Reviewer #1:

1. The first innovation, creating a database, is not considerable. It has been used before in optimization papers. Such as:

Kaveh A, Mottaghi L, Izadifard R.A. "Sustainable design of reinforced concrete frames with non prismatic beams" Engineering with Computers. https://doi.org/10.1007/s00366-020-01045-4

Kaveh, A., Fahimi-Farzam, M., & Kalateh-Ahani, M. Performance-based multi-objective optimal design of steel frame structures: Nonlinear dynamic procedure. Scientia Iranica, 2015, 22(2), 373-387.

Kaveh, A., Laknejadi, K., & Alinejad, B. Performance-based multi-objective optimization of large steel structures. Acta Mechanica, 2012, 223(2), 355-369. https://doi.org/10.1007/s00707-011-0564-1

2. What software was used to handle the design code constraints? Please explain further.

3. How is done parameters regulation in NSGA-II?

4. Throughout the text of the paper, when referring to the application of a code, the year of its publication should also be mentioned. For example, ACI 318-19.

5. How long does the solution process take to reach the optimal solution and until the termination criterion is met?

6. In the conclusion, it is best to discuss the results quantitatively.

Reviewer #2:

The paper presents a computational framework for the multi-objective optimization of reinforced-concrete frame structures, combining a discrete section database based on NSGAII algorithm.

While the topic is relevant and the overall workflow is clearly organized, the manuscript does not convincingly demonstrate a substantial degree of novelty. The main components of the framework, discrete section databases, opensees-based structural analyses, and NSGAII optimization, are well established in the existing literature, and the manuscript does not clarify which aspects represent genuine methodological advances. Moreover, different statements are overly strong and not supported by the evidence presented. A more rigorous and well-defined explanation of the actual innovations in the framework of the actual scientific literature on the topic, supported by a clearer comparison with previous studies, is required to properly assess the contribution of the work.

Given the considerations above, I recommend a major revision of the manuscript. To strengthen the contribution and improve the clarity and robustness of the study, I suggest addressing the following points:

1. line 149: The definition of Pareto dominance is incorrect for a minimization problem (as stated in line 131) the operators "≥" and ">" should be replaced with "≤" and "<". This inconsistency undermines the formal correctness of the optimization background section.

2. Section 2: The background section on MOOP, Pareto optimazation and NSGAII is disproportionately long given the journal's readers, while essential details of the structural modelling of the case study are largely omitted. This imbalance reduces the manuscript's clarity and reproducibility.

3. Equation 13: The aggregation of cost and CO2 emissions into a single objective function is not supported by correlation analysis or sensitivity studies. The choice of equal weights appears arbitrary, and the formulation prevents explicit exploration of the typical trade-off between economic and environmental criteria.

4. Equation 14: The second objective function, defined as the average of the maximum DCR values per element may conceal critical localized demands. Is there a reason why the author did considered alternative well-established metrics (e.g., maximum or percentile-based DCR) should be considered. Moreover, since constrains all DCRs to be ≤1, the added value of this objective function is unclear.

5. Section 3: The generation of the discrete section database is insufficiently described. Key

information is missing, including the total number of sections, the discretization strategy, the coverage of geometric combinations, and any sensitivity analysis regarding database granularity.

6. The manuscript states that SLS checks are embedded within the section database, however, many of these verifications depend on global structural properties (e.g., stiffness, boundary conditions) and cannot be reduced to local section checks alone.

7. The OpenSees modelling of the case study is only briefly mentioned significantly limit reproducibility, with no information on element type, material models for concrete and steel, inclusion of P-Delta effects, stiffness reduction due to cracking, boundary conditions at the base.

8. The seismic loads adopted in the case study appear unrealistic, the base shear of 40 kN (only reported in table 7) per direction seems pretty low for a RC frame like the one used for the case study. No reference is made to a design spectrum, soil category, or hazard level.

9. The numerical validation is limited to a single eight-story building, whereas the manuscript claims applicability to "buildings with diverse span lengths and irregular configurations". Without additional case studies, the generality of the proposed framework remains unsubstantiated.

10. The sensitivity of the GA parameters is evaluated primarily in terms of the convergence of the first objective function, with no assessment of: solution variability across different random seeds, Pareto-front quality metrics (e.g., hypervolume, spread), robustness of the obtained solutions.

11. The comparison between scenario A and B is performed under intentionally asymmetric loading conditions which amplify the effect of column rotation. The reported "9% improvement" cannot be considered general without additional, less tailored scenarios.

12. Practical design aspects are not fully addressed. Member grouping is predetermined by the user rather than optimized, and stirrup spacing is assumed uniform. These simplifications strongly affect both cost and performance, and should require deeper discussion.

13. The conclusions emphasize the practical relevance of the proposed framework, yet no complete decision-making example is provided, nor is any optimized design compared to a conventional code-based solution.

14. Caveat: the data availability statement contradicts the entire computational workflow

presented in the manuscript. The section database, cost/CO_2 parameters, and essential input files (opensees models, ga settings, random seeds) should be made available at least on request to the readers.

In this reviewer's opinion, only if the authors are able to satisfactorily address these points can the manuscript be considered tentative for publication.

Reviewer #3:

The manuscript proposes an optimisation-based approach for designing reinforced concrete building frames, considering sizing and layout design variables. The problem is formulated as a multi-objective optimisation to minimise a combined normalised total cost and embodied carbon indicator, and to minimise the average stress ratio. The Non-Dominated Sorting Genetic Algorithm II (NSGA-II) is used to solve the problem, and OpenSees is utilised for structural analysis.

