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YULE ANNI DOURADO MARTARELLO

ANALYTICAL INVESTIGATION OF THE BEHAVIOR OF COMPACT AND NON-COMPACT CIRCULAR TUBULAR COMPOSITE COLUMNS UNDER AXIAL COMPRESSION

Ilha Solteira
2025

POST-GRADUATE PROGRAM IN CIVIL ENGINEERING

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Dissertation presented to the São Paulo State University (UNESP), School of Engineering, campus of Ilha Solteira, in fulfillment of one of the requirements for obtaining the Master's degree in Civil Engineering.
Area of knowledge: Civil Construction Engineering.

Supervisor:
Prof. Dr. Emerson Alexandro Bolandim.

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IMPACTO POTENCIAL DESTA PESQUISA

O impacto desta pesquisa reside na realização de análises analíticas para a compreensão sobre o comportamento de pilares mistos tubulares circulares não-compactos submetidos à compressão axial, por meio da avaliação comparativa entre os resultados obtidos a partir de normas técnicas brasileiras e internacionais e dados experimentais. A identificação do nível de precisão e conservadorismo de cada norma contribui para aprimorar os critérios de dimensionamento desses elementos estruturais, resultando em projetos mais eficientes, seguros e econômicos. Os resultados podem subsidiar futuras revisões normativas, promovendo a otimização do uso de materiais e a redução do impacto ambiental, especialmente em obras de infraestrutura e em situações de altas demandas estruturais.

POTENTIAL IMPACT OF THIS RESEARCH

The impact of this research lies in conducting analytical evaluations to understand the behavior of non-compact circular concrete-filled steel tubular columns under axial compression, through a comparative assessment between results obtained from Brazilian and international design standards and experimental data. Identifying the level of accuracy and conservatism of each standard contributes to improving the design criteria for these structural elements, leading to more efficient, safe, and cost-effective projects. The findings may support future code revisions, promote material optimization and reduce environmental impact, particularly in infrastructure works and in scenarios with high structural demands.

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ABSTRACT

Structural elements ensure the stability of buildings by supporting various loads while preserving functionality and aesthetics. Concrete-filled steel tubular (CFST) columns combine the advantages of both materials, offering high load-bearing capacity, excellent seismic performance, and reduced self-weight compared to reinforced concrete columns. The circular section provides effective concrete confinement, delays local buckling, and enhances structural ductility. However, due to the higher slenderness of non-compact sections, their design requires more complex analytical evaluation. In this context, the present study investigates the behavior of compact and non-compact circular CFST columns subjected to axial compression through analytical approaches and comparison with experimental results, using design models from eight international standards. The literature review enabled the compilation of a comprehensive database and the implementation of a calculation tool based on these standards. The database included 1,580 experimental CFST columns covering a wide range of geometric and material parameters. The results demonstrate that the accuracy of normative models is strongly influenced by section slenderness limits, where the discrepancy between experimental and analytical results highlights the need for more refined formulations. The mean ratios between calculated and experimental axial resistances (N_{calc} / N_{exp}) indicated distinct levels of conservatism among the standards. About de compact columns, the Canadian and Australian/New Zealand standards were the most conservative, with mean values of 0.697 and 0.772, respectively. The first presented relatively low coefficients of variation (16%), but for the second standard, the coefficient of variation showed high dispersion (30%). Conversely, the Eurocode 4 and Chinese standards tended to overestimate the load-carrying capacity, especially for non-compact sections, with mean values of 1.176 and 0.959, and higher variability (CV = 41% and 26%, respectively). The updated Brazilian and American standards presented intermediate performance, with mean ratios of 0.808 and 0.806 and CVs of 17%, demonstrating satisfactory agreement with experimental results and balanced conservatism. For non-compact columns, the average ratios were generally higher, confirming that most standards underestimate experimental strengths to a greater extent in slender geometries. Among them, the Australian/New Zealand standard exhibited the lowest coefficient of variation (CV = 13%), indicating high consistency in its predictions. The American and the updated Brazilian standard followed, with slightly higher but still acceptable variability (CV = 17% and 18%, respectively). However, the coefficients of variation remained relatively similar between compact and non-compact groups, indicating that cross-section slenderness primarily affects the accuracy of predictions rather than their dispersion. Overall, the analytical evaluation highlights the sensitivity of CFST column predictions to section slenderness, the definition of local buckling limits, and the consideration of confinement effects, emphasizing the need for refined design provisions for non-compact CFST columns and the development of more accurate and efficient international standards.

Keywords: circular tubular composite columns; non-compact sections; axial compression; analytical model.

RESUMO

Os elementos estruturais garantem a estabilidade das edificações ao suportarem diversas cargas, preservando a funcionalidade e a estética. Os pilares mistos tubulares de aço preenchidos com concreto (CFST) combinam as vantagens de ambos os materiais, oferecendo elevada capacidade resistente, excelente desempenho sísmico e menor peso próprio em comparação aos pilares de concreto armado. A seção circular proporciona confinamento efetivo do concreto, atrasa a flambagem local e aumenta a ductilidade estrutural. No entanto, devido à maior esbeltez das seções não-compactas, o dimensionamento dessas peças requer avaliações analíticas mais complexas. Nesse contexto, o presente estudo investiga o comportamento de pilares mistos tubulares circulares compactos e não-compactos submetidos à compressão axial, por meio de abordagens analíticas e da comparação com resultados experimentais, utilizando modelos de cálculo de oito normas internacionais. A revisão bibliográfica possibilitou a compilação de um banco de dados abrangente e o desenvolvimento de uma ferramenta de cálculo baseada nessas normas. O banco de dados incluiu 1580 pilares mistos CFST experimentais, abrangendo uma ampla faixa de parâmetros geométricos e de materiais. Os resultados demonstram que a precisão dos modelos normativos é fortemente influenciada pelos limites de esbeltez das seções, onde a discrepância obtida entre os resultados experimentais e analíticos evidenciam a necessidade de formulações mais refinadas. Os valores médios entre as resistências axiais calculadas e experimentais (N_{calc} / N_{exp}) indicaram diferentes níveis de conservadorismo entre as normas analisadas. Para pilares mistos compactos, as normas canadense e australiana/neozelandesa foram as mais conservadoras, com valores médios de 0,697 e 0,772, respectivamente. A primeira, apresentou coeficiente de variação relativamente baixos (16%), porém para a segunda norma, o coeficiente de variação apresentou alta dispersão (30%). Por outro lado, as normas europeia e chinesa tenderam a superestimar a capacidade resistente, especialmente para seções não-compactas, com valores médios de 1,176 e 0,959 e maior variabilidade (CV = 41% e 26%, respectivamente). A norma brasileira recente e americana apresentaram desempenho intermediário, com razões médias de 0,808 e 0,806 e CVs de 17%, demonstrando boa concordância com os resultados experimentais e um conservadorismo equilibrado. Para pilares mistos não-compactas, os valores médios foram mais elevadas, confirmando que a maioria das normas tende a subestimar as resistências experimentais em maior grau em geometrias esbeltas. Entre elas, a norma australiana/neozelandesa apresentou o menor coeficiente de variação (CV = 13%), indicando alta consistência em suas previsões. As normas americana e brasileira atualizada apresentaram valores ligeiramente superiores, mas ainda dentro de uma variabilidade aceitável (CV = 17% e 18%, respectivamente). No entanto, os coeficientes de variação permaneceram relativamente próximos entre os grupos de seções compactas e não-compactas, indicando que a esbeltez da seção transversal afeta principalmente a precisão das previsões, e não sua dispersão. De modo geral, a avaliação analítica evidencia a sensibilidade das previsões de pilares mistos CFST à esbeltez da seção, à definição dos limites de flambagem local e à consideração dos efeitos de confinamento, ressaltando a necessidade de aprimoramento das prescrições normativas para pilares mistos CFST não-compactas e do desenvolvimento de normas internacionais mais precisas e eficientes.

Palavras-chave: pilares mistos tubulares circulares; seções não-compactas; compressão centrada; modelo analítico.

SUMMARY

1 INTRODUCTION

This chapter presents a brief introduction about the composite construction system, defining the composite column and outlining the objective, justification, methodology, and organization of this research.

1.1 GENERALITIES

Structural elements play a fundamental role in any building, ensuring the integrity and stability of the various types of construction systems. They are designed to sustain and distribute applied loads, ranging from self-weight to external loads such as wind and other actions forces.

The interaction between structural elements is essential to ensure safety but also preserves the functionality and aesthetics of constructions. In Brazil, reinforced concrete stands out as the most widely used construction system due to its high compressive strength, ease of execution, and practicality in handling (Fakury; Silva; Caldas, 2016; Queiroz, 2003).

The steel construction system offers several advantages for the construction industry. However, its use in Brazil remains limited due to the high costs associated with the material. As an industrialized material, steel is subject to the economic instability of raw materials, which directly affects its economic feasibility (Serafim *et al.,* 2016; Xue; Briseghella; Chen, 2012).

Additionally, steel shows a fast decrease in strength at high temperatures, such as during fire scenarios. This behavior is attributed to its high thermal conductivity and thermal expansion, which lead to a reduction in its modulus of elasticity and an increase in plastic deformation. Another limitation is its susceptibility to corrosion, which compromises its tensile and compressive strength (Abed; Alhamaydeh; Abdalla, 2013; Caldas, 2004 Sieczkowski, 2012; Uy, 1998).

