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THE PARC_CL 2.0: IMPLEMENTATION, VALIDATION AND APPLICATION ON RC SHEAR WALLS

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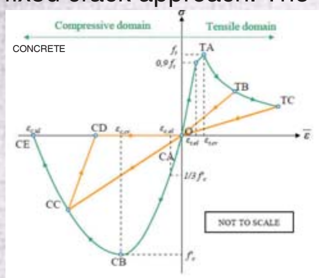
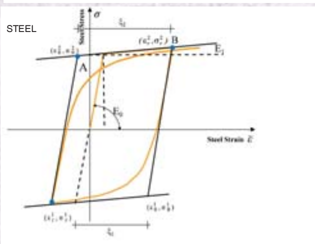
ABSTRACT

In the poster the new PARC_CL 2.0 crack model (Physical Approach for Reinforced Concrete under Cyclic Loading condition) is presented. The PARC_CL 2.0 crack model, implemented in the user subroutine UMAT.for in ABAQUS code, is based on a fixed crack approach and allows to consider plastic deformations and hysteretic cycles. In the poster, the PARC_CL 2.0 crack model is firstly illustrated, highlighting the cyclic behaviour of concrete and reinforcement. Successively the model is validated by means of comparison with experimental tests on simple RC panels and finally the model is applied on the assessment of the cyclic behaviour of RC shear walls.

1. PARC_CL 2.0 CRACK MODEL

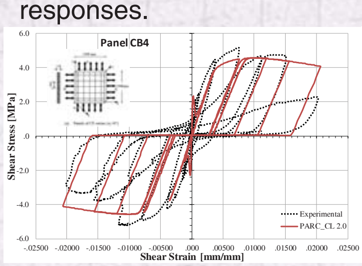
The proposed PARC_CL 2.0 [1] model is based on a total strain fixed crack approach. The concrete and steel behaviours, as well as their interaction effects, are modelled with constitutive relationships for loading-unloading-reloading conditions. The hysteretic stress-strain relationship for concrete does not consider plastic strains in tension while in compression field a simplified unloading path is implemented. The Menegotto-Pinto model is employed to represent the hysteretic stress-strain behaviour of reinforcing steel because it takes into account the bars yielding, strain hardening branch, the Bauschinger effect and the elastic modulus degradation under load reversal.

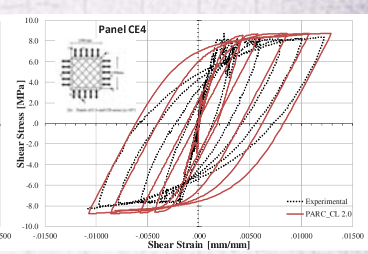




2. VALIDATION OF THE MODEL

In order to assess the efficiency of the proposed PARC_CL 2.0 model, some experimental tests on RC panels by Mansour and Hsu [2] are modeled by means of NLFEA. An acceptable level of agreement is observed between NLFEA and experimental results in terms of shear stress capacity, stiffness, ductility, shape of the unloading/reloading loops, and pinching characteristics of the response. Furthermore, the behavioral characteristics and failure modes observed during the tests, including yielding of reinforcement and crushing of concrete, were observed to be consistent with the analytically-predicted responses.

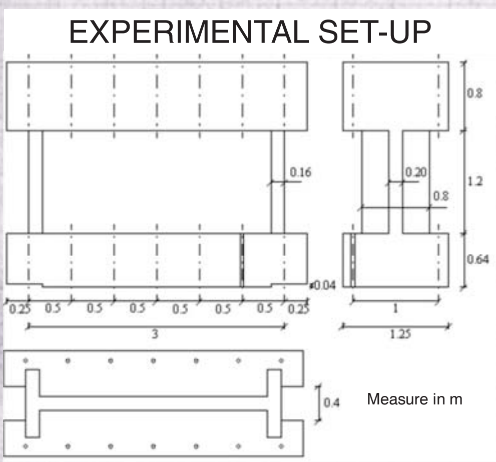


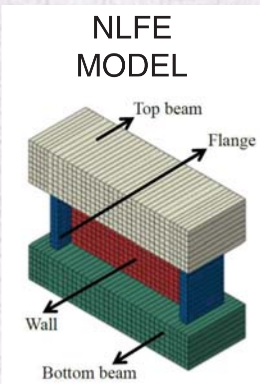


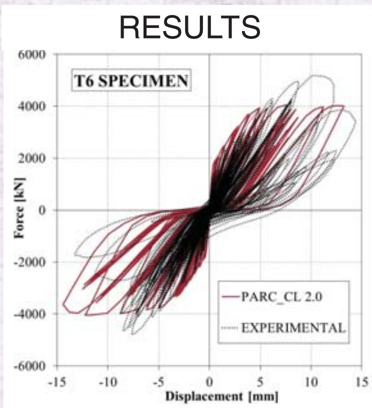
3. APPLICATION OF THE MODEL: NLFEA OF RC SHEAR WALL

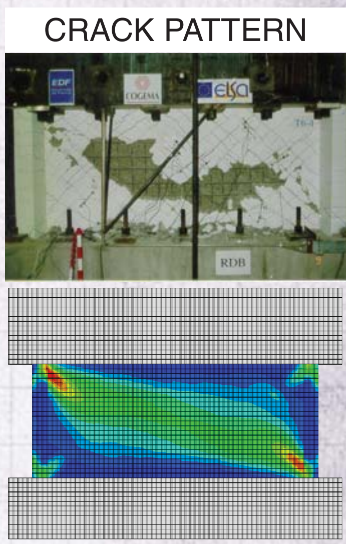
The shear walls tested at the JRC Ispra Laboratory in Italy [3], within the SAFE experimental campaign, have been used to validate the proposed PARC_CL2.0 crack model. In particular, for the purpose of this poster, 1 out of the 13 specimens characterizing the SAFE experimental campaign, is analyzed, T6 specimen.

NLFEA have been carried out using multi-layered shell elements. The top and the bottom beam is modeled with elastic material while, for the wall and the flange, the non-linear behavior of RC is considered by means of PARC_CL 2.0 crack model.









CONCLUSIONS

Multi-layered shell elements modeling with PARC_CL 2.0 crack model can well predict the global Force-Displacement cyclic behavior of RC shear walls. Moreover, shell elements and PARC_CL 2.0 crack model are very powerful for catching torsion and shear phenomena and may be very useful tools also for the evaluation of local engineering parameters, like crack openings and stresses distribution.

REFERENCES

[1] Belletti B., Scolari M., Vecchi F. (2016) "NLFEA of reinforced concrete shear walls under cycling loading by means of PARC_CL2.0 crack model", *fib Symposium 2016*, Cape Town, South Africa

[2] Mansour M., Hsu T.C. (2005), "Behavior of Reinforced Concrete Elements under Cyclic Shear I: Experiments", ASCE Journal of Structural Engineering, 131 (1): 44-53.

[3] Pegon P. (1998). Programme SAFE: Présentation générale des essais, JRC technical note.