The manuscript is generally well-organised and well-written. It can be stated that it represents a contribution regarding an interesting research topic; however, this was not adequately addressed. Although the proposed approach for the simultaneous sizing-layout optimisation may be novel, the research significance, advancements or improvements concerning existing approaches in the literature are arguable. Several clarifications and improvements are required regarding the methodology. Fundamental information regarding the numerical example is missing. Furthermore, the manuscript organisation should be revised, aiming to remove nonessential information. Therefore, the reviewer cannot recommend the publication of this manuscript.

Some general comments:

1) It is not clear what the rationale is behind the second objective function. The authors mention, "... if we aim for a more conservative design (...) enhancing long-term durability and user comfort". However, in any structural optimisation problem, stresses and displacements should be considered in the problem formulation. This is usually considered through design constraints. These constraints should be defined and evaluated appropriately to cover the relevant serviceability limit states and ultimate limit states verifications. Therefore, an optimal solution that minimises the cost while satisfying all design constraints will not present durability or user comfort problems. It is relevant to provide readers with justification for considering a measure of stress distribution as an objective function.

2) Title - The term "hybrid" should be removed. In this context, it may mislead readers by suggesting a hybrid optimisation algorithm. Moreover, the problem with sizing and shape design variables is not a hybrid optimisation problem.

3) Abstract, Page 1, Line 13 - The authors mention that "This study introduces a transformative hybrid size-shape optimization framework that bridges the critical gap between theoretical structural optimization and practical, on-site constructability for

reinforced concrete (RC) frames". However, this claim is not accurate because the manuscript does not provide any information regarding the reinforcement detailing, either when defining the design variables or presenting the optimisation results. The reinforcement detailing is fundamental for the execution of reinforced concrete structures.
4) A literature review article from 1998 (Sarma, K. C., & Adeli, H. (1998). Cost Optimization of Concrete Structures. Journal of Structural Engineering, 124(5), 570-578. https://doi.org/10.1061/(ASCE)0733-9445(1998)124:5(570)) highlights the relevance of considering the cost of the formwork when optimising reinforced concrete structures. Therefore, this cost must be considered to appropriately address this optimum design problem. Moreover, this reference should be added to the manuscript.
5) Page 2, Line 39 - Please revise the sentence to improve accuracy. Earthquakes are not external forces.
6) Page 4, Line 109 - Please revise. There is no need to mention "reinforced concrete moment-resisting frames", as reinforced concrete frames are by default moment-resisting frames.
7) Section 2 should be removed. Sections 2.1 and 2.2 should be moved to section 3.4 when the optimisation algorithm is described. These sections should be reduced to their essentials since they refer to an already known algorithm. The text in Section 2.3 should be almost entirely removed, as it corresponds to common knowledge and does not provide relevant information.
8) Table 2 - Please revise or clarify if the values of the concrete compressive strength correspond to common values used in practice.
9) Sections 3.2.1 and 3.2.2 - It would be relevant to provide readers with information about how the reinforcement detailing is calculated from the reinforcement ratios.
10) Section 3.3.2 - A Figure depicting the design variables is missing.
11) Page 17, Line 422 - The "weight" is not identified.
12) Page 17, Equation 14 - "DCR" is not defined.
13) Table 4 - The SLS of beam deflection is based on a simplified check. Moreover, nothing is mentioned about the time-dependent effects of concrete. These issues should be revised because they correspond to limitations of the proposed approach when compared to previous works by other authors.
14) Page 20, Line 478 - The authors mention "the execution of static analyses for all load combinations". However, they also state that seismic action is considered. It is fundamental

to clarify and provide information about how seismic action was considered in the analysis.

15) The manuscript lacks fundamental information concerning the modelling and structural analysis. Without this information, the proposed approach and its results cannot be appropriately evaluated, and the results cannot be replicated. Some issues:

a) Details on the load cases and their number are missing;

b) Details on the type of finite elements, number of elements, number of nodes, and type of structural analysis are missing;

c) No information is provided on how the seismic forces, depicted in Figure 7, are calculated;

d) Details are missing on how the loads on the floors are applied to the beams;

e) The dead loads (self-weight and superimposed dead load) do not have variable positions; thus, the checkerboard pattern should not be applied to these loads.

16) Section 4 - Given the random nature of the search process utilised by the algorithm, the optimisation results should be analysed statistically. No information is provided about the number of independent runs conducted. Later, in Section 5, the authors mention "three independent optimization trials". Only three runs are not statistically significant.

17) Section 4, Figure 8 - It is arguable if the "one-point" crossover is the best strategy. What would happen if more than 100 generations were considered?

18) Section 4.4, Table 9 - The results provide little information about the optimised solutions obtained. Only the cross-sectional sizes are clearly indicated; however, the reader does not know if these correspond to beams or columns. What is the correspondence between the values "0" and "1" and the column orientation? What are the longitudinal and shear reinforcement? What is the concrete compressive strength?

19) Section 4.4 - The results presented in Figure 15 are not analysed within the text.

20) It would be relevant to provide readers with the computational time required for solving the optimisation problem.

21) Although the manuscript is generally well-written, a detailed revision is required to avoid an excessive use of unnecessary adjectives. Some examples: "rigorous" (Page 19); "excellent" (Page 26); "notably" (Page 33).