第V部門
付着・定着・継手(2)
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[V-514] Concrete Cracked by Expansion Agent Filled Pipes in Bond Test Specimens with Stirrups
Concrete Cracked by Expansion Agent Filled Pipes in Bond Test Specimens with Stirrups

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キーワード：鉄筋腐食、静的破砕剤、ひび割れ幅、付着、横補強筋
Rebar corrosion, Expansion agent, Crack width, Bond test, Stirrup

付着とは鉄筋と周囲のコンクリートとの相互作用を指す。鉄筋の腐食は、鉄筋とコンクリートの間の付着劣化を引き起こし、 RC構造物の構造性能の低下へと繋がる。コンクリート表面のひび割れ幅は目視での観察が可能なため、鉄筋腐食による付着劣化を評価する上で有効な指標であると考えられる。本研究では、横補強筋が付着強度劣化に及ぼす影響を調査するために、破砕剤充填パイプ（ EAFP）によってひび割れを模擬した試験体の引抜き試験を行い、鉄筋腐食によるひび割れ幅及び横補強筋が付着強度劣化に与える影響について検討を行った。実験に用いた試験体と破砕剤充填パイプによるひび割れの模擬結果を示す。

Rebar corrosion can cause bond deterioration between rebar and concrete which directly affects the serviceability and durability of RC structures.
In this study, to investigate the influence of stirrup on bond strength degradation, specimens cracked by expansion agent filled pipe (EAFP) are subjected to a pull-out test and a relationship between the bond strength of bar and surface crack width as a variable is discussed. This part describes the design and cracks simulation results of those specimens.

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Concrete Cracked by Expansion Agent Filled Pipes in Bond Test Specimens with Stirrups

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1. INTRODUCTION

Bond refers to the interaction between reinforcing steel (rebar) and the surrounding concrete, which allows transferring of tensile stress from the steel into the concrete. Rebar corrosion can cause bond deterioration between rebar and concrete which directly affects the serviceability and durability of RC structures. Indeed, the surface crack width provides the clearest visual manifestation of reinforcement corrosion. Easily measurable, it can be a key parameter to solve this problem by directly correlating the bond deterioration of the surface crack width. Our previous studies [1,2] are based on specimens without stirrups. However, for real concrete structural members stirrups are present. In fact, the bond deterioration of stirrup-confined specimens is quite different from specimens without stirrups.

In this study, to investigate the influence of stirrup on bond strength degradation, specimens cracked by expansion agent filled pipe (EAFP) are subjected to a pull-out test and a relationship between the bond strength of bar and surface crack width as a variable is discussed. This part describes the design and cracks simulation results of those specimens.

2. PULL-OUT SPECIMENS OVERVIEW

2.1 Pull-out specimen

The pull-out specimen is designed as shown in Fig.1. The dimensions of the specimen are 260×170×170 mm, and the D19 rebar is embedded at 47.5 mm from the specimen cover side. A short bond length of 4 times the diameter of the rebar equal to 76 mm is chosen to focus on the local bond behavior. The main parameters examined are the induced crack width and stirrup quantity (see Table 1). D10 rebar is used as a stirrup. Two EAFPs are set to 50 mm from the rebar to simulate the cracking of surrounding concrete. Moreover, an unbonded part was set to avoid cone failure of concrete. The M6 coupler was fixed 100×50 mm at the upright position to set an LDVT for measuring the slip of the free end of the bar.

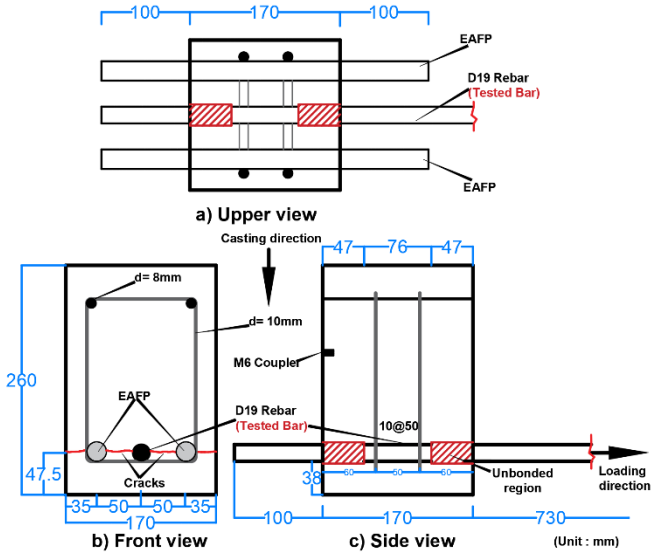

Fig. 1 Specimen detail (example Series S2)

