Analysis of Precast Concrete Beam Type L Joint at Moment Maximum

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Abstract: Cause of regarding many case was difficulted for adjusting between joint of elements, then this research was described about joint of element precast with L shape. L shape that is mean, joint of element precast have shape such as word of L and easier to adjusting. This research have molded two beam of conventional (K1,K2) and two beam of precast (P1,P2). Purpose of this research was determined of deflection and maximum moment occur at tension maximum. Just for question of this research was about deflection and moment maximum occur at tension maximum if any load were applicated. Result of precast L shape concrete beam P1 and P2 and conventional beam K1 and K2 were strength of flexural beam at ultimate and deflection of beam at ultimate. Strength of flexural conventional beam K1 at ultimate was achieved 11,38 T at deflection 138 mm. Strength of flexural conventional beam K2 at ultimate was achieved 11,25 T at deflection 163,9 mm. Strength of flexural precast beam P1 at ultimate was achieved 11,21 T at deflection 28,44 mm and strength of flexural precast beam P2 at ultimate was achieved 11,76 T at deflection 26,71 mm. Average compressive strength of concrete beam was achieved 311,89 kg/cm2. Average compressive strength of sika grout 215 was achieved 421,33 kg/cm2 at 9 day. Conclusion of this research about joint type L for precast concrete beam is having good performance only less for ductility. Conventional beam K1 and K2 were showed ductility du/dy behavior at least approximately 4,29 different with precast beam P1 and P2 was has less behavior ductility du/dy at least approximately 1,17.

1 INTRODUCTION

Aim of research of precast concrete beam type L joint was determined deflection and maximum load where load was applicated at its beam. This type could be easier to install or erection construction precast. Compared with research previously, this research was product joint where if it was erected so more facilitate.

The benefit of using precast concrete beam type L joint is more effective for construction than conventional beam (cast in site) and minimize cost of construction. Research of strength of flexural and deflection between diversification of two materials was investigated, Mario E. Rodríguez, Miguel Torres-Matos (2013) was researched of joint between beam to column with joint by embedded was connected by rebar and was welded Marco Breccolotti et al. (2017) was researched of Wet-joint techniques for the construction of precast concrete pipe rack structures in remote seismic zones.

Contradiction with this research was a connection between element used joint type L shape. L shape that is mean, joint of element precast have shape such as word of L.

For connecting between element of precast has welded and used Sika grout 215 to cover its void. Sika grout 215 was material for grouting between element concrete has welded and casted.

Specification of material sika grout have compressive strength for 3 days approximately 40,0 N/mm2 and for 7 days approximately 52,0 N/mm2. For this research have compressive strength 42,13 N/mm2.

The question for this research is how about strength of flexural precast concrete beam type L joint if any load were applicated and how about deflection occur. Eventually, aim of this research was determined of strength of flexural precast concrete beam type L joint beam P1,P2 and deflection occur if that was

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compared with deflection of conventional beam K1,K2.

1.1 Tension Non-prestressed

Bonded between rebar and concrete were determined for strength of flexure of conventional beam and precast beam. Code of ACI 318-2011 and SNI 03-2847-2019 was explained for bonded between them:

$$Ld = \left(\frac{18.fy.\alpha.\beta.\lambda.db}{25.\sqrt{fc'}} \right) > 300\,mm \qquad (1)$$

Where as :
fy = Strength of yield (Mpa)
β = Coating factor
α = Reinforcement location factor
λ = *Ligthweigth aggregate concrete factor*
db = Nominal diameter tulangan
fc' = Compressive strength (MPa)
T = Tension

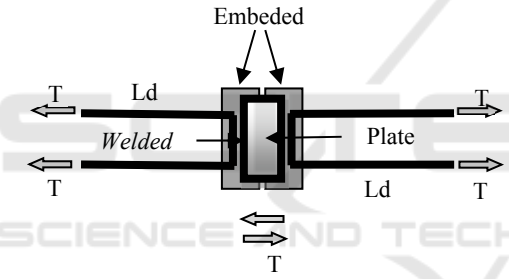

Figure 1: Joint L Shape.