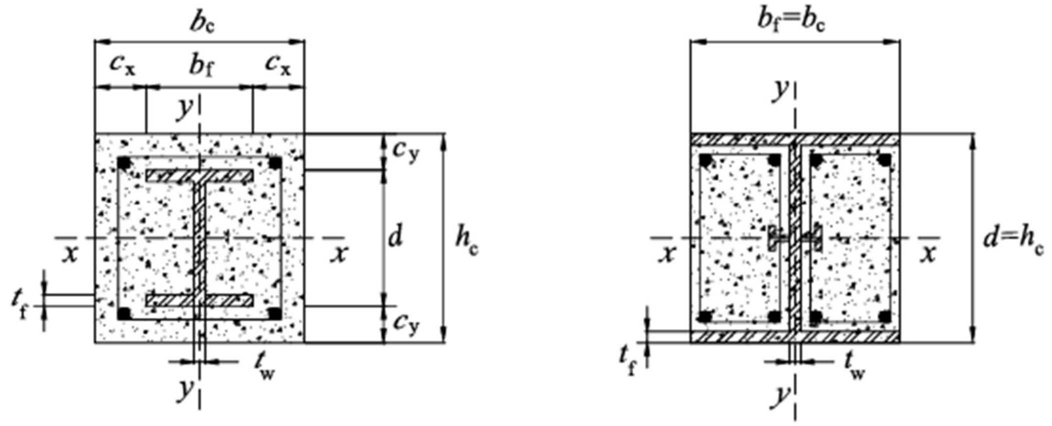
To deal with these challenges, the need to combine steel with concrete emerged. This solution aims to reduce costs, optimize space, and ensure greater structural safety. Additionally, the composite action between steel and concrete significantly contributes to the overall stability of the structure, particularly under compressive and lateral loads. In this system, it is crucial to ensure the interaction between the two materials, which can occur through friction or mechanical means (Caldas, 2004; Queiroz, 2003).

This combination allows both materials to work together efficiently, leveraging their complementary characteristics. Steel provides tensile strength, while concrete offers compressive strength and greater stiffness. Together, they enhance structural performance compared to the conventional reinforced concrete construction system (Fakury; Silva; Caldas, 2016; Caldas, 2004; Queiroz, 2003).

1.2 COMPOSITE COLUMNS

Composite columns consist of a structural steel profile that is either encased in or filled with concrete. According to NBR 8800 (ABNT, 2024), composite columns can be classified into four categories: steel profile completely encased in concrete (Figure 1.1a), steel profile partially encased in concrete (Figure 1.1b), concrete-filled steel tube with rectangular cross-section (Figure 1.2a), and concrete-filled steel tube with circular cross-section (Figure 1.2b).

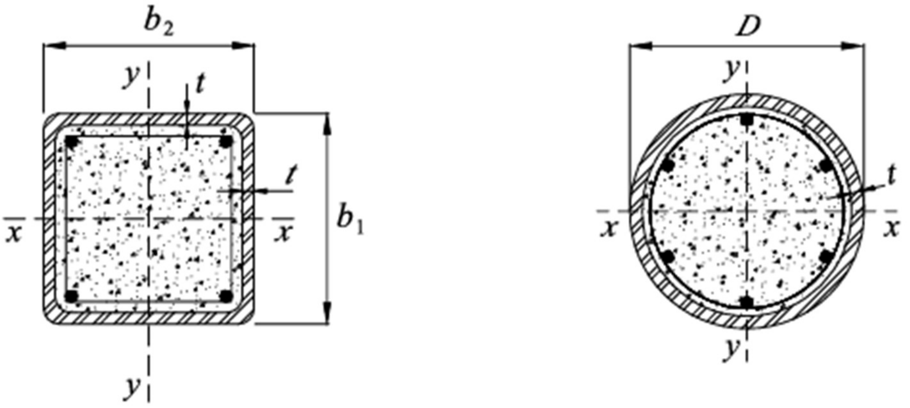
Figure 1.1 – Steel composite column encased completely and partially in concrete



a) Concrete Encased Section b) Partially Concrete Encased Section

Source: NBR 8800 (ABNT, 2024)

Figure 1.2 – Concrete-filled steel composite column, rectangular and circular cross-sections



a) Rectangular Section b) Circular Section

Source: NBR 8800 (ABNT, 2024)

The completely encased composite column is one in where the concrete completely encases the steel profile, making it impossible to see the profile. The partially encased composite column, on the other hand, is a type in which a steel profile is partially embedded in concrete.

The concrete-filled steel composite column features an external steel profile that serves as formwork for the concrete. The standard further divides these columns into two categories: rectangular and circular cross-sections; while also addressing other potential shapes, such as square and oval sections.

According to NBR 8800 (ABNT, 2008), concrete-filled steel composite columns can be manufactured without additional reinforcement, except in specific situations, such as fire conditions. Fully or partially encased composite columns, however, must include longitudinal and transverse reinforcements to ensure the integrity of the concrete. According to NBR 8800 (ABNT, 2024), the longitudinal reinforcement area must correspond to at least 0.4% of the concrete area.

NBR 8800 (ABNT, 2008) specifies that the composite column's strength must be achieved without the occurrence of local buckling of the steel profile in the cross-section, making it essential to classify the section to identify potential instabilities. This standard provides two classifications for the cross-section of composite columns: compact or non-compact. The updated NBR 8800 (ABNT, 2024) introduces a refined classification for non-compact composite steel columns filled with concrete, categorizing them as compact, semi-compact, or slender based on their cross-section. This classification is essential for properly accounting for instabilities and serves as the basis for the column's design and structural behavior analysis.

In compact sections, the geometry and dimensions of composite columns are such that the local slenderness ratio (*D/t*) remains within the limits prescribed by design standards. This condition allows the section to develop its full plastic strength before the onset of local instabilities, such as local buckling. As a result, the column can undergo significant plastic deformation, leading to a more uniform stress distribution and a delayed occurrence of buckling (Uy, 1998).

Non-compact cross-sections, however, have geometry and dimensions that prevent composite columns from reaching their maximum strength before local instability occurs. When the slenderness ratio (*D/t*) exceeds the normative limits. Certain standards, such as NBR 8800 (ABNT, 2024), AISC 360 (ANSI, 2022), and AS/NZ 5100.6 (2017), further classify these sections as semi-compact or slender, considering their influence on structural stability and resistance to local buckling.

Semi-compact sections can sustain loading beyond the elastic limit before local instability occurs, but do not reach their full plastic strength. They represent an intermediate state between compact and slender sections, exhibiting plastic local buckling in parts of the steel profile.

Slender sections, on the other hand, exhibit elastic buckling due to the relatively thin steel thickness compared to the diameter. This makes them prone to local instability before developing significant plastic deformations, reducing their load capacity.

Therefore, understanding the classification of composite column cross-sections is essential not only for accurate strength assessment but also for the development of efficient structural designs. These classifications directly influence the structural response under axial loads and are fundamental in guiding the application of design codes and the interpretation of failure mechanisms in composite columns.

1.3 OBJECTIVE

The main objective of this study is to evaluate the predictive capacity of design standards for concrete-filled steel tubular columns subjected to axial compression, with emphasis on compact and non-compact circular sections. The research focuses on the comparative analysis between analytical results obtained from main current standards and experimental data.

The specific objectives are:

- To compile and organize a database of experimental results on CFST columns;
- To implement a calculation tool in Excel to determine the axial compression resistance according to Brazilian (ABNT, 2008; ABNT, 2013; ABNT, 2024), American (ANSI, 2022), European (CEN, 2004), Canadian (CISC 2015), Chinese (2014), and Australian (BD, 2017) standards;
- To compare the analytical predictions of the standards with the experimental results in the database;
- To identify and point out the possible divergences between the standards' analytical models.

1.4 JUSTIFICATION

Despite significant advantages, such as lightweight construction and reduced steel consumption, composite columns face challenges related to local and global stability, especially in non-compact sections, which are more susceptible to buckling. In addition to the lack of studies about these instabilities, few investigations have been found that consider initial geometric and material imperfections, analyzing their effects on the behavior of composite columns with non-compact sections (Abed; Alhamaydeh; Abdalla, 2013; Fakury; Silva; Caldas, 2016; AISC 360, 2022; DG6, 2025).

Initially, design standards for composite columns addressed only compact sections. However, with updates to these standards, non-compact sections have been recently incorporated into their scope.

Given the growing use of composite columns, due to their efficiency in combining steel and concrete to optimize rigidity, stability, and durability in buildings, there is a need to gain a deeper understanding of the behavior of those with non-compact sections when subjected to compression loads.

The accuracy of these standards in estimating the load-bearing capacity of composite columns still requires thorough investigation to assess the level of conservatism in each standard (Kvocak *et al*., 2023).

Thus, this study is motivated by the need to evaluate discrepancies between the calculations prescribed by national and international standards and the experimental values, considering the susceptibility to instability in the design of concrete-filled steel composite columns. This aspect is crucial for ensuring the structural stability of buildings.

