

PERFORMANCE OF EMBEDDED OF *PRECAST* BEAM TYPE *WET* AND *DRY JOINT* AT MAXIMUM MOMENT

A.Rudi Hermawan¹, Eka Sasmita Mulya²

^{1,2}Politeknik Negeri Jakarta, Teknik Sipil, 16425

e-mail: arudihermawan@gmail.com¹; ekamulya66@yahoo.com²

ABSTRACT

Research of perform of embedded precast beam was result many data (a) average tensile strength of joint between plate embedeed with plate joint was 628,55 Mpa (b) average tensile strength of joint between plate with reinforce bar D12,59 was 597,16 Mpa for tensile strength of plate with failure at reinforce bar (c) average tensile strength of reinforce bar D12,59 was 605,23 Mpa and yield strength was 425,87 Mpa (d) average tensile strength of plate 4,58 mm thick was 456,86 Mpa and yield strength was 335,02 Mpa. For welded joint need several control quality so that no hole in that perform of welded couse can decrease tensile strength of joint. Conclusion of this research is embedded for precast concrete type wet and dry can be used for construction of joints of beam.

Keywords : Compressive strength; Embedded; Yield strength

INTRODUCTION

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* (Ersoy & Tankut, 1993). This research was used bending 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. Rodríguez, Miguel Torres-Matos concern bending embedded at negative moment in 2013 (E. Rodríguez & Torres-Matos, 2013). Andrea Belleri, Paolo Riva in 2012 research concern Seismic performance and retrofit of *precast* concrete grouted sleeve connections (Belleri & Riva, 2012). 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 wet and dry system with unbending embedded has performed so good to sustain of tension.

METHODS

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 (318, 2011; (SNI, 2012):

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

where :

- f_y = Yield Stress (Mpa)
- α = Reinforcement location factor
- β = Coating factor
- λ = Lighthweigh aggregate concrete factor
- d_b = Nominal Diameter
- f_c' = Compression Concrete (MPa)

and another formulated (Rodríguez & Torres M, 2013; Nadim & Manaser, 2008)

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

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

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)

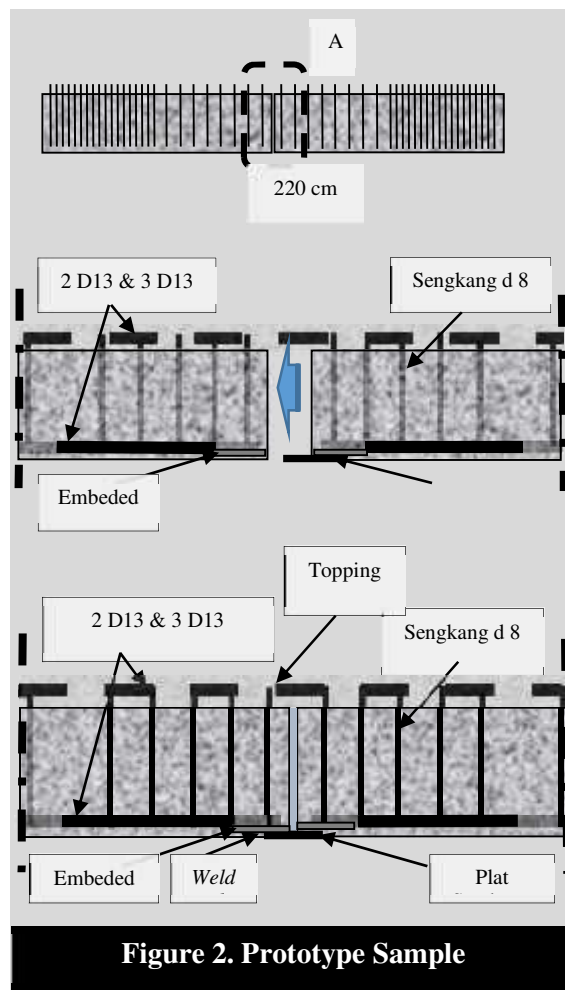


Figure 2. Prototype Sample

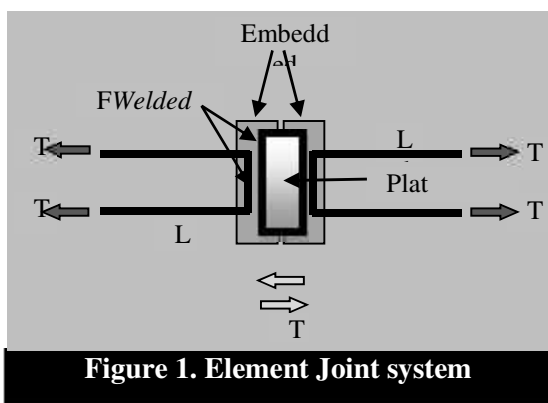


Figure 1. Element Joint system

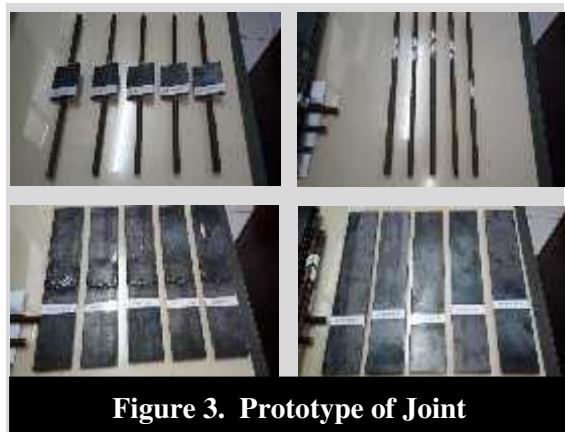


Figure 3. Prototype of Joint

Testing elements was 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 E.6013 to joint between plate and rebars with 5 mm thick.

