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Numerical Study on Beam-Column Connection of Cantilever Precast Concrete Beam with Asymmetric Shape Under Static Load

Solo–Indonesia

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OUTLINE

- Introduction
- Samples and Analysis Method
- Result & Discussion
- Conclusion

INTRODUCTION

- Beam is an important structural component, widely used for structural building, and usually used to support main loads on buildings and bridges.
- Beam is intended to support majorly shear and flexural loads.

INTRODUCTION

In this research, three specimens of cantilevered beam-based blocks of reinforced concrete of precast with three different shapes are discussed. It is hoped that from this research, it will be generated the stress-strain relationship, P-delta relationship, stiffness, ductility, energy dissipation and the biggest point in receiving load or damaged.

Samples and Analysis Method

This study will analyze the performance of the precast cantilever beam connections. Three samples were numerically analyzed using Abaqus 6.13 software with variation shown in Table 1. Each test object was converged first. The quality of concrete used f'_c = 28 MPa and Young's modulus of the reinforcing bar used is 200.000 MPa. From this numerical analysis, it is resulted many output namely P-delta relationship, stress-strain relationship and crack pattern that happened

Samples and Analysis Method

Samples	Dimension (mm)		Length (mm)	Main Reinforce	Shear Reinforce	
	Fix point	Free Point			Near fixed support	Near free support
BK-1	200x175	200x175	1500	6 D 10	Ø6 – 80	Ø6 – 40
BK-2	200x175	170x170	1500	6 D 10	Ø6 – 80	Ø6 – 40
BK-3	250x175	170x170	1500	6 D 10	Ø6 – 80	Ø6 – 40

Samples and Analysis Method

Detail of test samples in this research can be seen in Figure 1 to Figure 3. The given static point load is 30 kN in the free-supported. Sample 1 (BK-1) is a beam with a normal cross section where the fixed support and the free support have the same cross-sectional dimension, while sample 2 (BK-2) and sample 3 (BK-3) are precast cantilever beams that are not symmetrical in their cross-sectional size. Its cross section dimension at the fixed support is larger than the other.

Samples and Analysis Method

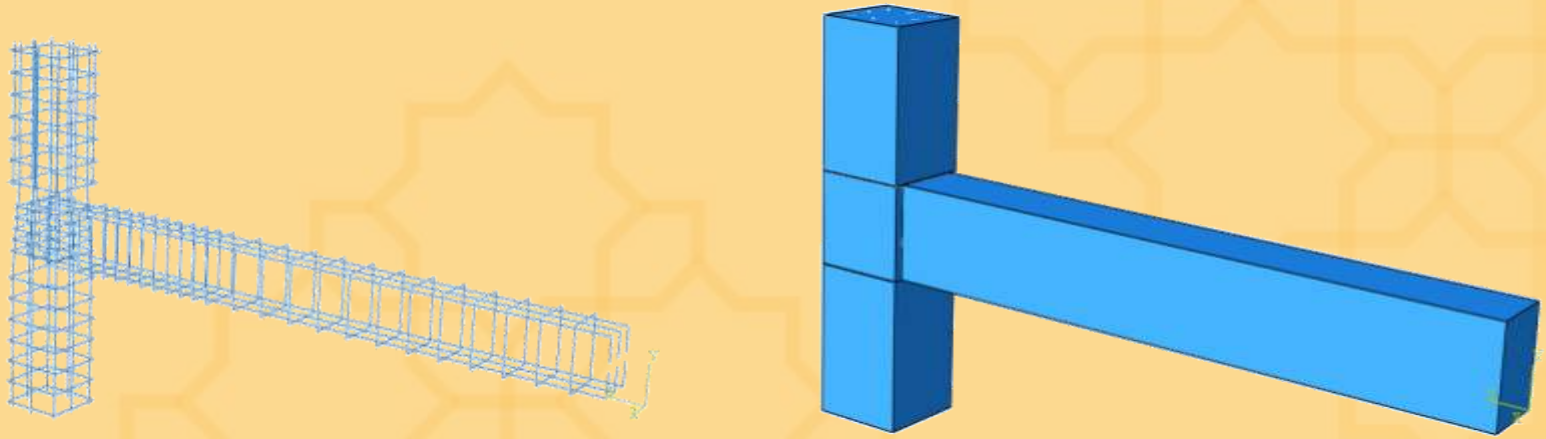


Fig. 1. Detail of Cantilever beam sample 1 (BK-1)

