A Review on Comparative Study of Precast and Monolithic Structures

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ABSTRACT:
Construction material such as brick, timber, concrete and steels are increasing in demand due to rapid expansion of construction activities for housing and other buildings. For structure which is constructed by using conventional concrete, its self-weight represents a very large proportion of the total load on the structure. Precast construction are now a day's generally been adopted in various residential and commercial projects. In this paper the RCC beam column junction is compared with precast beam column load. Initially beam-column junctions are analyzed for static linear point load which increases with time and with Blast Load. The analysis is done by FEM tool ANSYS workbench.

***KEYWORDS**: Precast, beam-column junction, ANSYS.*

I. INTRODUCTION

Precast concrete has been recognized as a viable way to create safe, robust, secure, quality, cost-effective structures and. nevertheless, its application in high seismic regions was restricted, mostly because the template guidelines are not accessible relative to those available for casting- Concrete in-place structures. The advent of precast concrete has shown, through the years, concrete building benefits, such as better-quality control, simpler management of concrete construction, Schedule of building, good usage of materials and cost reduction.

A. Precast Structure

Precast concrete building components and site amenities are used architecturally as fireplace mantels, cladding, trim products, accessories and curtain walls. Structural applications of precast concrete include foundations, beams, floors, walls and other structural components. It is essential that each structural component be designed and tested to withstand both the tensile and compressive loads that the member will be subjected to over its lifespan.

B. Monolithic Structure (Mivan System)

It is the most advanced formwork systems. It is fast, simple and adaptable. It produces total quality work which requires minimum maintenance and when durability is the prime consideration. It is a totally pre- engineered system where in the completemethodology is planned to the finest details. In this system the walls, columns and slab are casted in one continuous pour on concrete. Early removal of formwork can be achieved by the air curing/ curing compounds. These forms are made strong and sturdy, fabricated with accuracy and easy to handle. The components are made out of aluminum and hence are very light weight. They afford large number of repetitions (around 250). The re-propping is simple hence short cycle time can be achieved.

II.STATE OF DEVELOPMENT

EhsanNoroozinejadFarsangi et. al.[1]Finite element research was analyzed on 4 forms of precast ties that are pinned, rigid, semi rigid and a new proposed component. From the slope of the total load versus deflection graph in the elastic spectrum, the stiffness of the new relation was obtained. The seismic loading adjusted from the El Centro earthquake of 0.15g and 0.5g was then added to the whole system. From the results of the study, they inferred that the new relation has adequate stiffness, power and even greater ductility. Meanwhile, the findings of the whole structure review shows that the new relation acts as a semi rigid attachment. For research, LUSAS and SAP2000 were used.

Patrick TiongLiq Yee, et al[2]after exhibiting quite a lot of advantages compared to traditional cast-in-place building, in Malaysia, the approval level of precast concrete construction is still reportedly poor. The consequences placed by tougher provisions on seismic construction will just make the situation worse. The main objective of this study was to determine the most suitable form of beam-column connections for the precast concrete industry to be implemented, particularly in regions with low to moderate seismicity. This research therefore offered a detailed literature review of the results from studies undertaken to evaluate and examine the actions of precast concrete structures installed under simulated earthquake loading with standard connections or joints. The seismic efficiency of the precast concrete system was heavily dependent on the ductility ability of the connectors connecting each precast segment, especially crucial joints such as beam-to-column connections. From the study, it was discovered that (1) hybrid post-tensioned beam-column link and (2) Dywidag Ductile Connector were among the most frequently used precast construction connectors in seismically susceptible areas.

R.A. HawilehLankeetal[3]nonlinear finite element analysis and modelling of a precast hybrid beam-column link that is subject to cyclic loads have been studied. In order to analyse the response and forecast the conduct of the precast hybrid beam-column link subjected to cyclic loads tested at the National Institute of Standards and Technology (NIST) laboratory, a comprehensive three-dimensional (3D) nonlinear finite element model was developed. The pre-tension effect on the post-tension strand and the nonlinear material behaviour of concrete were taken into account in the model. The model response was compared with the experimental test results and at all stages of loading produced good agreement. The failure of the link resulted in the fracture of the mild-steel bars. Furthermore, the magnitude of the force developed in the steel tendon post-tensioning was also monitored and it was observed that during the entire loading history it did not yield. They concluded that successful modeling of finite elements would provide a practical and economical tool for investigating the behaviour of such links.

