Clay Brick CDP Verification Report

BSYIGMACAD v1.3.6 benchmark evidence package documenting comparison against extracted published reference cases.

Reference Case

150 mm fired clay brick cube compression CDP benchmark

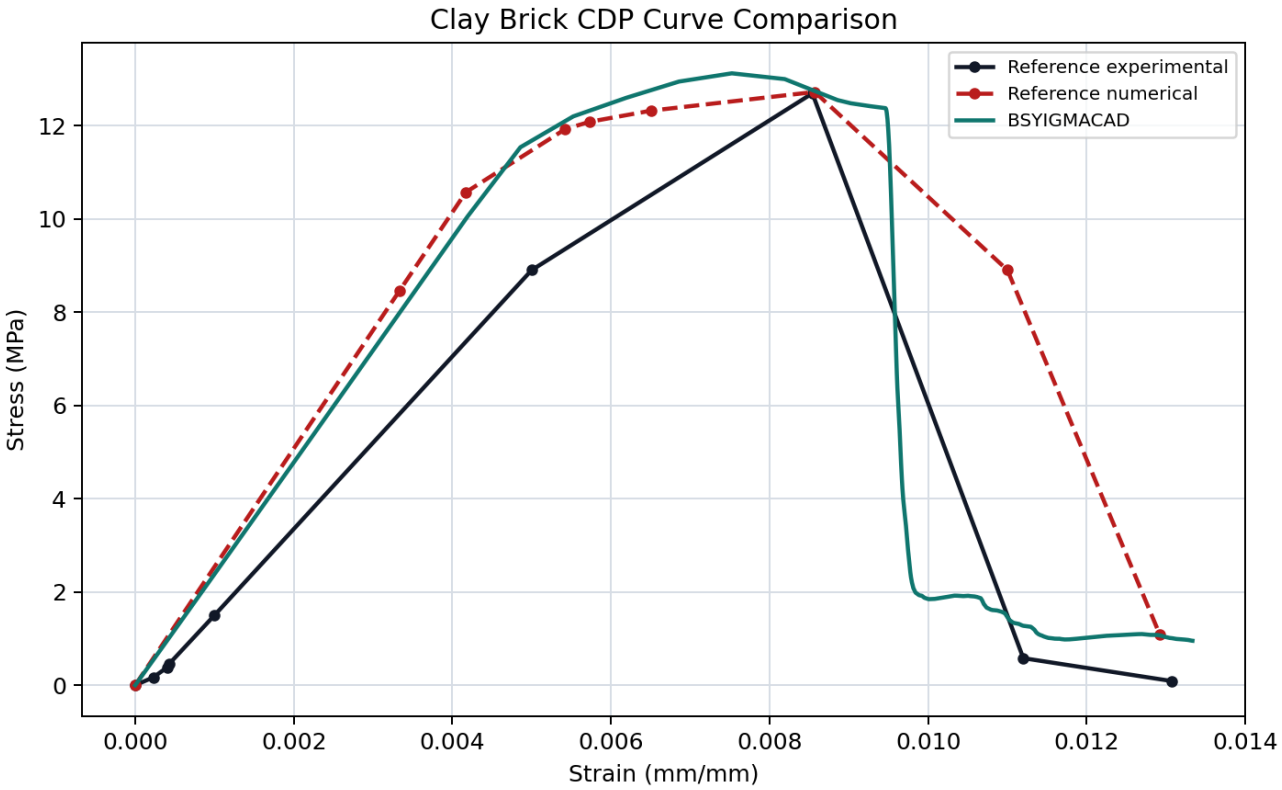
Celik, A., Anil, O., Mercimek, O., Akkaya, S. T., and Turan, A. I. (2025). Investigation of Mechanical Properties of Masonry Materials Under Compressive Loading: Experimental and Numerical Study. Journal of Polytechnic, 28(2), 565-572. DOI: 10.2339/politeknik.1478067.

Result Summary

Aligned default clay-brick output is compared against extracted experimental and numerical stress-strain targets.