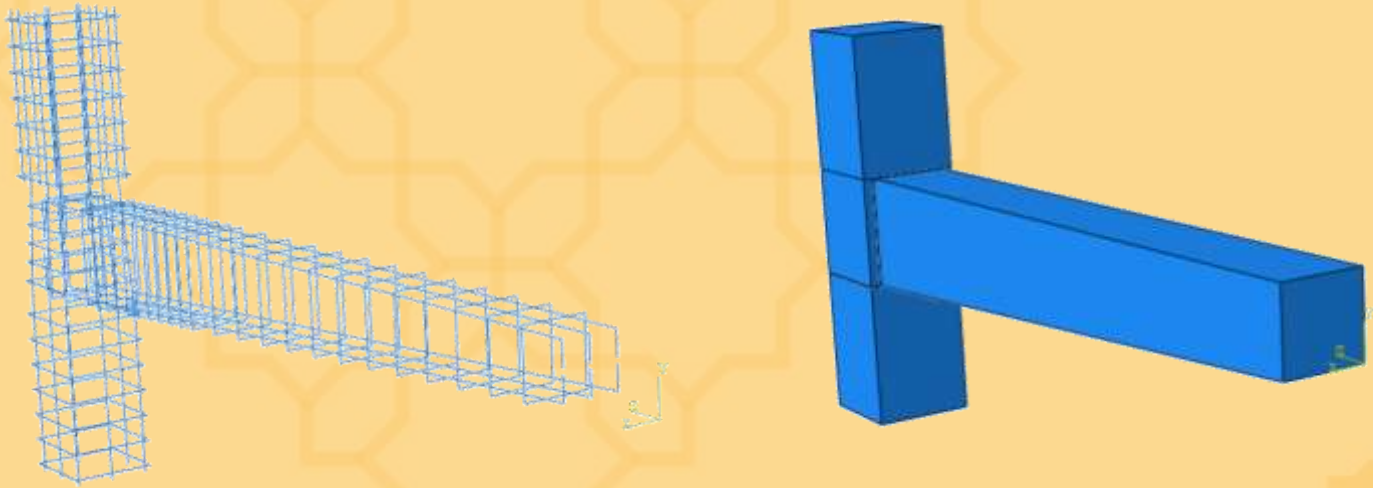


Fig. 2. Detail of Cantilever beam sample 2 (BK-2)

