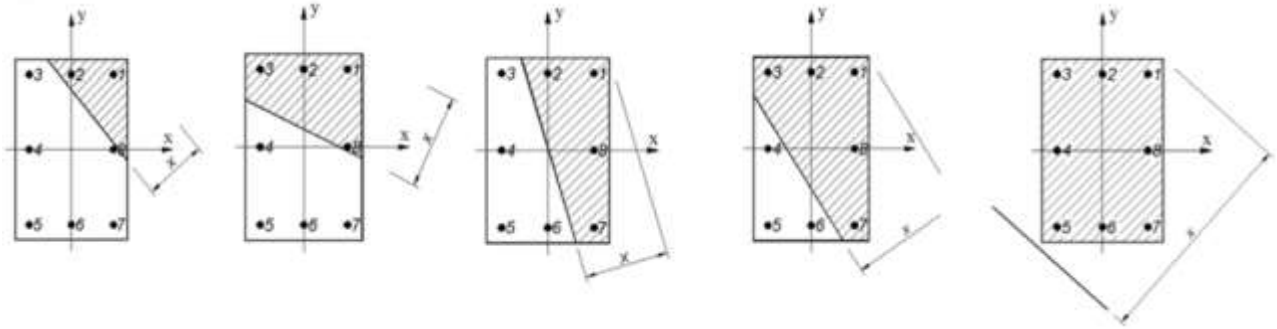

Figure 2. Types of compression zones

3. CONCLUSIONS

In this article, the principle of building interactive charts according to Vietnamese standards has been implemented. In addition, the Calculation of column reinforcement subjected to oblique eccentric compression is known as follows. When converting, the intermediate steel is increased by one and removed from the main bearing steel bar. It can be understood simply that the four corner plates of steel will work in the main bearing direction. Still, each bar only has ¾ section, and ¼ is shared for the intermediate edge, and then we have the reinforcement distributed according to the circumference (m2/m). In this way, when calculating the eccentricity in one direction, we have considered the work of the reinforcement in the direction perpendicular to it.

4. ACKNOWLEDGEMENT

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