(a) Series S0　(b) Series S1　(c) Series S2

Fig. 2 Specimen framework

Table 1 Specimen list

Series	Stirrup spacing (mm)	p_w (%)	Target induced crack width (mm)
S0	No stirrup	0	0 to 1.4
S1	76	1.10	
S2	50	1.68	

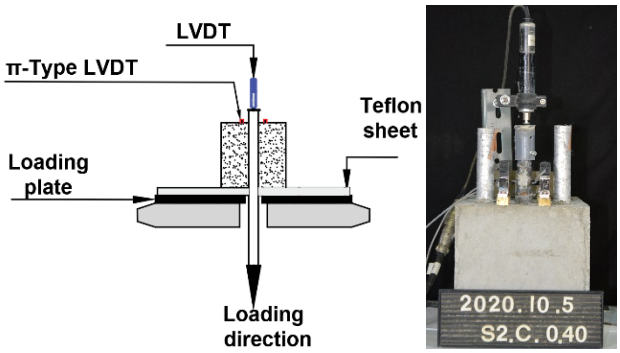

Fig. 3 Loading and measurement of pull-out test

Keywords　Rebar corrosion, Expansion agent, Crack width, Bond test , Stirrup.
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The reinforcement is a deformed bar of a nominal diameter of 19 mm. The specimen framework is also shown in Fig.2.

2.2 Loading and measurements

Fig. 3 shows the test set-ups for the pull-out test. The specimen was set on the Teflon sheet and the loading plate on which the hole with the same diameter corresponding to concrete cover to not restrict the lateral deformation of concrete. The D19 rebar is subjected to monotonic pull-out loading at a speed of 0.5mm/min. The measurement items are pull-out load, crack opening, and slippage of the rebar.

3. CRACK SIMULATION BY EAFP

3.1 Crack simulation by EAFP

The ratio of the water to an expansion agent was set to 30%. The specimen was placed to set vertically the axis of the pipe. As shown in Fig.4, the expansion agent was filled from the top of the pipe. The crack width increases over elapsed time after filling. Thus, this time is controlled to obtain the target crack width.

3.2 Cracking patterns induced by EAFP

Fig. 5 shows an example of crack patterns after filling the expansion agent. The side split type cracks took place in all specimens. The maximum induced crack width ranges from 0.15 to 0.95 mm in S0 specimens, 0.15 to 1.40 mm in S1 specimens, 0.15 to 0.70 mm in S2 specimens.

4. FAILURE PATTERNS BY PULL-OUT TEST

Example of failure pattern is shown in Fig.6. All specimens failed by splitting of concrete. S0 specimens failed by the widening of existing crack induced with EAFP. However, S1 and S2 specimens failed by a newly generated crack on the cover face despite existing induced crack. It was also observed that the stirrups can effectively restrain the opening of induced cracks

5. CONCLUSIONS

This study describes the outline of concrete cracks by expansion agent filled pipes in bond test specimens with stirrups. Side split cracks with various widths were simulated by EAFP in all specimens. By pull-out loading, the specimen either failed by widening of induces cracks or by a newly generated crack on the cover face.

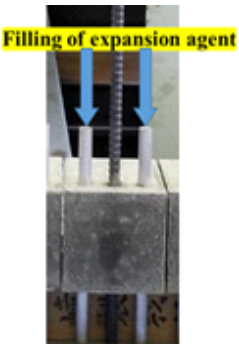
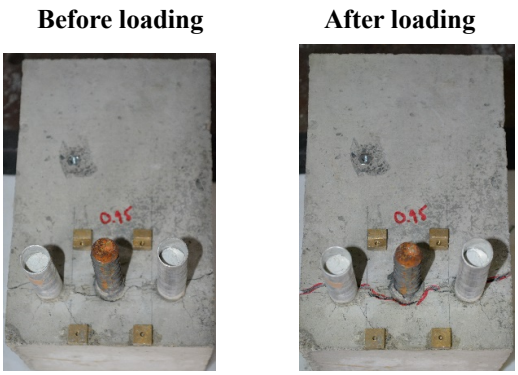


Fig. 4 Filling of expansion agent

(S0-C-0.95mm) (S1-C-0.70mm) (S2-C-0.60mm)

Fig. 5 Example of cracking by EAFP



(a) Widening of induced crack

(b) New crack on the cover face

Fig. 6 Example of failure pattern by pull-out loading

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