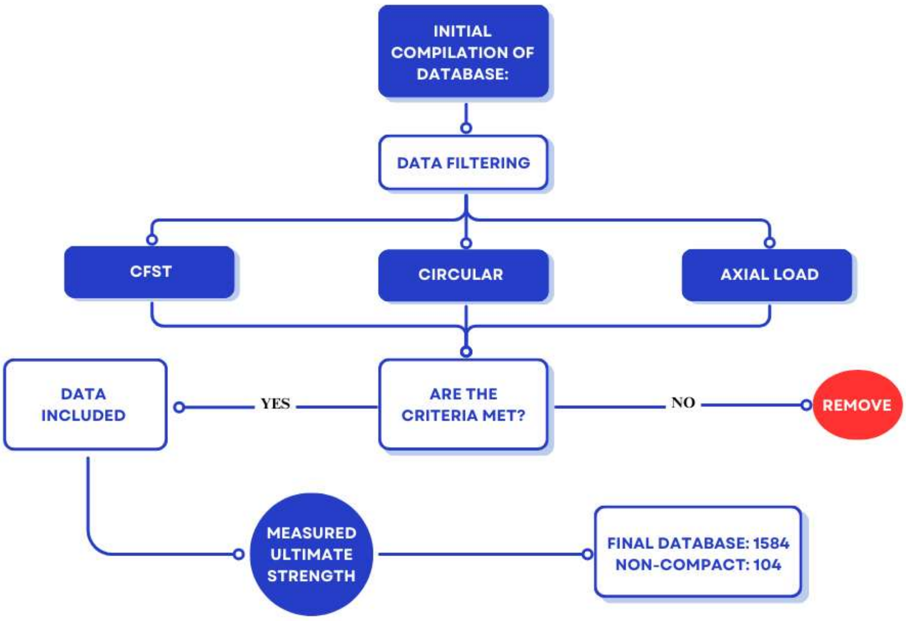
Although many studies are based on analytical approaches, few consider more than three standards. Therefore, a broader comparison is needed, highlighting the differences among the main standards and identifying those that overestimate or underestimate the calculated results. Accordingly, this research examines the most frequently cited standards, selecting the Brazilian standard along with five international ones: American, European, Canadian, Chinese, and Australian standards.

1.5 RESEARCH STRATEGY

Based on an extensive and robust search for relevant studies, a systematic literature review was conducted on the topic under investigation, encompassing the main existing databases.

Following this, the organization of the database used in the study was carried out, as presented in Figure 1.3, based on specific criteria to select the composite columns of interest for this research. The composite columns must consist of a steel tube filled with concrete, with circular cross-sections, and subjected to axial compression loads.

Figure 1.3 – Flowchart of the methodological steps



Source: The author

Composite columns that meet these criteria were included in the database and subsequently applied to the calculation tool. The analytical evaluation continues with the following standards: NBR 8800 (ABNT, 2008), NBR 8800 (ABNT, 2024), NBR 16239 (ABNT, 2013), the American standard AISC 360 (ANSI, 2022), the European standard EN 1994-1-1 (CEN, 2004), the Canadian standard CSA S16 (CISC, 2015), the Chinese standard GB 50936 (2014), and the Australian/New Zealand standard AS/NZS 5100.6 (BD, 2017).

All these standards provide calculation procedures for concrete-filled steel composite columns, subjected to axial compression. Finally, a comparison was conducted between the values obtained using the calculation tool and the experimental results from the database.

1.6 MASTER THESIS OUTLINE

In Chapter One, the subject of the research is introduced to contextualize the problem.

In addition to this chapter, the study is divided into five more chapters, structured as follows:

Chapter Two discusses the literature review on concrete-filled steel composite columns, focusing on circular tubular columns. It highlights their advantages, failure modes, the implications of initial geometric and material imperfections, and the calculation procedures outlined in the technical standards addressed.

Chapter Three presents the state of the art regarding studies on composite steel columns filled with concrete, based on a systematic literature review.

Chapter Four contains the calculation framework for determining the axial resistance force according to each standard.

Chapter Five provides the results obtained from the calculation tool developed in Excel.

Chapter Six discusses the results in comparison with the experimental data, followed by the conclusions of this research and suggestions for future studies.

6 CONCLUSION

In this study, the axial compression behavior of compact and non-compact circular concrete-filled steel tubular (CFST) columns was investigated through an analytical approach, comparing the predictive capacity of eight major design standards with experimental data. The database extracted from the studies cited above, was compiled for this purpose, including 1,584 composite columns collected from 107 independent studies, of which 104 were classified as non-compact.

The results revealed significant variability in the conservatism of the standards analyzed. The updated Brazilian NBR 8800 (ABNT, 2024), the American AISC 360 (ANSI, 2022), and the Australian AS/NZ 5100.6 (BD, 2017) exhibited conservative behavior, with calculated strengths lower than the experimental ones. In contrast, the Eurocode 4 (CEN, 2004) and the Chinese GB 50936 (2014) tended to overestimate the load-carrying capacity, showing fewer conservative predictions. The CSA S16 (CISC, 2015) and AS/NZ 5100.6 (BD, 2017) were the most conservative overall, while compact sections demonstrated better agreement with experimental results, indicating that the predictive accuracy of design standards decreases as section slenderness increases.

The influence of section stiffness is evident, as non-compact columns presented higher mean deviations. However, the standard deviations were similar between compact and non-compact sections, suggesting that compactness affects accuracy but not the consistency of the predictions. Thus, the discrepancies observed, particularly for non-compact sections, highlight the limitations of current analytical models in accurately representing the behavior of slender CFST geometries.

It is important to note that the database used in this study presents inherent limitations that may influence the generalization of the results. Variations in testing procedures, boundary conditions, material characterization, and measurement techniques among the 107 experimental studies may have introduced inconsistencies. Furthermore, incomplete information regarding geometric dimensions, material properties, or loading configurations restricted the inclusion of certain parameters in the comparative analyses. Differences among the design codes, especially in the definition of local slenderness limits, classification criteria, and confinement considerations, also contributed to discrepancies in the results. The limited number of non-compact specimens further reduced the statistical robustness of the conclusions drawn for this category.

Despite these limitations, the database provided a valuable and comprehensive foundation for measuring the predictive performance of international design standards, offering consistent insights into behavior of CFST columns under concentric compression. The findings contribute to a more accurate understanding of the behavior of non-compact composite columns and may guide the development of safer and more efficient design practices.

Finally, future research is recommended to incorporate numerical simulations using Abaqus software to explore the effects of geometric imperfections, post-buckling behavior, and the prediction of load capacity in non-compact CFST sections with greater precision.

REFERÊNCIAS

ABED F. ALHAMAYDEH M. ABDALLA S. Experimental and numerical investigations of the compressive behavior of concrete filled steel tubes (CFSTs). **Journal of Constructional Steel Research**. Sharjah v. 80 p. 429–439. 2013. https://doi.org/10.1016/j.jcsr.2012.10.005.

AGHDAMY S.; THAMBIRATNAM D. P.; DHANASEKAR M.; SAIEDI S. Computer analysis of impact behavior of concrete filled steel tube columns. **Advances in Engineering Software**. Australia v. 89 p. 52–63. 2015. https://doi.org/10.1016/j.advengsoft.2015.06.015.

AL-ANI Y. R. Finite element study to address the axial capacity of the circular concrete-filled steel tubular stub columns. **Thin-walled Structures.** Iraque v. 126 p. 2–15. 2018. https://doi.org/10.1016/j.tws.2017.06.005.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION. **ANSI/AISC 360:** Specification for Structural Steel Buildings. USA: AISC 2022.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION. **Design Guide 6**: Composite Column Design. 2. ed. Chicago IL: AISC 2025.

ASSOCIAÇÃO BRASILEIRA DE NORMAS TÉCNICAS. **ABNT NBR 16239:** Projeto de estruturas de aço e de estruturas mistas de aço e concreto de edificações com perfis tubulares. Rio de Janeiro: ABNT 2013.

ASSOCIAÇÃO BRASILEIRA DE NORMAS TÉCNICAS. **ABNT NBR 6023**: Informação e documentação - Referências - Elaboração. Rio de Janeiro: ABNT 2018.

ASSOCIAÇÃO BRASILEIRA DE NORMAS TÉCNICAS. **ABNT NBR 6118**: Projeto de estruturas de concreto — Procedimento. Rio de Janeiro: ABNT 2014.

ASSOCIAÇÃO BRASILEIRA DE NORMAS TÉCNICAS. **ABNT NBR 8800:** Projeto de estruturas de aço e de estruturas mistas de aço e concreto de edifícios. Rio de Janeiro: ABNT 2008.

ASSOCIAÇÃO BRASILEIRA DE NORMAS TÉCNICAS. **ABNT NBR 8800:** Projeto de estruturas de aço e de estruturas mistas de aço e concreto de edifícios. Rio de Janeiro: ABNT 2024.

AUSTRALIAN STANDARD. **AS/NZS 5100.5 – Bridge Design – Part 6**. Concrete. Australia: 2017

AUSTRALIAN STANDARD. **AS/NZS 5100.6 – Bridge Design – Part 6**. Steel and composite construction. Australia: 2017

AYOUGH P.; WANG Y. H. ZENG W.; HASSANEIN M. F.; ELCHALAKANI M. Numerical investigation and design of concrete-filled double square steel tube columns under axial compression. **Journal of Constructional Steel Research**. [S.I] v. 212 p. 1–20. 2024. https://doi.org/10.1016/j.jcsr.2023.108277.

