

Performance of Unbending Embedded for Precast Concrete

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Keywords: embedded, precast, concrete

Abstract: Usually we used embedded for joint of precast concrete with bending embedded system (PCI Standard). Bending embedded system used reinforced with bending in the end of plate but for unbending embedded system used reinforced with unbending in the end of plate. This research aims to determine perform of embedded with unbending system. The materials used in this research was reinforced with Diameter 12,59 mm, Plate 4,58 mm thick and electrodes used in this welding method was E6013. This experiment was testing of the ultimate tensile strength of unbending embedded joint of precast concrete and testing of ultimate tensile strength of the reinforced bar. The results of this research was the average value of ultimate tensile strength of unbending embedded 597,16 Mpa broken at the reinforced bars. Average value of ultimate tensile strength of reinforced bar was 605,23 Mpa. Conclusion of this research is embedded with unbending system for precast concrete can be used for construction of joints. Usually we used embedded for joint of precast concrete with bending embedded system (PCI Standard). Bending embedded system used reinforced with bending in the end of plate but for unbending embedded system used reinforced with unbending in the end of plate. This research aims to determine perform of embedded with unbending system. The materials used in this research was reinforced with Diameter 12,59 mm, Plate 4,58 mm thick and electrodes used in this welding method was E6013. This experiment was testing of the ultimate tensile strength of unbending embedded joint of precast concrete and testing of ultimate tensile strength of the reinforced bar. The results of this research was the average value of ultimate tensile strength of unbending embedded 597,16 Mpa broken at the reinforced bars. Average value of ultimate tensile strength of reinforced bar was 605,23 Mpa. Conclusion of this research is embedded with unbending system for precast concrete can be used for construction of joints.

1 INTRODUCTION

1.1 Previous Reserach

Unbending Embedded are elements joint of precast concrete which use materials consist of plate and reinforce bar. Research of embedded for precast concrete has been widely done since 1993 and widely used by society of Consultants or Contractors sector. In 1993 Ugur Ersoy and Tugrul Tankut on research *Precast Concrete Members With Welded Plate Connections Under Reversed Cyclic Loading*². This research was used unbending embedded element to joint between beam and column for sustain moment and shear occur.

Research of Seismic behavior of a type of *welded precast* concrete beam-column connection by Mario E. Rodriguez, Miguel Torres-Matos concern bending embedded at negative moment in 2013.⁵ Andrea

Belleri, Paolo Riva in 2012 research concern Seismic performance and retrofit of *precast* concrete grouted sleeve connections.⁴ All research above concern to bending embedded joint system. This research was used unbending embedded joint system which used materials same as with bending embedded. The different is at bend and unbend to reinforce bar.

Goal of this research is making joint with result perform not different to each other system. Result of research unbending embedded system has performed so good to sustain of tension.

1.2 Design of Joint

Many types of joint for precast concrete in construction and embedded system has been many using in construction sector. Type of Embedded system using materials plate and reinforce bars. To connecting material plate and reinforce bar using

electrode to weld between plate and reinforce bar.

Figure 1 show element unbending embedded system. And can be simple Formulated^{10,11} :

$$L_d = \left(\frac{18 \cdot f_y \cdot \alpha \cdot \beta \cdot \lambda \cdot d_b}{25 \cdot \sqrt{f_c'}} \right) > 300 \text{ mm}$$

where :

f_y = Yield Stress (Mpa)

α = Reinforcement location factor

β = Coating factor

λ = Lighthweight aggregate concrete factor

d_b = Nominal Diameter

f_c' = Compression Concrete (MPa)

and another formulated^{1,3}

$$T_u = A_s \cdot f_y \cdot (N)$$

$$F_w = L \cdot f_{sw} \cdot t$$

Where :

T_u = Tensile Strength Rebar (N)

A_s = Area of Rebar (mm²)

F_w = Shear Strength of Welded (N)