Samples and Analysis Method

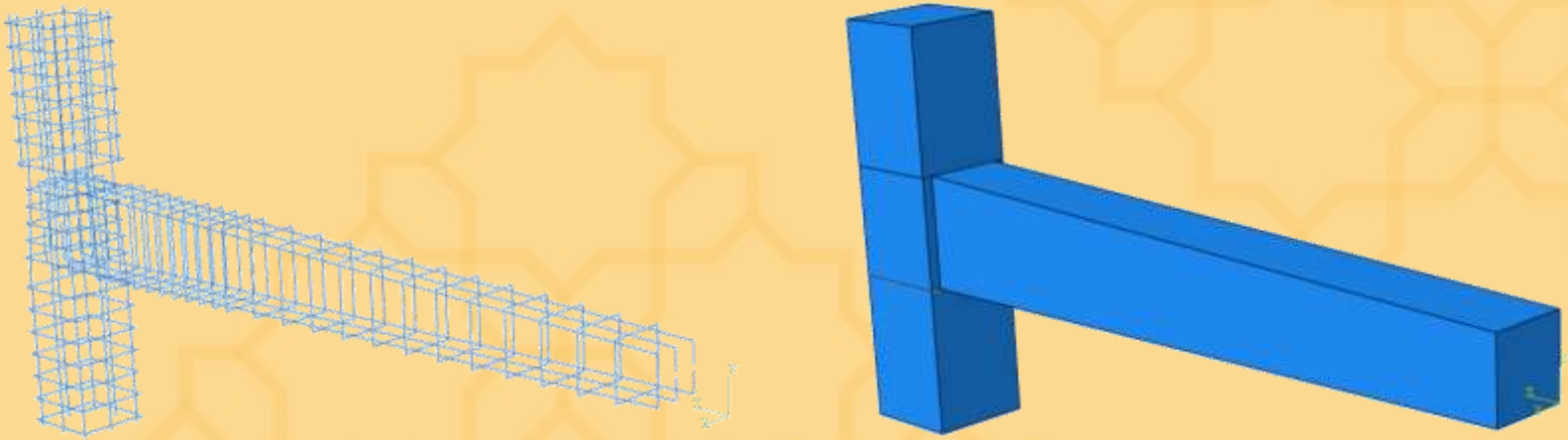


Fig. 3. Detail of Cantilever beam sample 2 (BK-2)

RESULT & DISCUSSION

Convergence Analysis

Before further analysis is done, samples that have been created should be tested with convergence test. This action aims to determine the exact number of mesh and reduce the error percentage. Figure 4 shows the relationship between number of mesh and the deflection that occurs, in this case, the mesh is stopped when the resulting deflection is constant or fixed. The three models have different amount of mesh according to the condition of the specimen, for BK-1 the number of elements is 2746, while the BK-2 is 2790 and the BK-3 is 2846.