AZNAR J. M. de la P. Implicaciones de la norma G40.20 de la Asociación de Normalización Canadiense (CSA) sobre la fabricación de perfiles huecos estructurales (PHE). **Informes de la Construcción** v. 32 n. 319 abr. 1980.

BAOCHUN. C.; HIROSHI. H. Eccentricity ratio effect on the behaviour of eccentrically loaded CFST columns. *In*: PROCEEDINGS ASSCCA'03 INTERNATIONAL CONFERENCE ADVANCES IN STRUCTURES (ASCCS-7). Sydney. Australia. 2003. p. 871–875.

BECK. A. T.; OLIVEIRA. W. L. A.; NARDIN. S. de; ELDEBS. A. L. H. C. Reliability-based evaluation of design code provisions for circular concrete-filled steel columns. **Engineering Structures**. v. 31. n. 10. p. 2299–2308. Oct. 2009. Doi: 10.1016/j.engstruct.2009.05.004.

BENEDETTY C. A.; SANTOS V. B. dos.; KRAHL P. A.; ROSSI A.; SILVA F. de A.; CARDOSO D. C.T.; MARTINS C. H. Flexural and shear behavior of steel-UHPC composite beams: a review. **Engineering Structures** v. 293 p. 1166-1187 2023. DOI: doi.org/10.1016/j.engstruct.2023.116649

BERGMANN. R. Load introduction in composite columns filled with high strength concrete. *In*: TUBULAR STRUCTURES VI. PROCEEDINGS OF THE SIXTH INTERNATIONAL SYMPOSIUM ON TUBULAR STRUCTURES. Melbourne. Australia. 14–16 Dec. 1994. Grundy. P.; Holgate. A.; Wong. B. (eds.). **Rotterdam**: A. A. Balkema. 1994. p. 373–380.

BRADFORD M. A.; LOH H. Y.; UY B. Slenderness limits for filled circular steel tubes. **Journal of Constructional Steel Research**. Australia v. 58 p. 243–252. 2002.

BRAGA J. J. V. **Modos de falha e previsão da resistência de vigas casteladas de aço do tipo litzka travadas lateralmente**. 2021. 226 f. Tese (Doutor em Engenharia civil) – Pontifícia Universidade Católica do Rio de Janeiro Rio de Janeiro 2021

CAI. S. H. A study on basic behaviour and strength of concrete-filled steel tubular short column. **Structural Institute of China Building Research Academy**. 1984.

CAI. S. H.; GU. W. L. Behaviour and ultimate strength of long concrete-filled steel tubular columns. **Journal of Building Structures**. p. 32–40. 1985.

CAI. S.; JIAO. Z. Behaviour and ultimate strength of short concrete-filled steel tubular columns. **Journal of Building Structures**. p. 13–29. 1984.

CALDAS R. B. **Análise numérica de pilares mistos aço-concreto**. 2004. 220 f. Dissertação (Mestre em Engenharia Civil) - Universidade Federal de Ouro Preto Ouro Preto 2004.

CANADIAN STANDARDS ASSOCIATION. **CISC CSA S16:** Design of Stell Structures. Canadá: CSA 2015.

CANADIAN STANDARDS ASSOCIATION. **CISC CSA S16:** Design of Stell Structures. Canadá: CSA 2009.

CHANG. X.; FU. L.; ZHAO. H.-B.; ZHANG. Y.-B. Behaviour of axially loaded circular concrete-filled steel tube (CFT) stub columns with notch in steel tubes. **Thin-Walled Structures**. v. 73. p. 273–280. Dec. 2013. Doi: 10.1016/j.tws.2013.08.018.

CHAPMAN. J. C.; NEOGI. P. K. Research on concrete-filled tubular columns. **Engineering Structures Laboratory Reports**. Civil Engineering Department. Imperial College. May 1966.

CHEN. B.; HIKOSAKA. H. Eccentricity ratio effect on the behaviour of eccentrically loaded CFST columns. *In*: PROCEEDINGS ASSCCA'03 INTERNATIONAL CONFERENCE ADVANCES IN STRUCTURES (ASCCS-7). Sydney. Australia. 2003. p. 973–978.

CHEN. S.; ZHANG. R.; JIA. L.-J.; WANG. J.-Y.; GU. P. Structural behaviour of UHPC-filled steel tube columns under axial loading. **Thin-Walled Structures**. v. 130. p. 550–563. Sep. 2018. Doi: 10.1016/j.tws.2018.06.016.

CHENG. Y.; XU. F.; XU. Z.; XU. X. Experimental research on dynamic behaviour of basic concrete-filled steel tubular elements. *In*: PROCEEDINGS 2ND ASCCS INTERNATIONAL CONFERENCE ON STEEL-CONCRETE COMPOSITE STRUCTURES. Harbin. China. 1988. p. 137–144.

CHITAWADAGI. M. V.; NARASIMHAN. M. C.; KULKARNI. S. M. Axial strength of circular concrete-filled steel tube columns — DOE approach. **Journal of Constructional Steel Research**. v. 66. n. 10. p. 1248–1260. Oct. 2010. Doi: 10.1016/j.jcsr.2010.04.006.

CHODRAUI G. M. de B. **Análise teórica e experimental de perfis de aço formados a frio submetidos à compressão**. 2006. 308 f. Tese (Doutor em Engenharia de Estruturas) – Universidade de São Paulo São Carlos 2006.

CORREA A. F.; DAUZACKER L. A. V. J. **Estruturas mistas – aço concreto:** vantagens da utilização. 2015. 68 f. TCC (Engenharia Civil) - Faculdade Capixaba da Serra Serra 2015.

DUARTE A. P. C.; SILVA B. A.; SILVESTRE N.; BRITO J. de; JÚLIO E.; CASTRO J. M. Finite element modelling of short steel tubes filled with rubberized concrete. **Composite Structures**. Portugal v. 150 p. 28–40. 2016. https://doi.org/10.1016/j.compstruct.2016.04.048.

DUNDU. M. Compressive strength of circular concrete-filled steel tube columns. **Thin-Walled Structures**. v. 56. p. 62–70. Jul. 2012. Doi: 10.1016/j.tws.2012.03.008.

EKMEKYAPAR. T.; AL-ELIWI. B. J. M. Experimental behaviour of circular concrete-filled steel tube columns and design specifications. **Thin-Walled Structures**. v. 105. p. 220–230. Aug. 2016. Doi: 10.1016/j.tws.2016.04.004.

ELCHALAKANI M.; KARRECH A.; HASSANEIN M. F.; YANG B. Plastic and yield slenderness limits for circular concrete filled tubes subjected to static pure bending. **Thin-Walled Structures**. [S.I] v. 109 p. 50–64. 2016. https://doi.org/10.1016/j.tws.2016.09.012.

EUROPEAN STANDARD. **CEN EN 1993 – 1 – 1**: Eurocode 3 – Design of steel structures – Part 1-1: General rules and rules for buildings. Europa: EN 2005.

EUROPEAN STANDARD. **CEN EN 1994 – 1 – 1**: Eurocode 4 – Design of composite steel and concrete structures – Part 1-1: General rules and rules for buildings. Europa: EN 2004.

FAKURY R. H. Sobre a revisão da norma brasileira de projeto de estruturas de aço e estruturas mistas de aço e concreto a NBR 8800. **Engenharia Civil**: Estrutura de Aço v. 60 n. 2 p. 233-239 jun. 2007.

FAKURY R. H.; REQUENA J. A. V.; BATISTA E. de M.; FREITAS A. M. S.; PIMENTA R. J.; ARAUJO A. H. M. de. Sobre A Recente Norma Brasileira De Projeto De Estruturas De Aço E Estruturas Mistas De Aço E Concreto Com Perfis Tubulares. *In*: CONGRESSO DA CONSTRUÇÃO METÁLICA – CONSTRUMETAL 2012. São Paulo. **Anais eletrônico**.

FAKURY R. H.; SILVA A. L. R. C.; CALDAS R. B. **Dimensionamento de elementos estruturais de aço e mistos de aço e concreto**. 1 ed. vol. 1. São Paulo: Pearson Education do Brasil Ltda. 2016.

FAM. A.; QIE. F. S.; RIZKALLA. S. Concrete-filled steel tubes subject to axial compression and lateral cyclic loads. **Journal Structural Engineering**. [S.I.] v. 130. p. 631–640. 2004

FANG H.; VISINTIN P. Structural performance of geopolymer-concrete-filled steel tube members subjected to compression and bending. **Journal of Constructional Steel Research**. Australia v. 188. 2022. https://doi.org/10.1016/j.jcsr.2021.107026.

FERREIRA E. M. **Análise de modelos computacionais para avaliação do comportamento mecânico do concreto fissurado**. 2021. 85 f. Dissertação (Mestre em Engenharia Civil) - Universidade Federal de Juiz de Fora Juiz de Fora 2021.

FIGUEIREDO L. M. B. **Projeto e Construção de Pilares Mistos Aço-Concreto**. 1998. 162 f. Dissertação (Especialista em Engenharia Estrutural) – Escola de Engenharia de São Carlos São Carlos 1998.

FUJII. K. Structural and ultimate behaviour of two types of mortar filled steel tubes in compression. *In*: STEEL-CONCRETE COMPOSITE STRUCTURES. Proceedings of the Fourth International Conference on Steel-Concrete Composite Structures. Javor. T. (ed.). Kosice. Slovakia. June 20-23. 1994. **Association for International Cooperation and Research in Steel-Concrete Composite Structures**. Bratislava. Slovakia. p. 194–197. 1994.