Figure 2 was show prototype of sample test tensile strength of beam and **figure 3** was show prototype of reinforced bar and plate 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 describe of dimension sample test for unbending embedded tensile strength which have measurement of total length of welded 44 mm, length of plate is 400 mm and dimension of plate 400/80 mm as base of welding.

Figure 6 show of method of research which was used UTM machine at Puspitek BPPT Serpong and appropriate ASTM standard for test tension of elements.

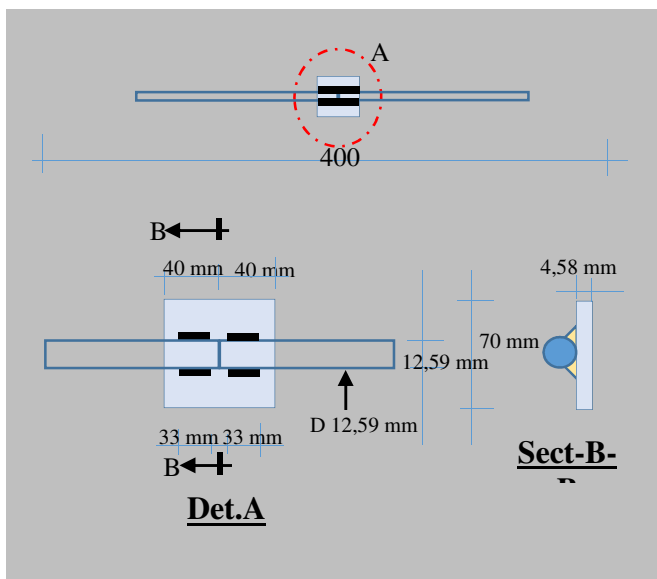


Figure 4. Sketch of Welded - Rebar

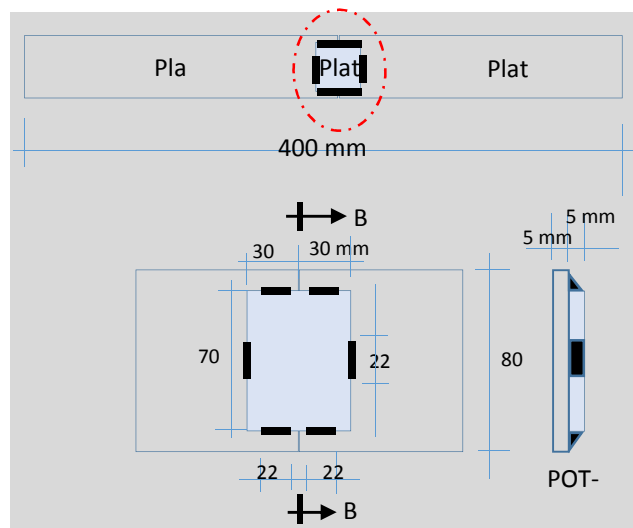


Figure 5. Sketch of Welded - Plate



Figure 6. UTM Machine

RESULTS AND DISCUSSION

The Research of wet and dry system with 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 7 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 8 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 11 show chart of load versus stress.

The Research of unbending embedded for all specimens were capable to resisting tensile load until broken, cause all specimens were its broken at the welded. Specimen 1A indicated average ultimate tensile strength value 621,56 Mpa as ultimate load 92,71 KN, specimen 1B indicated average ultimate tensile strength value 640,19 Mpa as ultimate load 100,16 KN, specimen 1C indicated average ultimate tensile strength value 549,4 Mpa as ultimate load 90,89 KN, specimen 1D indicated average ultimate tensile strength value 561,91 Mpa as ultimate load 88,85 KN and specimen 1E indicated average ultimate tensile strength value 586,40 Mpa as ultimate load 90,61 KN.

The results of this research was the average value of ultimate tensile strength of unbending embedded 591,89 Mpa as ultimate load 92,64 KN broken at welded.

Table 3 gives the result of ultimate tensile strength of all specimens unbending embedded system.

Figure 9 show of photo specimens of unbending embedded have tested. The Research of plates for all specimens were tested until broken. Specimen 3A indicated ultimate tensile strength value 456,38 Mpa as ultimate load 52,34 KN, specimen 3B indicated ultimate tensile strength value 445,60 Mpa as ultimate load 52,34 KN, specimen 3C indicated ultimate tensile strength value 465,14 Mpa as ultimate load 53,11 KN, specimen 3D indicated ultimate tensile strength value 460,79 Mpa as ultimate load 52,94 KN and specimen 3E indicated ultimate tensile strength value 456,61 Mpa as ultimate load 52,53 KN.