RESULT & DISCUSSION

Convergence Analysis

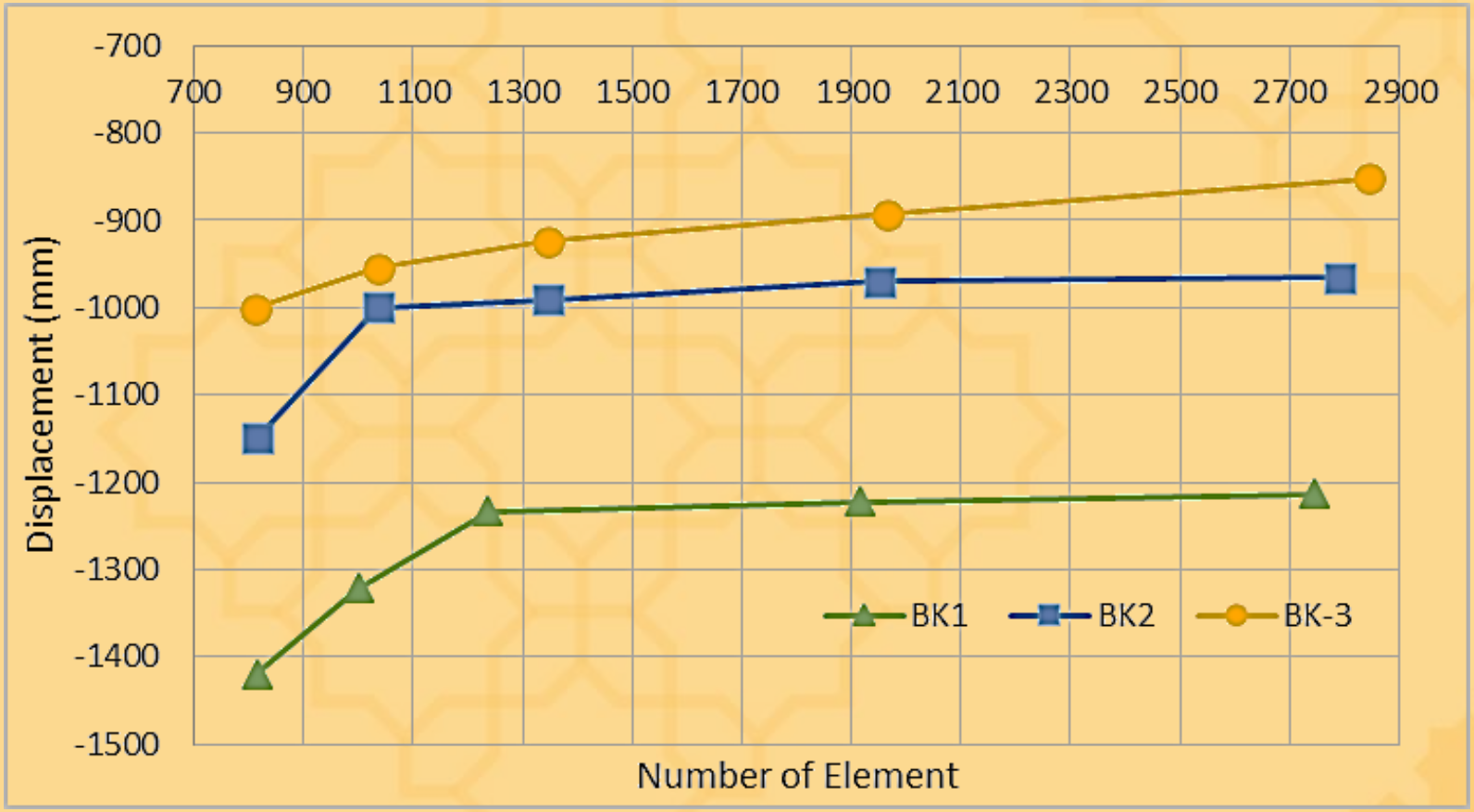


Fig. 4. Result of Convergence for all specimens

RESULT & DISCUSSION

Load-Deflection

Beam Sample	Yield		Crack	
	Force (N)	Displacement (mm)	Force (N)	Displacement (mm)
BK-1	11058.15	28.3342	8203.14	6.21138
BK-2	13157.76	18.0315	5680.08	2.629
BK-3	13946.46	22.7856	6481	2.3477