FURLONG. R. W. Design of steel-encased concrete beam-columns. **Journal of the Structural Division**. v. 94. n. 1. p. 267–282. 1968.

FURLONG. R. W. Strength of steel-encased concrete beam columns. **Journal of the Structural Division**. v. 93. n. 5. p. 113–124. 1967.

FURLONG. R. W. Strength of steel-encased concrete beam columns. **Journal of the Structural Division**. v. 93. n. 5. p. 113–124. 1967.

GARDNER. N. J. Use of spiral welded steel tubes in pipe columns. **ACI J**P. v. 65. p. 937-942. 1968.

GARDNER. N. J.; JACOBSON. E. R. Structural behaviour of concrete filled steel tubes. **ACI JP**. v. 64. n. 7. p. 404–413. jul. 1967. Doi: 10.14359/7575.

GERIN M. T. **Comportamento de pilares mistos preenchidos com concreto de resíduos de concreto submetidos a compressão axial centrada: efeito do teor de substituição e da forma de aplicação da força**. 2020. 153 f. Dissertação (Especialista em Engenharia Estrutural) – Escola de Engenharia de São Carlos São Carlos 2020.

GHANNAM. S.; JAWAD. Y. A.; HUNAITI. Y. Failure of lightweight aggregate concrete-filled steel tubular columns. **Steel and Composite Structures**. v. 4. n. 1. p. 1–8. 2004. Doi: 10.12989/scs.2004.4.1.001.

GIAKOUMELIS. G.; LAM. D. Axial capacity of circular concrete-filled tube columns. **Journal of Constructional Steel Research**. v. 60. n. 7. p. 1049–1068. jul. 2004. Doi: 10.1016/j.jcsr.2003.10.001.

GOODE, C. D. Composite columns - 1819 tests on concrete-filled steel tube columns compared with Eurocode 4. **The Structural Engineer**. Australia, v. 86, n. 16. p. 33-38. 1989.

GOPAL, S. R.; MANOHARAN. P. D. Structural behaviour of slender steel tubular columns infilled with fibre reinforced concrete. *In*: ASSCCA'03 INTERNATIONAL CONFERENCE ADVANCES IN STRUCTURES (ASCCS-7). Sydney. 2003. p. 871–875.

GU. W.; CAI. S.; FENG. W. Research on the behaviour and load-carrying capacity of high-strength CFST columns under eccentric loading. **Science of Construction**. China. v. 3. p. 8–12. 1993.

GUIAUX. P.; JANSS. J. Buckling behaviour of columns made with steel tubes and filled with concrete. **CIDECT** Issue 70/42/E. n. MT 65. 1970.

GULER. S.; ÇOPUR. A.; AYDOGAN. M. Axial capacity and ductility of circular UHPC-filled steel tube columns. **Magazine of Concrete Research**. v. 65. n. 15. p. 898–905. ago. 2013. Doi: 10.1680/macr.12.00211.

GUPTA. P. K.; SARDA. S. M.; KUMAR. M. S. Experimental and computational study of concrete filled steel tubular columns under axial loads. **Journal Construction Steel Research**. v. 63. p. 182–193. 2007.

HAN. L. Theoretical analyses and experimental research for the behaviour of high strength concrete filled. **Industrial Construction**. China. v. 11. p. 39–44. 1997.

HAN. L.-H. Tests on concrete filled steel tubular columns with high slenderness ratio. **Advances in Structural Engineering**. v. 3. n. 4. p. 337–344. out. 2000. Doi: 10.1260/1369433001502265.

HAN. L.-H.; YAN. S.-Z. Experimental studies on the strength with high slenderness ratio concrete filled steel tubular columns. *In*: PROCEEDINGS OF THE SIXTH ASCCS INTERNATIONAL CONFERENCE ON STEEL-CONCRETE COMPOSITE STRUCTURES. Los Angeles: **Association for International Cooperation and Research in Steel-Concrete Composite Structures**. 2000. p. 419–426.

HAN. L.-H.; YAO. G.-H. Behaviour of concrete-filled hollow structural steel (HSS) columns with pre-load on the steel tubes. **Journal of Constructional Steel Research**. v. 59. n. 12. p. 1455–1475. dez. 2003. Doi: 10.1016/S0143-974X(03)00102-0.

HAN, L.-H.; YAO, G.-H. Experimental behaviour of thin-walled hollow structural steel (HSS) columns filled with self-consolidating concrete (SCC). **Thin-Walled Structures**, v. 42, n. 9, p. 1357–1377, set. 2004. Doi: 10.1016/j.tws.2004.03.016.

HAN. L.-H.; YAO. G.-H.; ZHAO. X.-L. Tests and calculations for hollow structural steel (HSS) stub columns filled with self-consolidating concrete (SCC). **Journal of Constructional Steel Research**. v. 61. n. 9. p. 1241–1269. set. 2005. Doi: 10.1016/j.jcsr.2005.01.004.

HAN. L-H.; YAO. G-H.; TAO. Z. Behaviour of concrete-filled steel tubular members subjected to shear and constant axial compression. **Thin-Walled Structures**. v.46. n. 7. p. 765-780. set. 2008. Doi: 10.1016/j.tws.2008.01.026

HE. F.; ZHOU. X. H.; TANG. C. H. Experimental research on the bearing behaviour of high strength-concrete-filled steel tube under axial compression. **Engineering Mechanicals**. v. 17. p. 61–66. 2000 (in Chinese).

HE. F.; ZHOU. X. H.; TANG. C. H. Experimental research on the bearing behaviour of high strength-concrete-filled steel tube under axial compression. **Engineering Mechanicals**. v. 17. p. 61–66. 2000 (in Chinese).

HO J. C. M.; LAI M. H. Behaviour of uni-axially loaded CFST columns confined by tie bars. **Journal of Constructional Steel Research**. Hong Kong v. 83 p. 37–50. 2013. https://doi.org/10.1016/j.jcsr.2012.12.014.

HUANG Y.; LI W.; LU Y.; LIANG H.; YAN Y. Behaviour of CFST slender columns strengthened with steel tube and sandwiched concrete jackets under axial loading. **Journal of Building Engineering**. China v. 45. 2021. https://doi.org/10.1016/j.jobe.2021.103613.

HUANG. C. S.; YEH. Y. K.; LIU. G. Y.; HU. H. T.; TSAI. K. C.; WENG. Y. T.; WANG. S. H.; WU. M. H. Axial load behaviour of stiffened concrete-filled steel columns. **Journal Structural Engineering**. ASCE. v. 128. p. 1222–1230. 2002.

IBANEZ. C.; HERNÁNDEZ-FIGUEIRIDO. D.; PIQUER. A. Shape effect on axially loaded high strength CFST stub columns. **Journal of Constructional Stel Research**. v. 147. p. 247-256. ago. 2018. Doi: 10.1016/j.jcsr.2018.04.005

JIA Z. L.; SHI Y. L.; WANG W. da; ZHENG L. Numerical studies on creep behaviour of SRCFST columns with initial stress of steel tube. **Journal of Constructional Steel Research**. China v. 211. 2023. https://doi.org/10.1016/j.jcsr.2023.108214.

JOHANSSON. M.; GYLLTOFT. K. Mechanical behaviour of circular steel–concrete composite stub columns. **Journal of Structural Engineering**. v. 128. n. 8. p. 1073–1081. ago. 2002. Doi: 10.1061/(ASCE)0733-9445(2002)128:8(1073).

KATO. B. Compressive strength and deformation capacity of concrete-filled tubular stub columns (strength and rotation capacity of concrete-filled tubular columns. part 1). **Journal Structural Construction Engineering**. AIJ. v. 468. p. 183–191. 1995.

KENNY. J. R.; BRUCE. D. A.; BJORHOVDE. R. Removal of yield stress limitation for composite tubular columns. **Engineering Journal**. AISC. v. 31. n. 1. p. 1–11. 1994.

KHAN M.; UY B.; TAO Z.; MASHIRI F. Concentrically loaded slender square hollow and composite columns incorporating high strength properties. **Engineering Structures**. Australia v. 131 p. 69–89. 2017. https://doi.org/10.1016/j.engstruct.2016.10.015.

KILPATRICK. A. E. Response of composite columns to applied axial shortening. *In*: PROCEEDINGS OF THE FOURTH INTERNATIONAL CONFERENCE ON STEEL-CONCRETE COMPOSITE STRUCTURES. **ASCCS**. Kosice. Slovakia. p. 218–221. jun. 1994.

KILPATRICK. A. E.; RANGAN. B. V. Tests on high-strength concrete-filled steel tubular columns. **SJ**. v. 96. n. 2. p. 268–274. mar. 1999. Doi: 10.14359/618.

KLOPPEL. K.; GODER. W. Traglastversuche mit ausbetonierten Stahlrohen und Aufstellung einer Bemessungsformel. **Der Stahlbau**. Berlim. v. 26. n. 1. jan. 1957.

KNOWLES. R. B.; PARK. R. Strength of concrete filled steel tubular columns. **Journal of the Structural Division**. v. 95. n. 12. p. 2565–2588. 1969.