2 RESEARCH METHOD

Element conventional concrete beam and precast concrete beam were tested at Bina Teknik Permukiman dan Perumahan Direktorat Jenderal Cipta Karya Kementerian PUPR Jl. Panyaungan, Cileunyi Wetan Kab. Bandung. This research have 2 samples of precast concrete beam type L joint (P1,P2) and 2 samples precast conventional beam (K1,K2). All of samples would be tested flexural tensile strength. Reinforced bars used D12,59 mm. At below describe Figure 1 was showing prototype element joint embedded precast concrete beam type L shape. Figure 2 was showing Prototype element precast type L Joint concrete beam will be tested and Figure 3 was showing detail and Section of element precast type L Joint concrete beam also figure 4 was showing setting up of Loading Test will be tested. Figure 5 was showing element Universal Testing Machine (UTM) and figure 6 was showing element precast beam was under tested also figure 7 was showing element precast beam has tested.

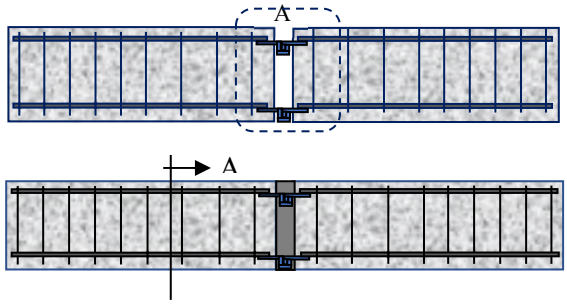

Figure 2: Prototype element precast type L Joint concrete beam.

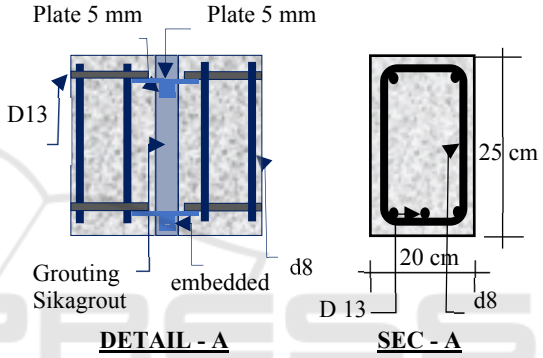

Figure 3: Detail and Section of element precast type L Joint concrete beam.

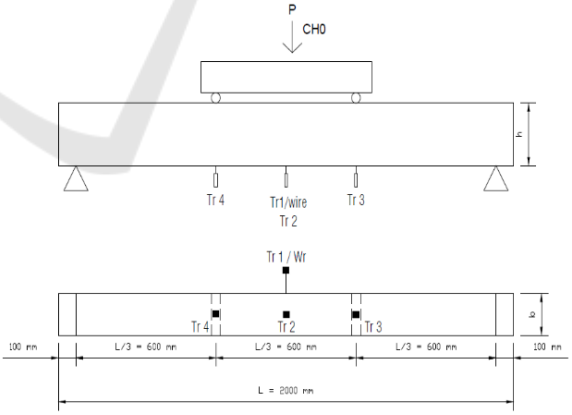

Figure 4: Setting up of Loading Test.

Figure 5: UTM machine.

Figure 6: Specimen precast beam was under tested.

Figure 7: Specimen of precast beam has tested.

3 RESULT AND DISCUSSION

Research of precast concrete beam type L joint for all specimens were indicated that precast concrete beam type L joint was capable for resistance under loading until at least more than 11 T equal with specimens conventional beam, accordingly all specimens were indicated that strength of flexural and deflection was not different respectively between specimens and will be explained at below. For pattern of crack, all of specimens have pattern of crack were not equal crack due to moment, indicate that all specimen have different behavior. Specimen precast type L joint have embedded with long width enough at the below then was extruded concrete at below of embedded and cause of crack pattern was different by conventional (figure 6,7). Average of compression strength of specimens were 311,89 kg/cm2 and 421,33 kg/m2 for sika grout 215 at 9 days.