RESULT & DISCUSSION

Load-Deflection

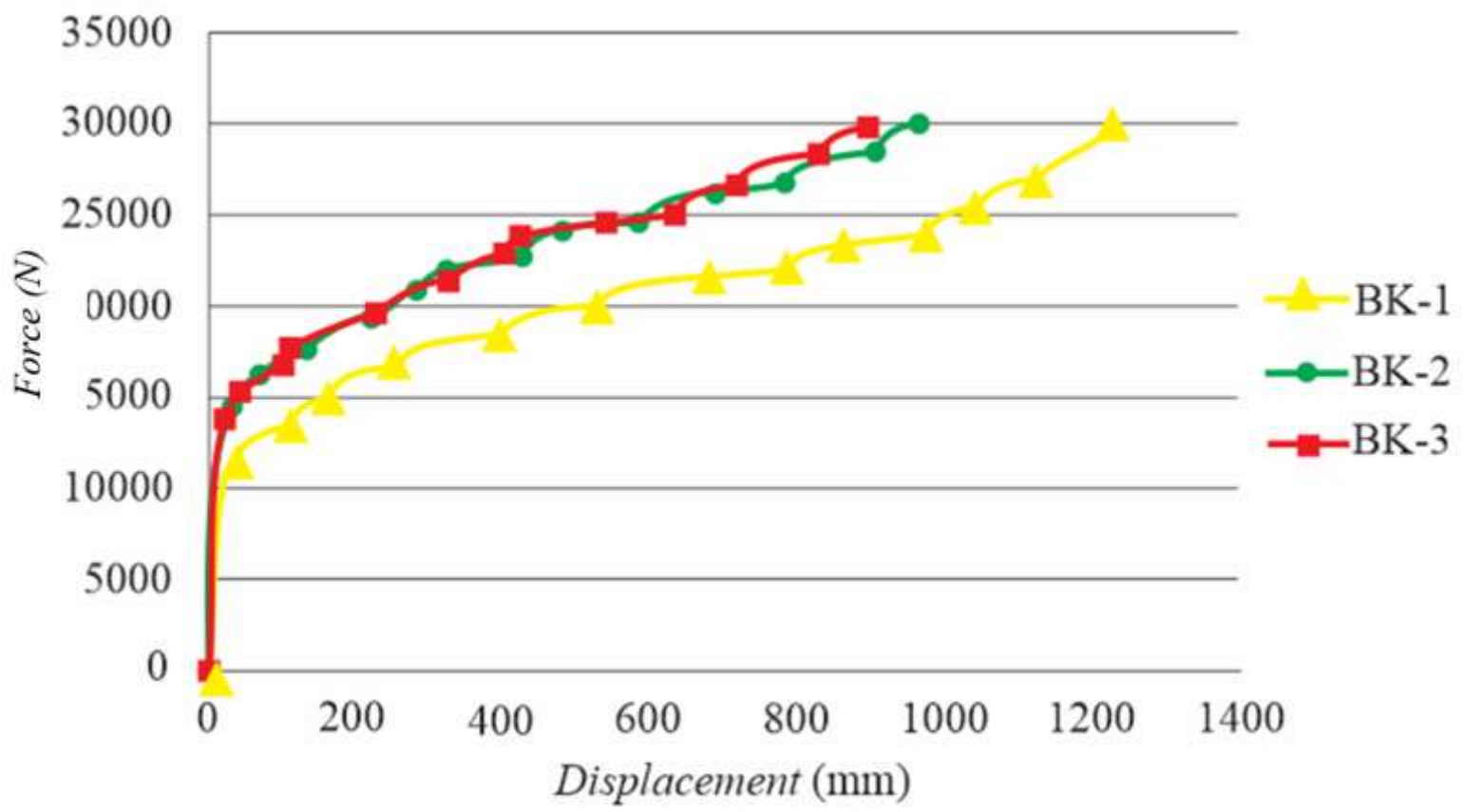
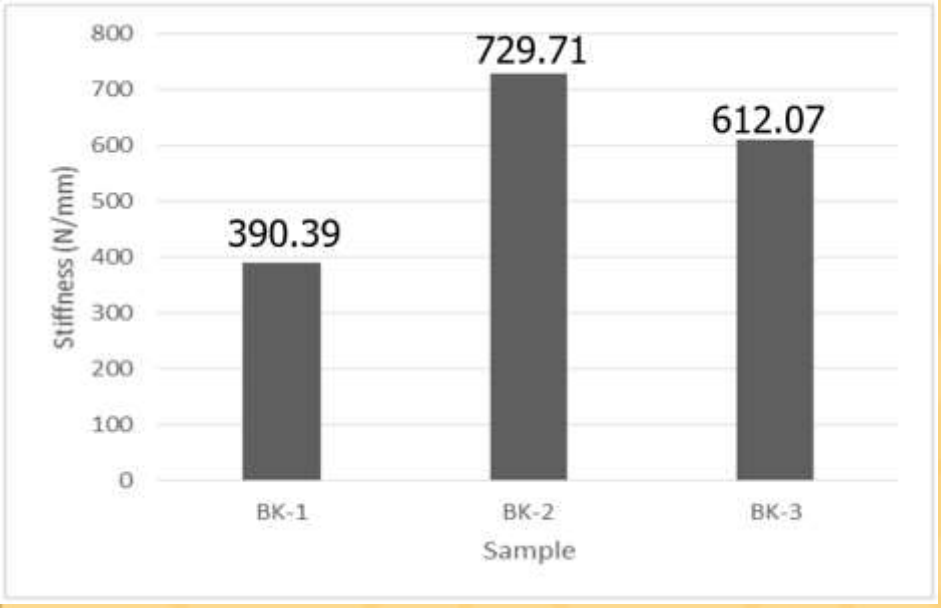