KVOCAK V.; KANISHCHEV R.; PLATKO P.; HODOVANETS E.; AL ALI M. Stability of steel columns with concrete-filled thin-walled rectangular profiles. **Sustainability**. Kosice v. 15 n. 23 p. 1–19. 2023. https://doi.org/10.3390/su152316217.

KWON. Y. B.; SEO. S. J.; KANG. D. W. Prediction of the squash loads of concrete-filled tubular section columns with local buckling. **Thin-Walled Structures**. v. 49. n. 1. p. 85–93. jan. 2011. Doi: 10.1016/j.tws.2010.08.009.

LAHLOU. K.; AITCIN. P. C. Colonnes en beton a hautes performances confine dans des minces enveloppes en acier. **Bulletin des Laboratoires des Ponts et Chaussees**. v. 209. p. 49–68. 1997.

LAHLOU. K.; LACHEMI. M. Prédiction delacharge ultime decolonnes mixtesconstituées de tubes remplis de béton à haute résistance: étude comparative des codes de calcul. **Canadian Journal of Civil Engineering**. v. 26. p. 476–488. 1999.

LAI Z.; JIANG H.; CAI Y. A new design equation to estimate the axial compressive strength of circular concrete-filled steel tubular stub columns. **Structures**. China v. 46 p. 1043–1054. 2022. https://doi.org/10.1016/j.istruc.2022.10.101.

LAI Z.; VARMA A. H. Noncompact and slender circular CFT members: Experimental database analysis and design. **Journal of Constructional Steel Research**. [S.I] v. 106 p. 220–233 2015. https://doi.org/10.1016/j.jcsr.2014.11.005.

LAI Z.; VARMA A. H.; ZHANG K. Noncompact and slender rectangular CFT members: experimental database analysis and design. **Journal of Constructional Steel Research**. USA v. 101 p. 455–468. 2014. https://doi.org/10.1016/j.jcsr.2014.06.004.

LEE. S.-H.; UY. B.; KIM. S.-H.; CHOI. Y.-H.; CHOI. S.-M. Behavior of high-strength circular concrete-filled steel tubular (CFST) column under eccentric loading. **Journal of Constructional Steel Research**. v. 67. n. 1. p. 1–13. jan. 2011. Doi: 10.1016/j.jcsr.2010.07.003.

LI W.; ZHA X.; WANG H. A unified formulation for axial compression of steel tube-confined concrete and concrete-filled steel tube stub columns. **Structures**. China v. 58 p. 1–11. 2023. https://doi.org/10.1016/j.istruc.2023.105319.

LIEW. J. Y. R.; XIONG. M.; XIONG. D. Design of concrete filled tubular beam-columns with high strength steel and concrete. **Structures**. v. 8. p. 213–226. nov. 2016. Doi: 10.1016/j.istruc.2016.05.005.

LIN. C. Y. Axial capacity of concrete infilled cold-formed steel columns. *In*: NINTH INTERNATIONAL SPECIALTY CONFERENCE ON COLD-FORMED STEEL STRUCTURES. St. Louis. Missouri. U.S.A. p. 443–457. 1988.

LIN. S.; ZHAO. Y.-G.; HE. L. Stress paths of confined concrete in axially loaded circular concrete-filled steel tube stub columns. **Engineering Structures**. v. 173. p. 1019–1028. out. 2018. Doi: 10.1016/j.engstruct.2018.06.112.

LIU. J. P.; ZHANG. S. M.; ZHANG. X. D.; GUO. L. H. Behavior and strength of circular tube con f ined reinforced-concrete (CTRC) columns. **Journal Construction Steel Research**. v. 65. p. 1447–1458. 2009.

LOURENÇÃO J. S.; ARPINI P. A. T.; ERLACHER G.; ALVES É. C. Optimized design of concrete-filled steel columns. **Revista IBRACON de Estruturas e Materiais**. Espírito Santo v. 15 n. 1 p. 1–20. 2022. https://doi.org/10.1590/s1983-41952022000100002.

LU. Y.; LI. N.; LI. S.; LIANG. H. Behavior of steel fiber reinforced concrete-filled steel tube columns under axial compression. **Construction and Building Materials**. v. 95. p. 74–85. out. 2015. Doi: 10.1016/j.conbuildmat.2015.07.114.

LUKSHA. L. K.; CHERKASOV. D. V.; SHEVCHUK. V. E. Strength testing of large-diameter concrete filled tubular members. *In*: PROCEEDINGS OF THE THIRD INTERNATIONAL CONFERENCE ON STEEL-CONCRETE COMPOSITE STRUCTURES. **Wakabayashi. M. (ed.)**. Fukuoka. Japan. 26-29 set. 1991. p. 67–71.

LUKSHA. L. K.; NESTEROVICH. A. P. Strength of tubular concrete cylinders under combined loading. *In:* PROCEEDINGS OF 3RD INTERNATIONAL CONFERENCE ON STEEL-CONCRETE COMPOSITE STRUCTURES. Fukuoka. Japan. p. 67–71. 1991.

MASUO. K.; ADACHI. M.; KAWABATA. K.; KOBAYASHI. M.; KONISHI. M. Buckling behavior of concrete filled circular steel tubular columns using light-weight concrete. *In*: PROCEEDINGS 3RD ASCCS INTERNATIONAL CONFERENCE ON COMPOSITE CONSTRUCTION. Fukuoka. Japan. p. 95–100. 1991.

MATSUI. C.; TSUDA. K. Strength and behavior of slender concrete filled steel tubular columns. *In*: PROCEEDINGS OF THE SECOND INTERNATIONAL SYMPOSIUM ON CIVIL INFRASTRUCTURE SYSTEMS. **Chang. P. T. Y.; Lu. L. W.; Wei. L. (eds.)**. Hong Kong. China. 1996.

MATSUI. C.; TSUDA. K.; ISHIBASHI. Y. Slender concrete filled steel tubular columns under combined compression and bending. *In*: STRUCTURAL STEEL. PSSC95. 4TH PACIFIC STRUCTURAL STEEL CONFERENCE. v. 3. **Steel-Concrete Composite Structures**. Singapura. p. 29–36. 1995.

MCATEER. P.; BONACCI. J. F.; LACHEMI. M. Composite response of high-strength concrete confined by circular steel tube. **ACI Structural Journal**. v. 101. p. 466–474. 2004.

MEI. H.; KIOUSIS. P. D.; EHSANI. M. R.; SAADATMANESH. H. Confinement effects on high strength concrete. **ACI Structural Journal**. v. 98. p. 548–553. 2001.

MORINO S.; TSUDA K. Design and construction of concrete-filled steel tube column system in Japan. **Earthquake Engineering and Engineering Seismology**. Japão v. 4 n. 1 51–73. 2003.

NATIONAL STANDARD OF THE POPULAR REPUBLIC OF CHINA. **GB 50010:** Code for Design of Concrete Structures. China GB 2010.

NATIONAL STANDARD OF THE POPULAR REPUBLIC OF CHINA. **GB 50936:** Código técnico para estruturas tubulares de aço preenchidas com concreto. China GB 2014.

NIKOLIĆ J.; TOŠIĆ N.; MURCIA-DELSO J.; KOSTIĆ S. M. Comprehensive review of the structural behaviour and numerical modelling of recycled aggregate concrete-filled steel tubes. **Engineering Structures**. Barcelona v. 303. 2024. https://doi.org/10.1016/j.engstruct.2024.117514.

O'SHEA. M. D.; BRIDGE. R. Q. Tests on circular thin-walled steel tubes filled with medium and high strength concrete. **Research Report No. R755**. Sydney: University of Sydney. Department of Civil Engineering. 1997a

O'SHEA. M. D.; BRIDGE. R. Q. **Tests on circular thin-walled steel tubes filled with medium and high strength concrete**. Research Report No. R755. Sydney: University of Sydney. Department of Civil Engineering. 1997.

OLIVEIRA W. L. A. de; NARDIN S. de; EL DEBS A. L. H. D. C.; EL DEBS M. K. Influence of concrete strength and length/diameter on the axial capacity of CFT columns. **Journal Of Constructional Steel Research**. São Carlos v. 65 n. 12 p. 2103–2110. 2009. https://doi.org/10.1016/j.jcsr.2009.07.004.

OLIVEIRA. W. L. A.; NARDIN. S. de; ELDEBS. A. L. H. C.; ELDEBS. M. K. Evaluation of passive confinement in CFT columns. **Journal of Constructional Steel Research**. v. 66. n. 4. p. 487–495. Apr. 2010. Doi: 10.1016/j.jcsr.2009.11.004.

O'SHEA. M. D.; BRIDGE. R. Q. Design of circular thin-walled concrete filled steel tubes. **Journal of Structural Engineering**. v. 126. n. 11. p. 1295–1303. nov. 2000. Doi:

10.1061/(ASCE)0733-9445(2000)126:11(1295).

O'SHEA. M. D.; BRIDGE. R. Q. Design of circular thin-walled concrete filled steel tubes. **Journal of Structural Engineering**. v. 126. n. 11. p. 1295–1303. nov. 2000. Doi: 10.1061/(ASCE)0733-9445(2000)126:11(1295).

O'SHEA. M. D.; BRIDGE. R. Q**. Design of thin-walled concrete filled steel tubes.** University of Sydney. Department of Civil Engineering. Research Report No. R758. 1997b.

O'SHEA. M. D.; BRIDGE. R. Q**. Design of thin-walled concrete filled steel tubes.** University of Sydney. Department of Civil Engineering. Research Report No. R758. 1997.