B. Analysis of model in Staad

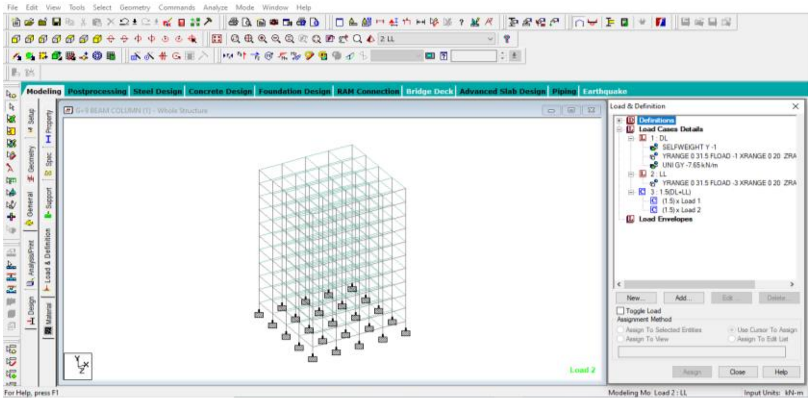


Fig 1 Modeling in Staad

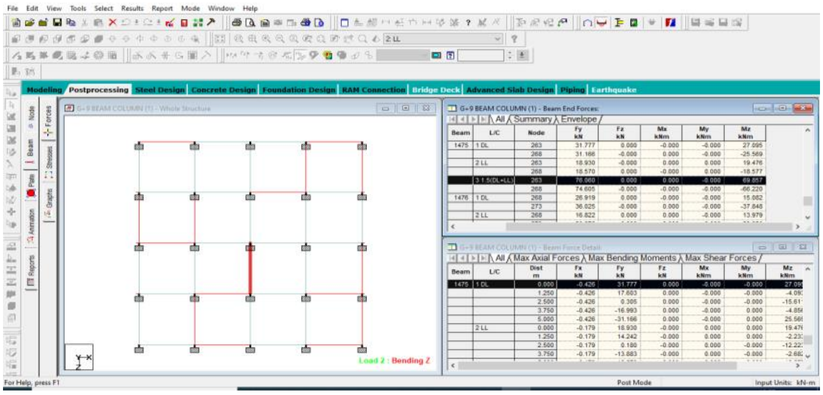
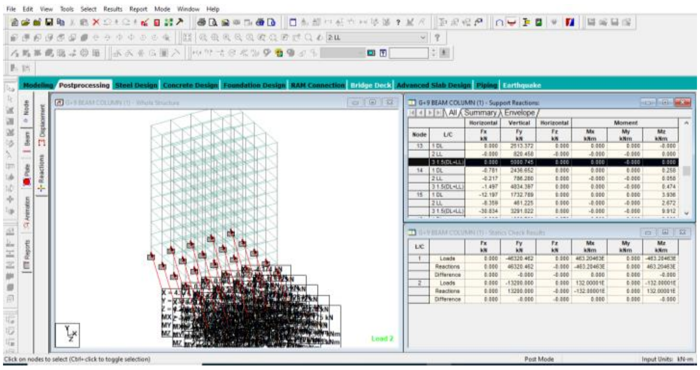


Fig 2 MaxBending moment of beams in staad for RCC



For RCC Structure Maximum Bending Moment observed at Beam No. 263 as shown in Fig. 4.3.2. is 76.06 KN and Maximum Column Force at node point 13 of 5000KN is observed. The concrete design output obtained from Staad file is shown in fig along with its RCC details.

III. Result and Discussion

For the FEM analysis prepare model in ANSYS for RCC, and another three different types of precast connections and analyse for static loads as given from Staad, Maximum Bending Moment observed at Beam is 76.06 KN and Maximum Column Force of 5000KN is observed .