Fig. 5. Force Displacement Result

RESULT & DISCUSSION



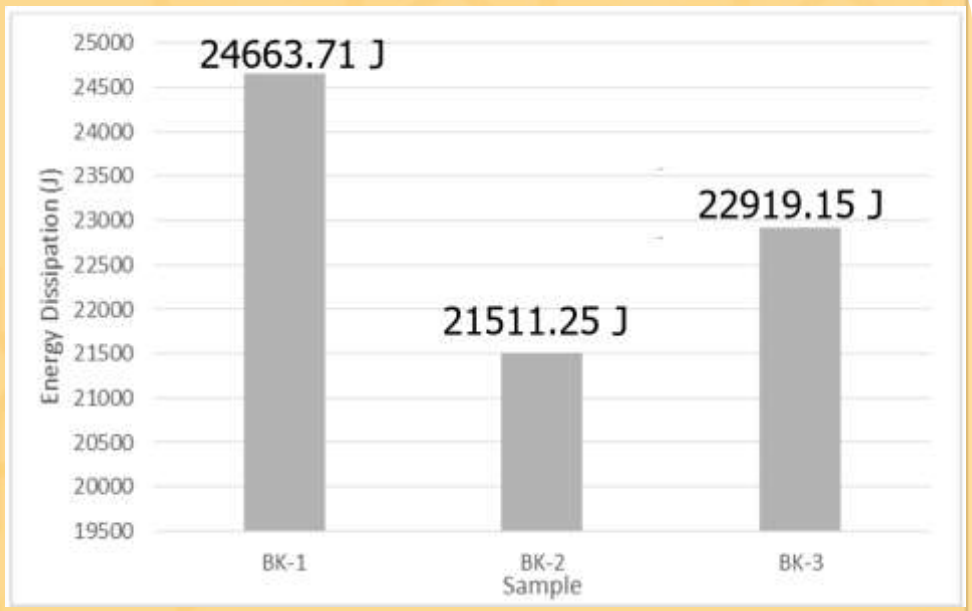


Fig. 6. (a) Stiffness Result; (b) Energy Dissipation Result

RESULT & DISCUSSION

Stress-Strain

Table 3. Stress and strain result.

Type structure	Ductility	Strength (N/mm^2)		Strain	
		Yield	*Ultimate*	*Yield*	*ultimate*
BK-1	47.8027	314.2	352.9	0.0005	0.0239
BK-2	8.8452	489.2	638.5	0.0017	0.0158
BK-3	7.1516	417.8	609.6	0.0022	0.0160