Metric	Value	Unit
BSYIGMACAD peak	13.119	MPa
BSYIGMACAD peak displacement/strain	0.008	strain
Reference experimental peak	12.690	MPa
Reference numerical peak	12.720	MPa
Peak error vs experimental	3.38	%
Peak error vs reference numerical	3.14	%
RMSE vs experimental key points	1.085	MPa
RMSE vs reference numerical key points	2.499	MPa

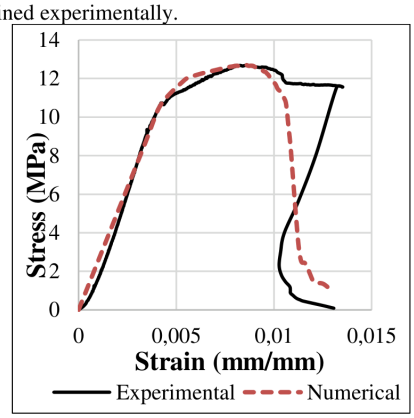
Curve Comparison



Visual Evidence

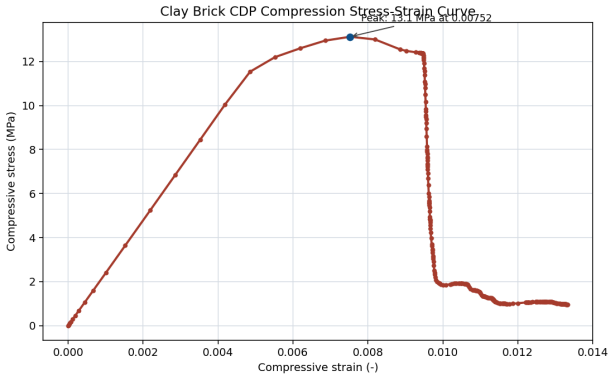
Reference excerpt

ined experimentally.



ure 10. Comparing experimental and numerical stress-strain curves

BSYIGMACAD output



Reference excerpt

Figure 9. CDP a) Compression model, b) Tension model

Table 5. CDP model parameters

Compression			
Stress	**Inelastic Strain**	**Plastic Strain**	**Damage C**
10.97	0.00000	0.00000	0.00000
11.59	0.00014	0.00014	0.00000
12.64	0.00274	0.00274	0.00000
11.76	0.00579	0.00542	0.06929
11.56	0.00863	0.00818	0.08512
8.80	0.00992	0.00831	0.30395
6.03	0.01121	0.00844	0.52278
3.27	0.01250	0.00857	0.74160
0.50	0.01379	0.00870	0.96043
Tension			
Stress	**Inelastic Strain**	**Plastic Strain**	**Damage T**
1.36	0.00000	0.00000	0.00000
0.97	0.00131	0.00119	0.23016
0.68	0.00262	0.00238	0.46032
0.39	0.00394	0.00357	0.69048
0.10	0.00525	0.00476	0.92063

cube element as a result of the analysis were shown in **Figure 11-a** and **Figure 11-b**, respectively. Also, the damage distribution obtained experimentally is given in **Figure 11-c.** The numerical analysis using the CDP model shows that the damage distributions are very similar to the experimental results. Thus, the proposed CDP model can be used in future numerical studies with clay-based brick material.

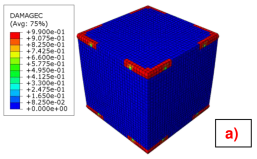
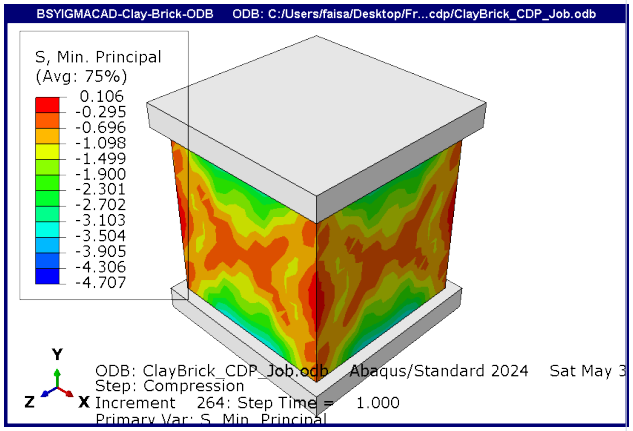


Figure 11. Damage distributions of the cube specimen a) Compression damage, b) Tension damage, c) Experimental damages