The results of this research was the average value of ultimate tensile strength of plates 456,9 Mpa as ultimate load 52,65 KN.

Table 4 gives the result of ultimate tensile strength of all specimens plates.

Figure 10 show of photo specimens of plates until tested. The value of average ultimate tensile strength both of specimens unbending embedded or specimens plates have resulted almost not different only about 39,99 KN for ultimate load and 98.37 Mpa for ultimate tensile strength and all of specimens broken at the plates. This result test can be category fulfill of tensile strength and can be used for construction as specially joint of precast concrete.

Figure 11a and Figure 11b show chart of load versus stress.



Figure 7. Samples Have Tested



Figure 8. Photo of Reinforced bar



Figure 9. Photo of Reinforced bar



Figure 10. Samples Have Tested

Table 1.
Result Test Of Unbending Embedded

No	Sample	Max.Load	t.Plate	L.Rigth	L.Left	fu.Rigth	fu.Left	Result
		kN	mm	mm	mm	MPa	MPa	
1	2A	75.67	4.56	66.50	64.50	608.14	608.14	Reinf failed
2	2B	75.88	4.65	67.00	65.50	609.83	609.83	Reinf failed
3	2C	73.21	4.54	64.00	65.50	588.37	588.37	Reinf failed
4	2D	73.95	4.57	64.00	67.00	594.32	594.32	Reinf failed
5	2E	72.81	4.56	65.00	64.00	585.15	585.15	Reinf failed
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	Area	Fy	Fu	fy	fu	Result
		mm	mm ²	kN	kN	MPa	MPa	
1	4A	12.59	124.43	58.82	80.44	472.72	646.47	Reinf failed
2	4B	12.59	124.43	51.83	74.25	416.54	596.73	Reinf failed
3	4C	12.59	124.43	51.28	73.74	412.12	592.63	Reinf failed
4	4D	12.59	124.43	50.86	73.81	408.75	593.19	Reinf failed
5	4E	12.59	124.43	52.16	74.30	419.20	597.13	Reinf failed
Average				52.99	75.31	425.87	605.23	

Table. 3
Result Test of Welded Plate-Plate

No	Sample	MaxLoad	t	L.Rigth	L.Left	fu.Rigth	fu.Left	Exp.
		kN	plate mm	mm	mm	Mpa	Mpa	
1	1A	92.71	4.56	55.50	64.50	668.18	574.95	Welded failed
2	1B	100.16	4.65	59.50	66.00	673.34	607.03	Welded failed
3	1C	90.89	4.54	64.00	68.50	568.06	530.74	Welded failed
4	1D	88.85	4.57	59.50	67.50	597.31	526.52	Welded failed
5	1E	90.61	4.56	57.00	67.50	635.86	536.95	Welded failed
Average		92.64	4.58	59.10	66.80	628.55	555.24	

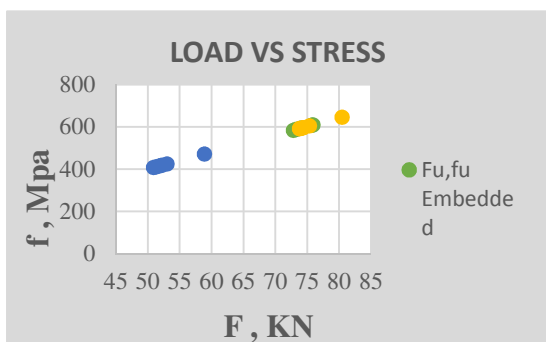


Figure 11a. Chart of Load vs Stress

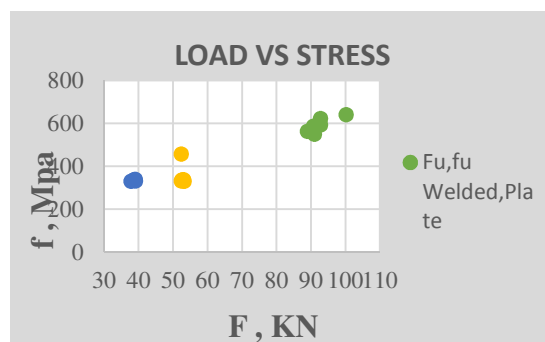


Figure 11b. Chart of Load vs Stress

Table .4
Result Test Of Plate

No	Sample	t.Plate mm	Area mm ²	Fy kN	Fu kN	fy Mpa	fu Mpa	Exp.
1	3A	4.56	114.7	38.9	52.34	339.4	456.38	Plate failed
2	3B	4.65	117.5	39.0	52.34	332.3	445.60	Plate failed
3	3C	4.54	114.2	37.7	53.11	330.1	465.14	Plate failed
4	3D	4.57	114.9	38.8	52.94	337.9	460.79	Plate failed
5	3E	4.56	115.1	38.6	52.53	335.5	456.41	Plate failed
Average				38.6	52.65	335.0	456.9	

CONCLUSION

Result of test element joint of precast beam indicates that embedded with type wet and dry joint can be used for connection between element of precast beam joint.

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