Results of Strength of flexural precast beam P1 at ultimate was achieved 11,21 T at deflection 28,44 mm. Strength of flexural precast beam P2 at ultimate was achieved 11,76 T at deflection 26,71 mm and strength of flexural conventional beam K1 at ultimate was achieved 11,38 T at deflection 138 mm and strength of flexural conventional beam K2 at ultimate was achieved 11,25 T at deflection 163,9 mm. That indicate, specimens precast type L have strength ultimate better than specimens conventional nevertheless have behavior less for ductility. Table 1 showing result of flexural test of loading test.

Table 1: Result of Flexural Test.

No	Element	Load	Deflection.
		Ton	mm
1	K1	0,00-2,65	0,00-1,22
		2,83-5,66	1,27-3,91
		5,86-8,83	4,01-6,68
		9,01-10,36	6,77-15,61
		10,25-10,51	16,42-29,99
		10,33-10,73	30,99-49,16
		10,76-11,06	50,23-73,48
		11,10-11,33	74,97-108,40
		11,35-11,38	111,50-138,00
2	K2	0,00-2,65	0,00-1,18
		2,85-7,26	1,33-4,50
		7,53-9,86	4,59-8,11
		9,88-10,28	8,44-20,48
		10,33-10,28	22,49-46,91
		10,21-10,88	48,21-80,77
		10,95-11,18	86,67-132,90
		11,18-11,25	135,50-163,90
3	P1	0,00-2,62	0,00-0,90
		2,77-3,92	0,94-1,71
		3,93-4,96	1,75-3,43
		5,01-5,76	3,66-6,04
		5,75-6,65	6,30-9,13
		6,83-8,93	9,47-17,39
		9,66-11,21	18,52-28,44
4	P2	0,00-2,13	0,00-1,2
		2,23-3,72	1,27-2,83
		3,87-5,46	2,92-6,42
		5,55-7,53	6,58-12,23
		7,71-19,55	12,48-17,73
		9,60-11,65	17,81-15,14
		11,70-11,76	25,40-26,71

Figure 8 showing chart of result of loading versus deflection of specimen beam K1. Figure 9 showing chart of result of loading versus deflection of specimen beam K2. Figure 10 showing chart of result of loading versus deflection of specimen beam P1.

Figure 11 showing chart of result of loading versus deflection of specimen beam P2. It is evidence that result all of specimen indicate have equal performance for ultimate strength nevertheless different for behavior of pattern of failure, precast concrete beam type L joint was behavior less for ductility and conventional beam was behavior sufficient for ductility. For further information could be see chart at below.

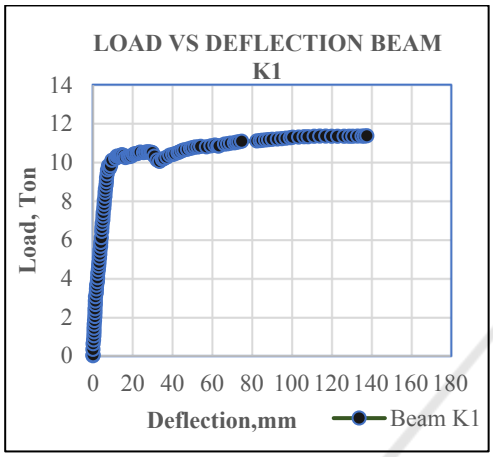

Figure 8: Chart of Result Beam K1.

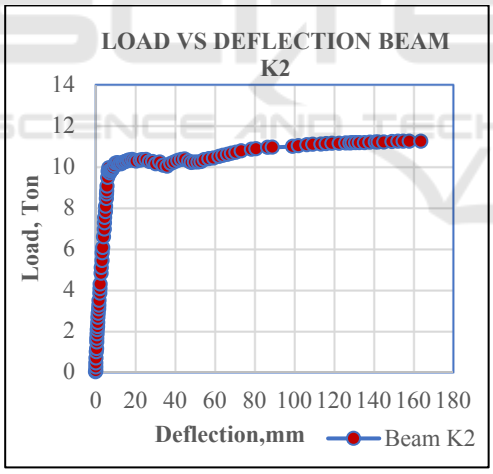

Figure 9: Chart of Result Beam K2.