RESULT & DISCUSSION

Stress-Strain

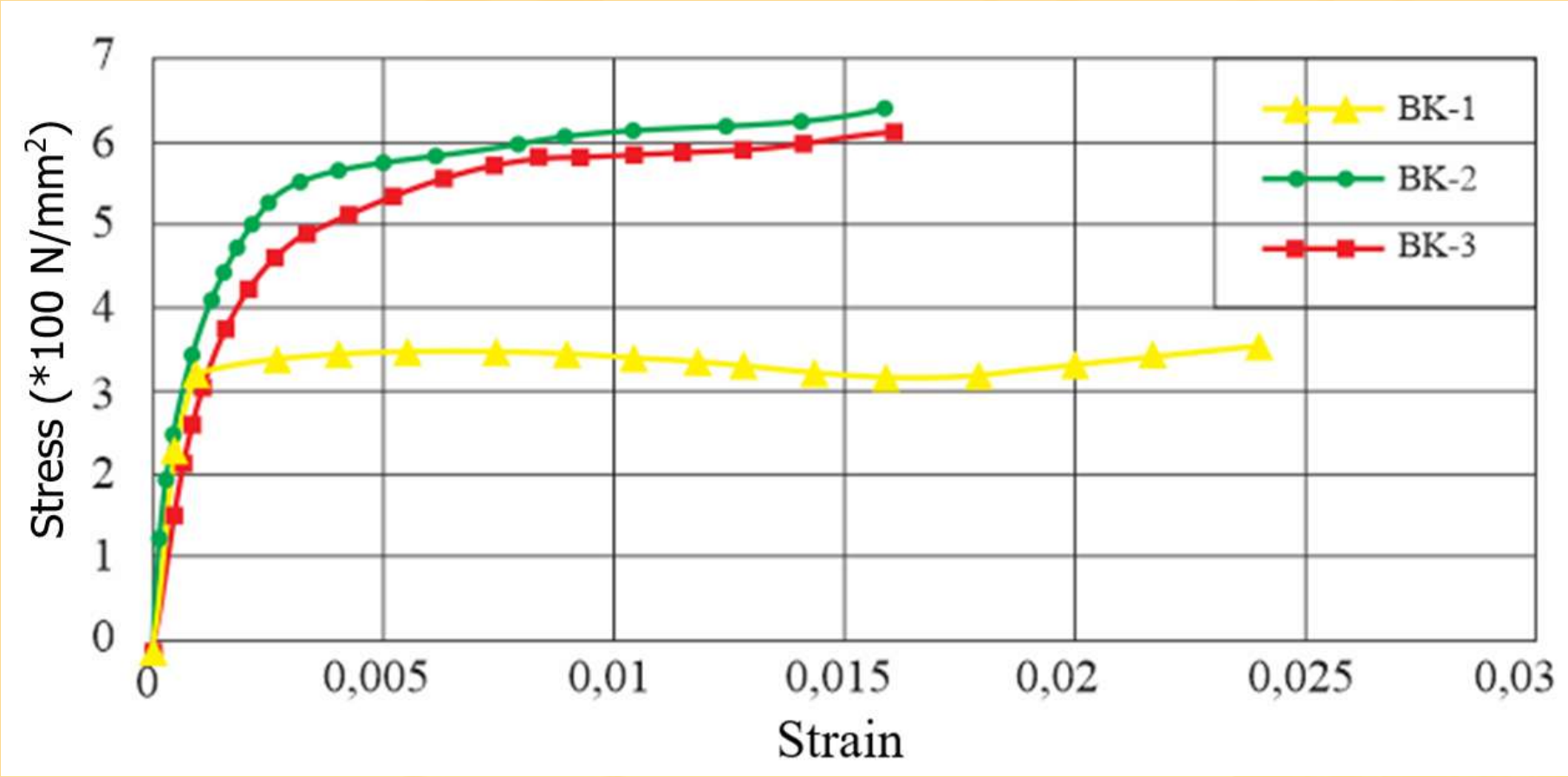
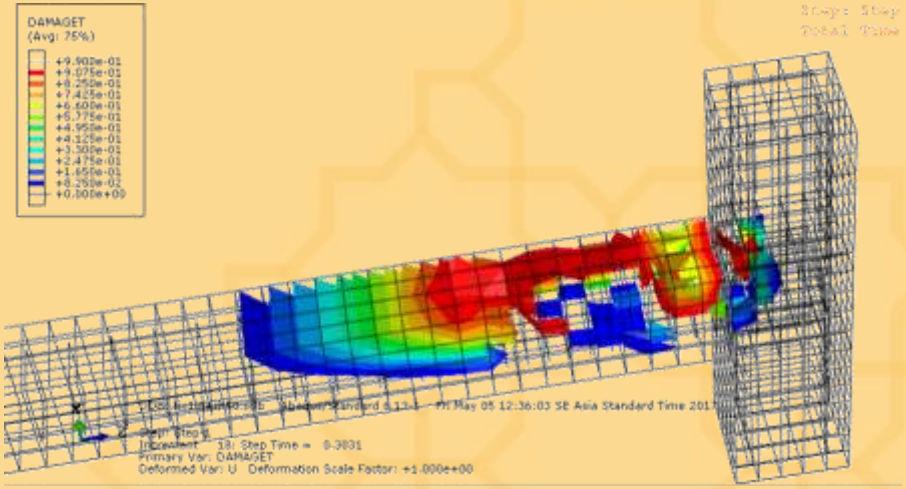
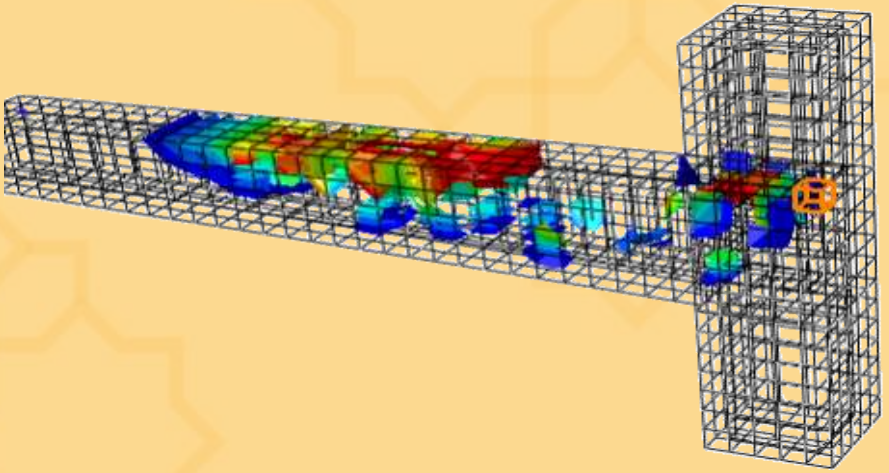