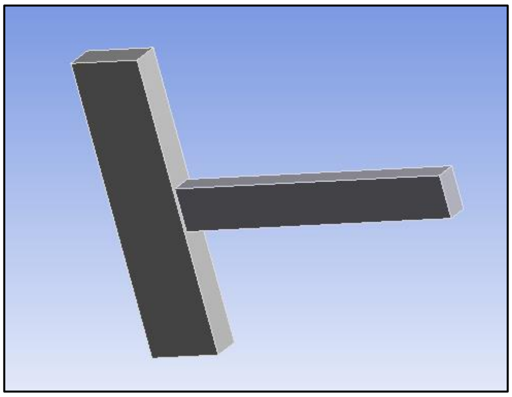


Fig 4 Model of RCC

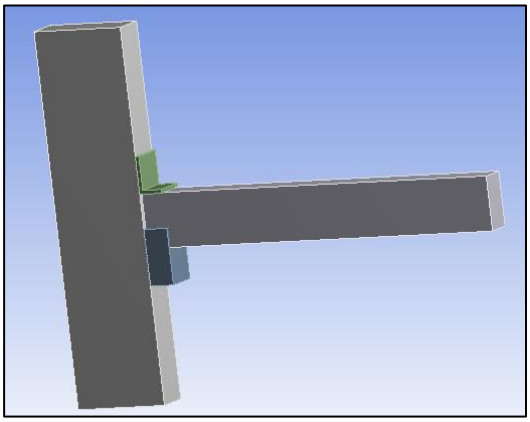


Fig 5 Precast No 1

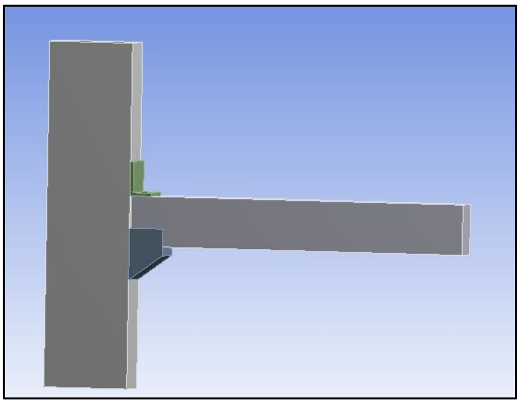


Fig 6 Precast No 2

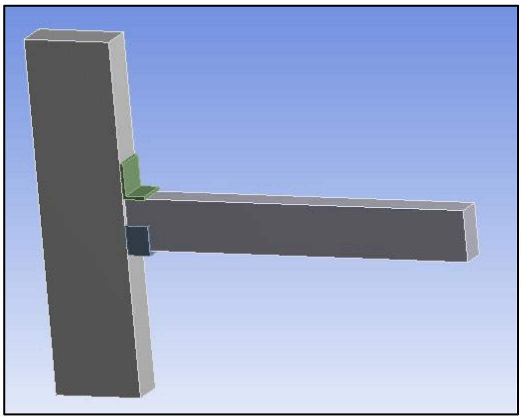


Fig 7 Precast No 3

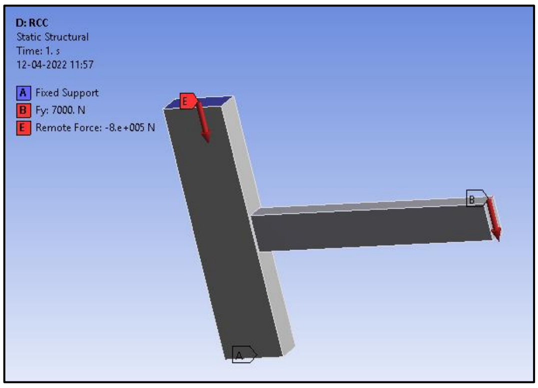


Fig 8 Load applied on model

A. RESULTS FOR STATIC ANALYSIS