L = Length of Welded (mm)

f_{sw} = Shear Stress of Welded (Mpa)

t = Thick of Welded (mm)

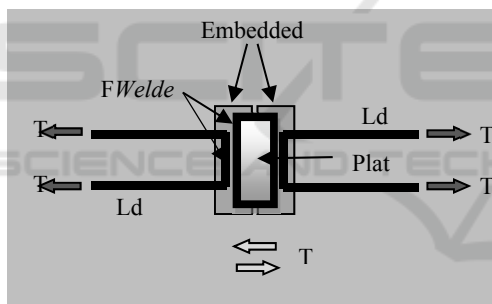


Figure 1. Element unbending embedded system



Figure 2. Photo of Unbending Embedded

2 RESEARCH METHOD

Testing elements used location at Lembaga Uji Konstruksi (LUK) BPPT Serpong South of Tangerang. This research has 5 samples for tested unbending embedded tensile strength dan 5 samples for tested tensile strength reinforced bars. Reinforced bars used D12,59 and plate which have 4,58 mm thick with electrode type E6013.. to joint between plate and rebars with 5 mm thick. **figure 2** was show prototype of sample test unbending embedded tensile strength and **figure 3** was show prototype of reinforced bar tensile strength. **Figure 4** describe of dimension sample test for unbending embedded tensile strength which have measurement of total length of welded 66 mm, length of reinforced bar 400 mm and dimension of plate 80/70 mm as base of welding. **Figure 5** show of method of research which was used UTM machine at Puspitek BPPT Serpong and appropriate ASTM standard for test tension of elements.



Figure 3. Photo of Reinforced bars

3 RESULTS AND DISCUSSION

The Research of unbending embedded for all specimens were capable to resisting tensile load until broken, cause all specimens were its broken at the reinforce bars. Specimen 2A indicated ultimate tensile strength value 608,12 Mpa as ultimate load 75,67 KN, specimen 2B indicated ultimate tensile strength value 609,84 Mpa as ultimate load 75,88 KN, specimen 2C indicated ultimate tensile strength value 589,38 Mpa as ultimate load 73,21 KN, specimen 2D indicated ultimate tensile strength value 594,29 Mpa as ultimate load 73,95 KN and specimen 2E indicated ultimate tensile strength value 585,18 Mpa as ultimate load 72,81 KN. The results of this research was the average value of ultimate tensile strength of unbending embedded 597,16 Mpa as ultimate load 74,31 KN broken at the reinforced bars. **Table 1** gives

the result of ultimate tensile strength of all specimens unbending embedded system. **Figure 6** show of photo specimens of unbending embedded have tested. The Research of reinforce bars for all specimens were tested until broken. Specimen 4A indicated ultimate tensile strength value 646,47 Mpa as ultimate load 80,44 KN, specimen 4B indicated ultimate tensile strength value 596,73 Mpa as ultimate load 74,25 KN, specimen 4C indicated ultimate tensile strength value 592,63 Mpa as ultimate load 73,74 KN, specimen 4D indicated ultimate tensile strength value 593,19 Mpa as ultimate load 73,81 KN and specimen 4E indicated ultimate tensile strength value 597,13 Mpa as ultimate load 74,30 KN. The results of this research was the average value of ultimate tensile strength of reinforce bars 605,23 Mpa as ultimate load 75,31 KN. **Table 2** gives the result of ultimate tensile strength of all specimens reinforce bars. **Figure 7** show of photo specimens of reinforce bars until tested. The value of average ultimate tensile strength both of specimens unbending embedded or specimens reinforce bars have resulted almost not different only about 1,01 KN for ultimate load and 8.07 Mpa for ultimate tensile strength and all of specimens broken at the reinforced bar. This result test can be category fulfill of tensile strength and can be used for construction as specially joint of precast concrete. **Figure 8** show chart of load versus stress.