For figure 12 showing of result of loading versus deflection of specimen entirely beam K and P. If refer to figure 12, showing indeed behavior of conventional beam K1 and K2 were showed ductility δu/δy behavior at least approximately 4,29 different with precast beam P1 and P2 was has less behavior ductility δu/δy at least approximately 1,17.

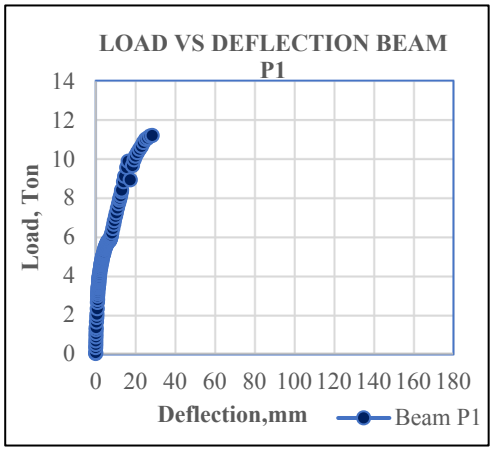

Figure 10: Chart of Result Beam P1.

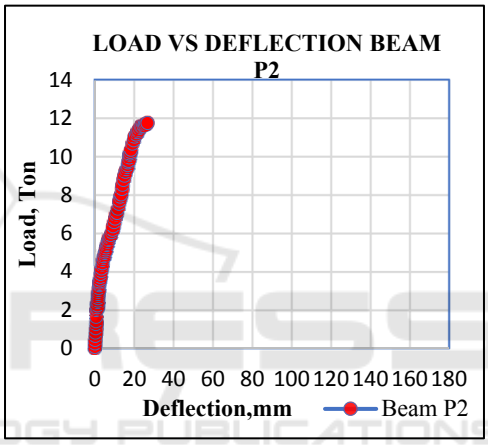

Figure 11: Chart of Result Beam P2.

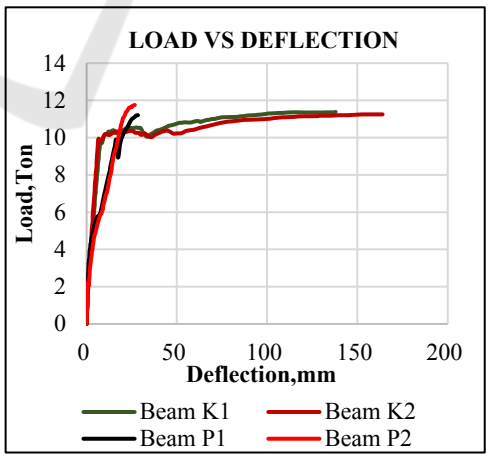

Figure 12: Chart of Result Beam K,P.

The benefit of precast concrete beam type L joint is more effective for construction than conventional beam (cast in site) and minimize cost of construction, cost of all element will be cheaper and can be

applicated at location with difficult to rotate and difficult for availability of materials for mixing concrete.

4 CONCLUSION

Result of precast concrete beam type L joint (P1,P2) and conventional beam (K1,K2) were strength of flexural beam at ultimate and deflection of beam at ultimate. Strength of flexural precast concrete beam type L joint P1 at ultimate was value 11,21 T at deflection 28,44 mm. Strength of flexural precast concrete beam type L joint P2 at ultimate was value 11,76 T at deflection 26,71 mm and strength of flexural conventional beam K1 at ultimate was value 11,38 T at deflection 138 mm and strength of flexural conventional beam K2 at ultimate was value 11,25 T at deflection 163,9 mm. Result all of specimen indicate have equal performance for ultimate strength nevertheless different for behavior of pattern of failure, precast concrete beam type L joint was behavior less for ductility δu/δy at least approximately 1,17 and conventional beam was behavior sufficient for ductility δu/δy behavior at least approximately 4,29. Result all of specimen indicate have same as performance.

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