- **Equivalent Stress Mpa**

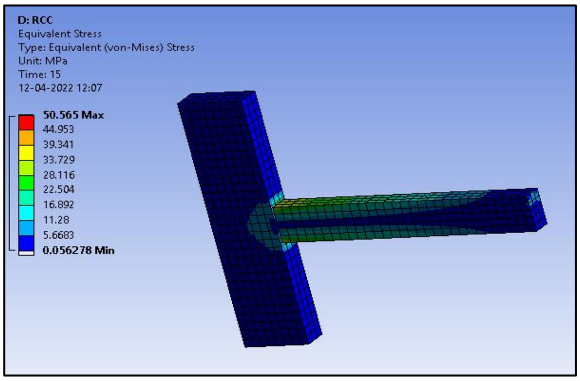


Fig 9 Equivalent Stress RCC

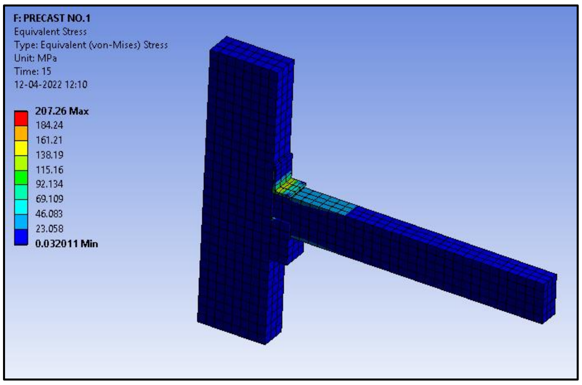


Fig 10 Equivalent Stress Precast No 1

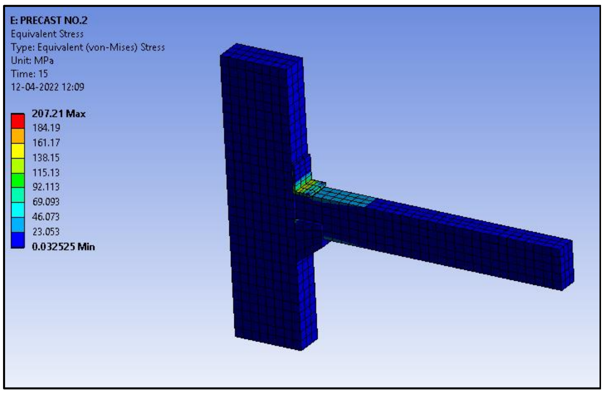


Fig 11 Equivalent Stress Precast No 2

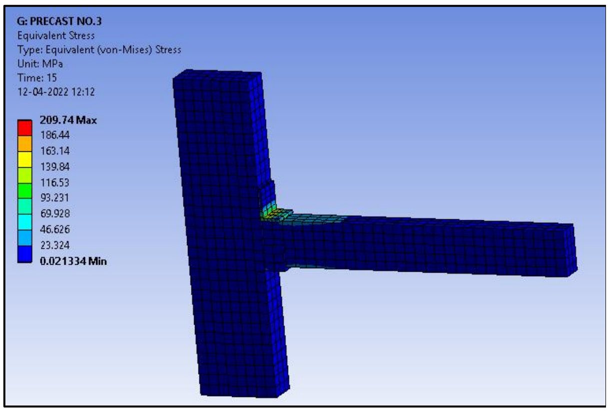
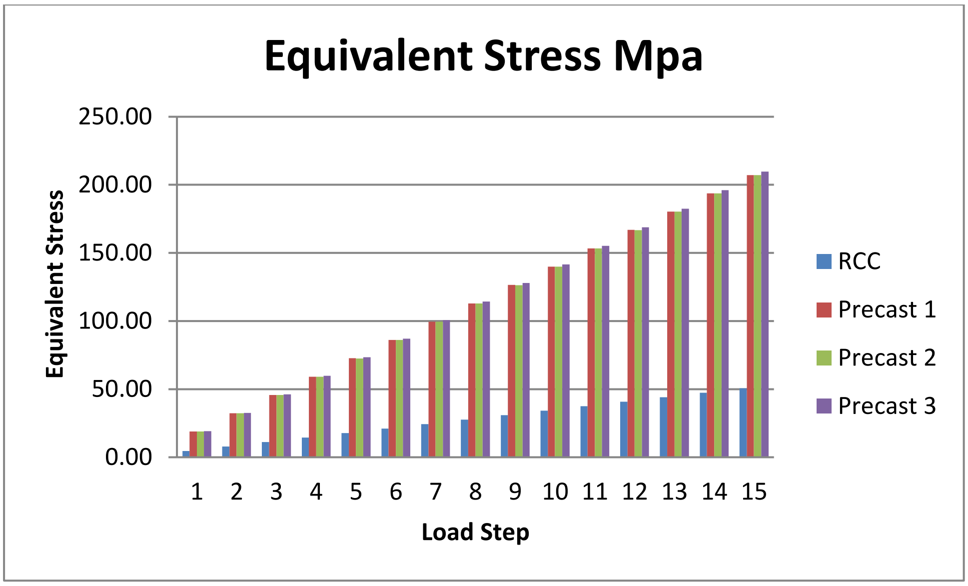