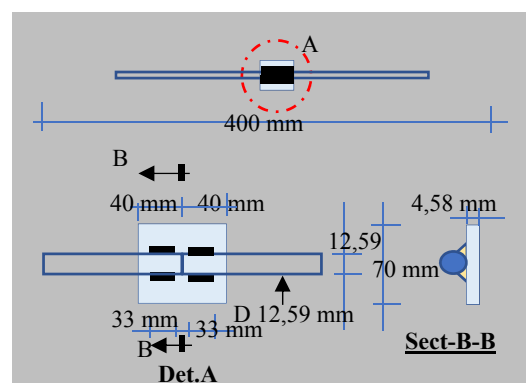


Figure 4: Sketch of Unbending Embedded



Figure 5: UTM Machine

Table 1: Result Test of Unbending Embedded

No	Sample	Max.Load kN	t.Plake mm	L.Rigth mm	L.Left mm	fu.Rigth MPa	fu.Left MPa	Result
1	2A	75.67	4.56	66.50	64.50	608.14	608.14	Reinf.broken
2	2B	75.88	4.65	67.00	65.50	609.83	609.83	Reinf.broken
3	2C	73.21	4.54	64.00	65.50	588.37	588.37	Reinf.broken
4	2D	73.95	4.57	64.00	67.00	594.32	594.32	Reinf.broken
5	2E	72.81	4.56	65.00	64.00	585.15	585.15	Reinf.Broken
Average		74.31	4.58	65.30	65.30	597.16	597.16	

Table 2: Result Test Of Reinforce Bar D 12.59 mm

No	Sample	Dia mm	Area mm ²	Fy kN	Fu kN	fy MPa	fu MPa	Result
1	4A	12.59	124.43	58.82	80.44	472.72	646.47	Reinf.broken
2	4B	12.59	124.43	51.83	74.25	416.54	596.73	Reinf.broken
3	4C	12.59	124.43	51.28	73.74	412.12	592.63	Reinf.broken
4	4D	12.59	124.43	50.86	73.81	408.75	593.19	Reinf.broken
5	4E	12.59	124.43	52.16	74.30	419.20	597.13	Reinf.Broken
Average				52.99	75.31	425.87	605.23	



Figure 6: Samples Have Tested



Figure 7: Photo of Reinforced bar

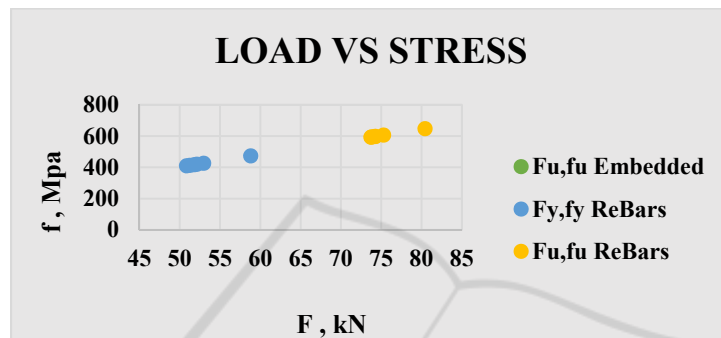


Figure 8. Ultimate load vs ultimate tensile strength.

4 CONCLUSION

The results of this research was the average value of ultimate tensile strength of reinforce bars 605,23 Mpa as ultimate load 75,31 KN and the average value of ultimate tensile strength of unbending embedded 597,16 Mpa as ultimate load 74,31 KN broken at the reinforced bars and difference both of specimens almost not different, only about 1,01 KN for ultimate load and 8.07 Mpa for ultimate tensile strength and all of specimens broken at the reinforced bars, indicate that research about connection use unbending embedded system can be applicated. SNI and ACI requiring 1,25 f_y strength of rebars if joint element used welded for connect each others

Advantage of this system, for making element joint will be faster than system bending embedded joint with the result that, cost of all element joint will be cheaper.

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