Received: 26 September 2022 | Revised: 16 December 2022 | Accepted: 22 January 2023

DOI: 10.1002/suco.202200931

DISCUSSION

fib CEB-FIP WILEY

Discussion of the article "Prediction of creep of recycled aggregate concrete using back-propagation neural network and support vector machine"

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In a recent study, Rong et al.[1] investigate the prediction of recycled aggregate concrete (RAC) creep using back-propagation neural network and support vector machine. For this purpose, the authors compiled a database of experimental results on the creep of RAC on which they first tested five analytical RAC creep prediction models[2–6] and concluded that the performance of all five models is inadequate, thereby justifying the use of a back-propagation neural network and a support vector machine.[1]

The main argument for declaring the performance of the five analytical models inadequate is the analysis of "performance indices" of the correlation coefficient (R), mean absolute error (MAE), mean square error (MSE), and integral absolute error (IAE). The found ranges of values were 0.45–0.55 for R, 0.41–0.64 for MAE, 0.33–0.70 for MSE, and 0.33–0.53 for IAE.

Nonetheless, there are errors and uncertainties regarding the study that are pointed out herein, some methodological and some formal.

1. The authors do not provide the compiled database as Supporting Information and, further, in their Data Availability Statement state that "Data sharing is not applicable to this article as no new data were created or analyzed in this study." One Supporting Information file has been shared, the computer codes of the SVM and BPNN models, which both call on the reading of Excel files "Creep SVM.xlsx" and "Creep BPNN.xlsx," which we believe should both be openly available. It is our general belief that each paper should contain all data necessary to enable other researchers to repeat the reported analysis—transparency and repeatability are essential requirements for achieving the quality of the published work.
2. Reproducing the analysis is further hampered by the fact that out of the 22 studies that comprise the database,[1] 9 (original references 42, 43, 62, 63, 71, 73, 76, 77, 78) cannot be downloaded or accessed via Scopus, as they are nonindexed publications and in Chinese, therefore generally inaccessible to an English-language reader. The study by Feng et al.[7] used in the database (original reference 49) is itself a database of 254 cyclic loading tests—it is therefore, a secondary and not a primary source (as the database itself is also not provided there) and furthermore, it is unclear whether the compiled tests are adequate for compressive creep. Original reference 75 is cited as Huo et al. "Experimental study on creep properties of prediction of reed bales based on SVR and MLP" in *Plant Methods*; however, a Google Scholar search reveals

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that the authors are actually Li et al.[8] and that the study does not deal with concrete but with reed bale samples from Bosten Lake, China.

3. The studies by Chinzorigt et al.[9] and Pedro et al.[10] contain mixes that also include fine recycled aggregate, however, it is not clear whether these mixes are included in the database. It must be noted that the models by Fathifazl and Razaqpur,[3] Tošić et al.[6] are applicable only to RAC with coarse recycled concrete aggregate (RCA). The remaining models as well cannot be checked as they are inaccessible to an English-language reader.
4. Information provided for the Tošić et al. model in the original article is not accurate. Explaining the model, authors state that the creep coefficient $\varphi_{MC}(t, t_0)$ used in this model "is calculated as reported in another study (64)." Original reference 64 is a work by Fathifazl and Razaqpur[3] and is not related to Model Code provisions; therefore, it does not include the explanation of the φ_{MC} parameter.
5. There is a major difference between the analytical prediction model intended for code application and data predicted by a machine learning algorithm: the former should be simple and need not have higher reliability compared with the reliability of the prediction model for natural aggregate concrete (NAC) in existing codes; the latter (machine learning algorithm) is not a model but a technology, which seriously limits its application. This was pointed out in the paper, but then not elaborated further in the subsequent assessment, comparison, and conclusion parts. Methodologically, in the first case, the conclusion on the adequacy of the model only based on its performance on RAC creep is not fully sound. Models such as that by Tošić et al.[6] and Fathifazl and Razaqpur[3] are modifications of existing models for NAC, specifically, the *fib* Model Code 2010[11] and ACI 209R-92[12] models, respectively. These models themselves have significant scatter when applied to NAC: Wendner et al.[13] found coefficients of variation (CoVs) for these two models to be 0.341 and 0.565, respectively considering a large database of bridge and laboratory data. A particular subset of creep data can deviate significantly from these values. Therefore, what should be done first, is to test these original models on "reference NAC" concretes that are typically always provided in studies. Then, their performance on that particular subset of NAC creep data should be a benchmark for analyzing the modified models' performance on RAC. This is the procedure followed by Tošić et al.[6]: on their NAC database, the *fib* Model Code 2010[11] creep model had a mean predicted/measured ratio for creep coefficients of 1.11 with a CoV of 44.4%, whereas on RAC, for 100% of coarse RCA the mean was 0.96 with a CoV of 42.0%. By just looking at RAC, one might conclude the model performs well, but it actually underestimates RAC relative to NAC (having similar compressive strength), therefore, if the aim is to have same reliabilities of the models, the model must be modified for RAC.[6]
6. The evaluation of the performance indicators R, MSE, MAE, and IAE was done for data from creep curves dividing the time curves into 10 periods and selecting a data point from each period. It is not clear how this selection was done (if several points in each 1/10 of time were available, by which criterion was each point selected). Finally, time-weighting across intervals needs to be done *across* creep curves in order to eliminate bias towards shorter testing times (i.e., if out of 100 curves in the database 99 go up to 100 days, and only one up to 1000 days, the data point for 1000 days in the latter needs to be give additional weight).[14]

DATA AVAILABILITY STATEMENT

Data sharing is not applicable to this article as no new data were created or analyzed in this study.

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How to cite this article: Tošić N, de la Fuente A, Marinković S. Discussion of the article "Prediction of creep of recycled aggregate concrete using back-propagation neural network and support vector machine". Structural Concrete. 2023. https://doi.org/10.1002/suco.202200931