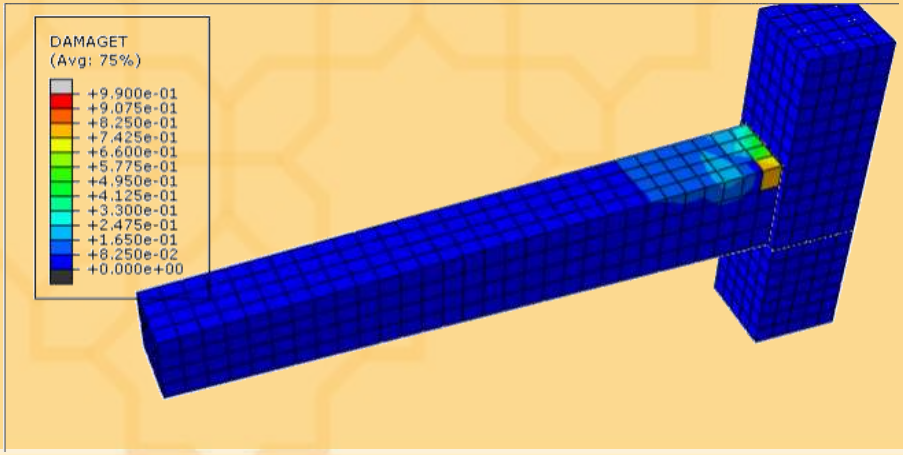
Fig. 7. Stres and Strain Result

RESULT & DISCUSSION

Crack Pattern







CONCLUSION

Based on the results of numerical analysis using software Abaqus 6.13, from the three specimens can be concluded that sample which has the smallest stress value is BK-1 (3.53 N/mm^2), while the smallest strain is achieved by BK-2 (1.58%). Different with the stress and strain, the least deflection is attained by BK-2 on 18.031 mm. These results can give related researchers as the reference and consideration for engineers in the field who use beam-column connection using precast concrete.

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Thank you for your attention

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