O'SHEA. M. D.; BRIDGE. R. Q. **Tests on Circular Thin-Walled Steel Tubes Filled with Very High Strength Concrete**. University of Sydney. Department of Civil Engineering. Research Report No. R754. 1997.

PAN. Y.; LIANG. J. H. The effect of local welding on the behavior of concrete filled steel tubular columns under axial compression. *In*: PROCEEDINGS 2ND ASCCS INTERNATIONAL CONFERENCE ON STEEL-CONCRETE COMPOSITE STRUCTURES. Harbin. China. p. 131–136. 1988.

PORTOLÉS J. M.; SERRA E.; ROMERO M. L. Influence of ultra-high strength infill in slender concrete-filled steel tubular columns. **Journal Of Constructional Steel Research**. Espanha v. 86 p. 107–114. 2013. https://doi.org/10.1016/j.jcsr.2013.03.016.

PRION. H. G. L.; BOEHME. J. Beam-column behaviour of steel tubes filled with high strength concrete. **Can. J. Civ. Eng**. v. 21. n. 2. p. 207–218. abr. 1994. Doi: 10.1139/l94-024.

QUEIROZ F. D. **Modelos para análise de pilares mistos pelo método dos elementos finitos**. 2003. 207 f. Dissertação (Mestre em Engenharia Estrutural) – Universidade Federal De Minas Gerais Belo Horizonte 2003.

ROSSATO L. A.; MARTINS C. H.; ROSSI A.; CARVALHO A. S. de; CARDOSO H. S. Aferição de modelos analíticos para pilares mistos tubulares de aço preenchidos de concreto por meio de análise em Elementos Finitos. In: CONGRESSO DA CONSTRUÇÃO METÁLICA – CONSTRUMETAL 9. 2023. São Paulo. **Anais eletrônico**. Disponível em: https://www.researchgate.net/publication/374113279. Acesso em: out. de 2023.

SAISHO. M.; ABE. T.; NAKAYA. K. Ultimate bending strength of high-strength concrete filled steel tube column. **Journal Structural Construction Engineering**. AIJ. v. 523. p. 133–140. 1999.

SAKINO. K.; HAYASHI. H. Behavior of concrete filled steel tubular stub columns under concentric loading. *In*: PROCEEDINGS OF THE THIRD INTERNATIONAL CONFERENCE ON STEEL-CONCRETE COMPOSITE STRUCTURES. **Wakabayashi. M. (ed.)**. Fukuoka. Japan. 26-29 set. 1991. p. 25–30.

SAKINO. K.; NAKAHARA. H.; MORINO. S.; NISHIYAMA. I. Behavior of Centrally Loaded Concrete-Filled Steel-Tube Short Columns. **Journal of Structural Engineering**. v. 130. n. 2. p. 180–188. fev. 2004. Doi: 10.1061/(ASCE)0733-9445(2004)130:2(180).

SAKINO. K.; TOMII. M.; WATANABE. K. Sustaining Load Capacity of Plain Concrete Stub Columns Confined by Circular Steel Tube. *In*: PROCEEDINGS 1ST ASCCS INTERNATIONAL CONFERENCE ON STEEL-CONCRETE COMPOSITE STRUCTURES. Harbin. China. p. 112–118. 1985.

SALANI. H. J.; SIMS. J. R. Behavior of Mortar Filled Steel Tubes in Compression. **JP**. v. 61. n. 10. p. 1271–1284. out. 1964. Doi: 10.14359/7827.

SANTOS L. R. dos; CALDAS R. B.; FAKURY R. H.; RODRIGUES F. C. Conectores parafusos instalados em dois níveis em pilares mistos preenchidos com concreto autoadensável. In: CONGRESSO DA CONSTRUÇÃO METÁLICA – CONSTRUMETAL 2016. São Paulo. **Anais eletrônico**. Disponível em: https://www.researchgate.net/publication/309155261. Acesso em: fev. de 2024.

SCHNEIDER. S. P. Axially Loaded Concrete-Filled Steel Tubes. **Journal of Structural Engineering**. v. 124. n. 10. p. 1125–1138. out. 1998. Doi: 10.1061/(ASCE)0733-9445(1998)124:10(1125).

SERAFIM J. A.; RASI J. R.; NARDIN S. de; SOUZA A. S. C. de. Elementos mistos de aço e concreto em estruturas para edifícios de andares múltiplos-estudo comparativo. In: JORNADAS SUDAMERICANAS DE INGENIERÍA ESTRUCTURAL 37. 2016. Paraguai. **Anais eletrônico**. Disponível em: https://www.researchgate.net/publication/344285461. Acesso em out. de 2024.

SIECZKOWSKI B. N. **Estrutura mista de aço e concreto: verificação de pilares por meio de programa computacional**. 2012. 93 f. TCC (Engenharia Civil) – Universidade Federal do Rio Grande do Sul Porto Alegre 2012.

SILVA P. H. L. **Dimensionamento de pilares mistos de aço e concreto**. 2012. 318 f. Dissertação (Mestre em Engenharia) – Universidade de São Paulo São Paulo 2012.
START Systematic Review (SR). Versão 2.3.4.2 [S. l.]: Departamento de Computação - Universidade Federal de São Carlos 2024.

STRUCTURAL STABILITY RESEARCH COUNCIL. Task Group 20. A Specification for the Design of Steel-Concrete Composite Columns - American Institute of Steel Construction. **Engineering Journal**. AISC. v. 16. n. 4. p. 101–115. 1979.

TAN, K. F. Prediction of the strength and constitutive relationship of very high strength concrete filled steel tubular columns, **Journal of Sichuan University,** v. 35, p. 10–13, 2003 (in Chinese).

TAN. K. F.; PU. X. C.; CAI. S. H. Study on mechanical properties of extra-strength concrete encased in steel tubes. **Journal Building Structural**. P. R. China. v. 20. n. 1. p. 10–15. 1999.

TANG. G. Z.; ZHAO. B. Q.; ZHU. H. X.; SHEN. X. M. Study on the fundamental structural behaviour of concrete filled steel tubular columns. **Journal of Building Structures**. China. p. 13–31. 1982.

TAO Z.; HAN L-H.; WANG D-Y. Experimental behaviour of concrete-filled stiffened thin-walled steel tubular columns. **Thin-Walled Structures** v. 45 p. 517–527 2007.

TAO Z.; HAN L-H.; WANG D-Y. Strength and ductility of stiffened thin-walled hollow steel structural stub columns filled with concrete. **Thin-Walled Structures** v. 46 p. 1113–1128 2008.

TAO Z.; HAN L-H.; WANG Z-B. Experimental behaviour of stiffened concrete-filled thin-walled hollow steel structural (HSS) stub columns. **Journal of Constructional Steel Research** v. 61 p. 962–983 2005.

TAO Z.; UY B.; LIAO F.; HAN L. Nonlinear analysis of concrete-filled square stainless steel stub columns under axial compression. **Journal of Constructional Steel Research**. [S. I.] v. 67 p. 1719 – 1732 2011. https://doi.org/10.1016/j.jcsr.2011.04.012.

THAI H. T.; TAI S.; NGO T.; UY B.; KANG W. H.; HICKS S. J. Reliability considerations of modern design codes for CFST columns. **Journal Of Constructional Steel Research**. Australia v. 177 p. 1–18. 2021. https://doi.org/10.1016/j.jcsr.2020.106482.

THAI H. T.; THAI S.; NGO T.; UY B.; KANG W. H.; HICKS S. J. Concrete-filled steel tubular (CFST) columns database with 3208 tests. **Mendeley Data,** v. 1 2020. Doi: 10.17632/j3f5cx9yjh.

TIAN. H. **Static behavior of high strength concrete-filled SHS and RHS steel tubular beam-columns.** 2003. Dissertation (master's in civil engineering) – Harbin Institute of Technology. Harbin. China. 2003.

TSUJI. B.; NAKASHIMA. M.; MORITA. S. Axial compression behavior of concrete filled circular steel tubes. *In*: PROCEEDINGS OF THE THIRD INTERNATIONAL CONFERENCE ON STEEL-CONCRETE COMPOSITE STRUCTURES. **Wakabayashi. M. (ed.)**. Fukuoka. Japan. p. 19–24. set. 1991.

UENAKA. K.; KITOH. H.; SONODA. K.; HAYAMI. M. Experimental Study on Concrete Filled Double Tubular Steel Columns under Axial Loading. **Advances in Structures**. Balkema Press. p. 877–882. 2003.

USLU F. **Investigação de seções de tubos circulares de aço preenchidos com concreto pelo método experimental e de elementos finitos**. 2022. 150 f. Tese (Doutor em Engenharia Civil) - Universidade Técnica de Eskisehir Eskisehir 2022.

USLU F.; TASKIN K. Experimental and Finite Element Method Investigation of Axial Load Carrying Capacity of Concrete Filled Circular Steel Tube Columns According to Different Slenderness Ratios. **International Journal of Steel Structures**. [S. I.] v. 24 p. 619–634 2024. https://doi.org/10.1007/s13296-024-00842-7.

UY B. Local and post-local buckling of concrete filled steel welded box columns. **Journal Of Constructional Steel Research**. Australia v. 47 p. 47–72. 1998.