BSYIGMACAD output



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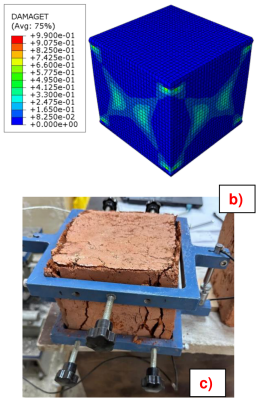


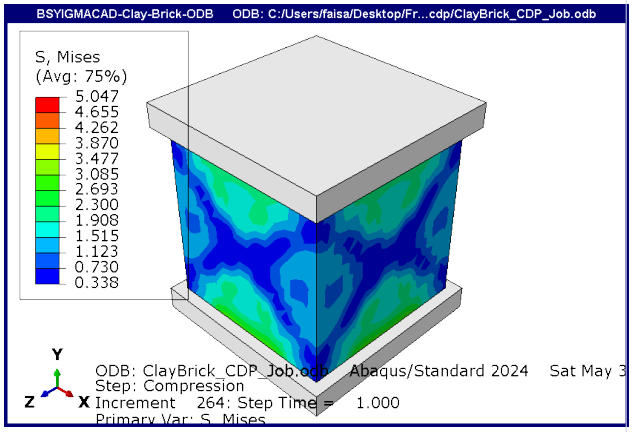
Figure 11. (Continue) Damage distributions of the cube specimen a) Compression damage, b) Tension damage,

- approximately 2-fold difference in the modulus of elasticity may be due to the void configuration in the hollow brick unit or the difference in the firing process involved in the production process of the bricks.
- When masonry units are compared in terms of energy consumption, clay brick has the highest capacity, while the second and third ranked units are hollow brick and aerated concrete, respectively.
- A general CDP model for clay-based fired bricks is proposed by utilising the experimental results of clay brick material. The stress-strain behaviour and damage distributions obtained in the numerical validation study carried out with the proposed material model were compared with the experimental results and it was found that the results overlapped with each other. This proposed material model can be used in the analysis models of masonry structures consisting of clay-based bricks with different void types or with different geometric dimensions.

ACKNOWLEDGEMENT

This study was supported by Scientific and Technological Research Council of Turkey (TUBITAK-1002/A) under the Grant Number 123M152. The authors thank to TUBITAK for their supports.

BSYIGMACAD output



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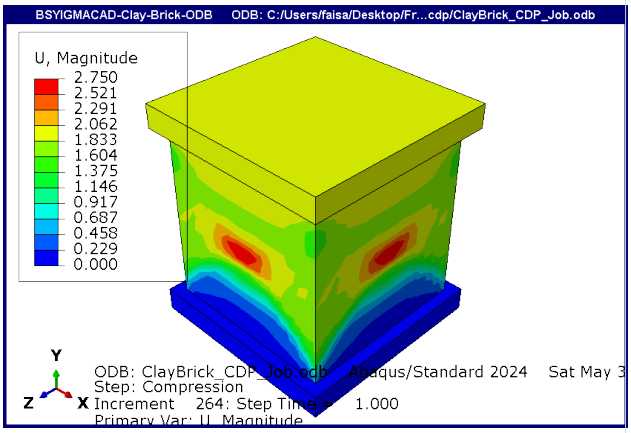

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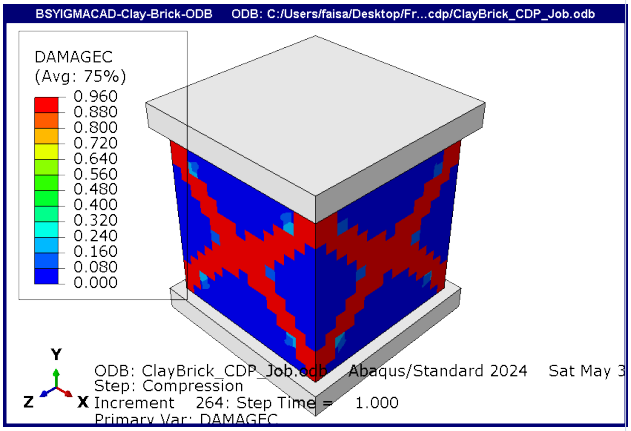

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