UY B.; BRADFORD M. A. Elastic local buckling of steel plates in composite steel-concrete members. **Engineering Structures**. Australia v. 18 n. 3 p. 193–200. 1996.

WANG Z-B.; TAO Z.; HANC L-H.; UY B.; LAM D.; KANG W-H. Strength stiffness and ductility of concrete-filled steel columns under axial compression. **Engineering Structures**. [S.I.] v. 133 p. 209 – 221 2017. Doi: 10.1016/j.engstruct.2016.12.049.

WANG. L. S.; QIAN. J. R. Experimental study on axial load capacity of high-strength concrete filled steel tube columns under axial compression. **Building Structural**. v. 33. p. 46–49. 2003 (in Chinese).

WANG. Y.; CHEN. P.; LIU. C.; ZHANG. Y. Size effect of circular concrete-filled steel tubular short columns subjected to axial compression. **Thin-Walled Structures**. v. 120. n. Supplement C. p. 397–407. nov. 2017. Doi: 10.1016/j.tws.2017.09.010.

WANG. Z.; YANG. S. Experimental research of comprehensive strength and comprehensive modulus of elasticity of concrete filled steel tube. *In*: PROCEEDINGS 1ST ASCCS INTERNATIONAL CONFERENCE ON STEEL-CONCRETE COMPOSITE STRUCTURES. Harbin. China. p. 74–80. 1985.

WEI Y.; JIANG C.; WU; Y-F. Confinement effectiveness of circular concrete-filled steel tubular columns under axial compression. **Journal of Constructional Steel Research**. [S. I.] v. 158 p. 15-27. 2019. Doi: 10.1016/j.jcsr.2019.03.012

XIONG. M.-X.; LIEW. J. Y. R.; WANG. Y.-B.; XIONG. D.-X.; LAI. B.-L. Effects of coarse aggregates on physical and mechanical properties of C170/185 ultra-high strength concrete and compressive behaviour of CFST columns. **Construction and Building Materials**. v. 240. p. 117967. abr. 2020. Doi: 10.1016/j.conbuildmat.2019.117967.

XIONG. M.-X.; XIONG. D.-X.; LIEW. J. Y. R. Axial performance of short concrete filled steel tubes with high- and ultra-high- strength materials. **Engineering Structures**. v. 136. p. 494–510. abr. 2017. Doi: 10.1016/j.engstruct.2017.01.037.

XIONG. M.-X.; XIONG. D.-X.; LIEW. J. Y. R. Behaviour of steel tubular members infilled with ultra-high strength concrete. **Journal of Constructional Steel Research**. v. 138. n. Supplement C. p. 168–183. nov. 2017. Doi: 10.1016/j.jcsr.2017.07.001.

XIONG. M.-X.; XIONG. D.-X.; LIEW. J. Y. R. Flexural performance of concrete filled tubes with high tensile steel and ultra-high strength concrete. **Journal of Constructional Steel Research**. v. 132. p. 191–202. mail 2017. Doi: 10.1016/j.jcsr.2017.01.017.

XU. L.; LU. Q.; CHI. Y.; YANG. Y.; YU. M.; YAN. Y. Axial compressive performance of UHPC filled steel tube stub columns containing steel-polypropylene hybrid fibre. **Construction and Building Materials**. v. 204. p. 754–767. abr. 2019. Doi: 10.1016/j.conbuildmat.2019.01.202.

XUE J. Q.; BRISEGHELLA B.; CHEN B. C. Effects of debonding on circular CFST stub columns. **Journal Of Constructional Steel Research**. China v. 69 n. 1 p. 64–76. 2012. https://doi.org/10.1016/j.jcsr.2011.08.002.

XUE. J. Q.; BRISEGHELLA. B.; CHEN. B. C. Effects of debonding on circular CFST stub col umns. **Journal Construction Steel Research**. v. 69. p. 64–76. 2012 (in Chinese).

YAMAMOTO. T.; KAWAGUCHI. J.; MORINO. S; YAMAMOTO. K.; MIZUNO. Y. Experimental Study of Scale Effects on the Compressive Behavior of Short Concrete-Filled Steel Tube Columns. **Composite Construction in Steel and Concrete IV**. v. 25. p 27-44. set. 2000. doi: 10.1061/40616(281)76.

YANG. Y. F.; HAN. L. H. Concrete filled steel tube (CFST) columns subjected to concentrically partial compression. **Thin-Walled Structures**. v. 50. n. 1. p. 147–156. jan. 2012. Doi: 10.1016/j.tws.2011.09.007.

YE. Y.; HAN. L.-H.; SHEEHAN. T.; GUO. Z.-X. Concrete-filled bimetallic tubes under axial compression: Experimental investigation. **Thin-Walled Structures**. v. 108. p. 321–332. nov. 2016. Doi: 10.1016/j.tws.2016.09.004.

YE. Y.; HAN. L-H.; GUO. Z-X. Concrete-filled bimetallic tubes (CFBT) under axial compression: Analytical behaviour. **Thin-Walled Structures**. v. 119. p. 839-850. out. 2017. Doi: 10.1016/j.tws.2017.08.007

YU. Q.; TAO. Z.; WU. Y.-X. Experimental behaviour of high-performance concrete-filled steel tubular columns. **Thin-Walled Structures**. v. 46. n. 4. p. 362–370. abr. 2008. Doi: 10.1016/j.tws.2007.10.001.

YU. Q.; TAO. Z.; WU. Y.-X. Experimental behaviour of high-performance concrete-filled steel tubular columns. **Thin-Walled Structures**. v. 46. n. 4. p. 362–370. abr. 2008. Doi: 10.1016/j.tws.2007.10.001.

YU. Z. W.; DING. F. X.; LIN. S. Research on behavior of high-performance concrete filled tubular steel short columns. **Journal Building Structural**. v. 23. p. 41–47. 2002 (in Chinese).

YU. Z. W.; DING. F. X.; LIN. S. Research on behavior of high-performance concrete filled tubular steel short columns. **Journal Building Structural**. v. 23. p. 41–47. 2002 (in Chinese).

YU. Z.; DING. F.; CAI. C. S. Experimental behavior of circular concrete-filled steel tube stub columns. **Journal of Constructional Steel Research**. v. 63. n. 2. p. 165–174. fev. 2007. Doi: 10.1016/j.jcsr.2006.03.009.

YU. Z.; DING. F.; CAI. C. S. Experimental behavior of circular concrete-filled steel tube stub columns. **Journal of Constructional Steel Research**. v. 63. n. 2. p. 165–174. fev. 2007. Doi: 10.1016/j.jcsr.2006.03.009.

YUAN. H. X.; DU. X. X.; SHOKOUTHIAN. M.; YE. J.; SCHAFER. B. W. Behaviour and design of circular hollow section steel columns strengthened by infilling concrete under preload. **Journal of Constructional Steel Research**. v. 159. p. 415–427. ago. 2019. Doi: 10.1016/j.jcsr.2019.05.001.

ZEGHICHE. J.; CHAOUI. K. An experimental behaviour of concrete-filled steel tubular columns. **Journal of Constructional Steel Research**. v. 61. n. 1. p. 53–66. jan. 2005. Doi: 10.1016/j.jcsr.2004.06.006.

ZHANG Z.; WANG J.; SUN Q.; TIAN P.; WANG J.; WU Y.; LI Y. Experimental and Numerical Study of the Behavior of Concrete-Filled High-Strength Steel Tube Columns with

Large D/t Ratio under Axial Compression. **Buildings** v. 12 p. 1953 2022. Disponível em: https://doi.org/10.3390/buildings12111953. Acesso em: 03 de julho de 2024.

ZHANG. S.; GUO. L.; WANG. Y.; TIAN. H. Experimental research and theoretical analysis on high-strength concrete-filled SHS steel tubes subjected to eccentric load. **Journal of Building Structures**. China. v. 25. n. 1. p. 17–24. 2004.

ZHAO. J. H.; QIANG. G.; MA. S. F. The study of the axial compressive strength of concrete filled steel tube (CFST) based on the twin shear unified strength theory**. Engineering Mechanical**. v. 19. p. 32-35. 2002 (in Chinese).

ZHONG. S.; WANG. Y. Mechanical properties and design method of load-carrying capacity of CFST under compression. **Journal of Harbin University of Civil Engineering and Architecture**. Harbin. China. p. 1–33. 1978.

ZHONG. S.-T. High-rise buildings of concrete filled steel tubular structures. **Harbin**: Heilongjiang Science and Technology Publishing House. 1999.

ZHOU. X.; MOU. T.; TANG. H.; FAN. B. Experimental study on ultrahigh strength concrete filled steel tube short columns under axial load. **Advances in Materials Science and Engineering**. 2017. Doi: 10.1155/2017/8410895.

ZHU. J.-Y.; CHAN. T.-M. Experimental investigation on octagonal concrete filled steel stub columns under uniaxial compression. **Journal of Constructional Steel Research**. v. 147. p. 457–467. ago. 2018. Doi: 10.1016/j.jcsr.2018.04.030.

ZHU. L. MAI. L.; BAI. Y.; LI. S.; SONG. Q.; WEI. Y.; ZHANG. L.; ZHANG. Z.; SHA. X. Large diameter concrete-filled high strength steel tubular stub columns under compression. **Thin-Walled Structures**. v. 108. p. 12–19. nov. 2016. Doi: 10.1016/j.tws.2016.08.004.