Fig 11 Equivalent Stress Precast No 3

Table 1 Equivalent Stress Mpa

Equivalent Stress Mpa				
Load KN	RCC	Precast 1	Precast 2	Precast 3
800	4.60	18.82	18.82	19.05
1100	7.88	32.27	32.26	32.65
1400	11.16	45.72	45.71	46.26
1700	14.45	59.17	59.15	59.87
2000	17.73	72.62	72.60	73.49
2300	21.01	86.07	86.05	87.10
2600	24.30	99.53	99.51	100.72
2900	27.58	112.99	112.96	114.34
3200	30.86	126.45	126.42	127.96
3500	34.15	139.91	139.88	141.59
3800	37.43	153.38	153.34	155.21
4100	40.71	166.85	166.81	168.84
4400	44.00	180.32	180.27	182.47
4700	47.28	193.79	193.74	196.11
5000	50.57	207.26	207.21	209.74



Graph 1 Equivalent Stress Mpa

From the above graph Equivalent Stress for RCC are less than precast models because of fix beam column joint but for precast models the Equivalent Stress for model 1 and model 2 are economical than model 3

B. **RESULTS FOR BLAST LOAD ANALYSIS**

- **Equivalent stress**

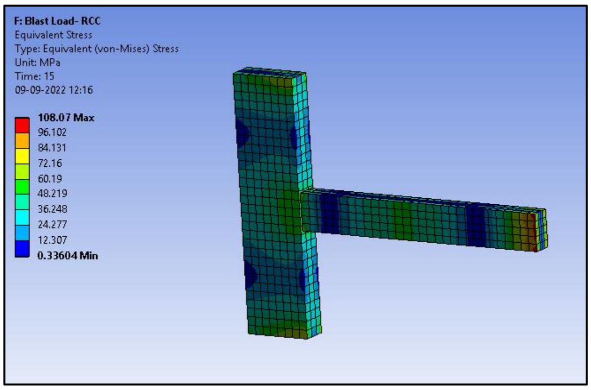


Fig 12RCCEquivalent stress

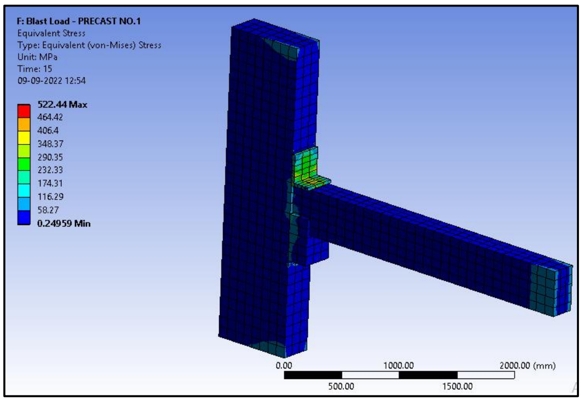


Fig 13 Precast 1 Equivalent stress

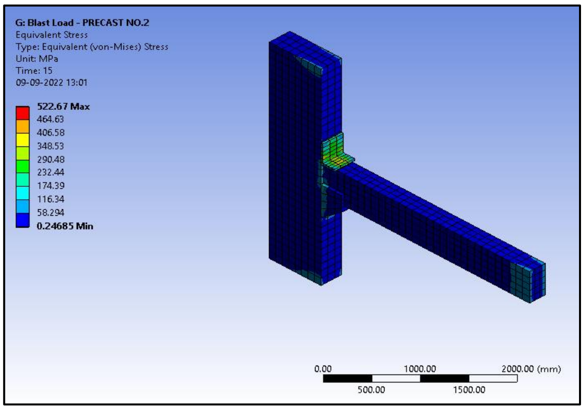


Fig 14 Precast 2 Equivalent stress

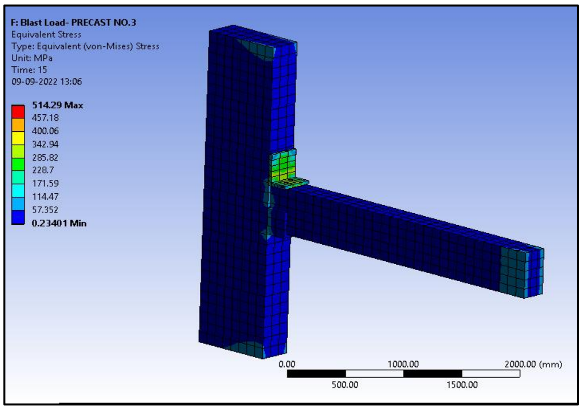
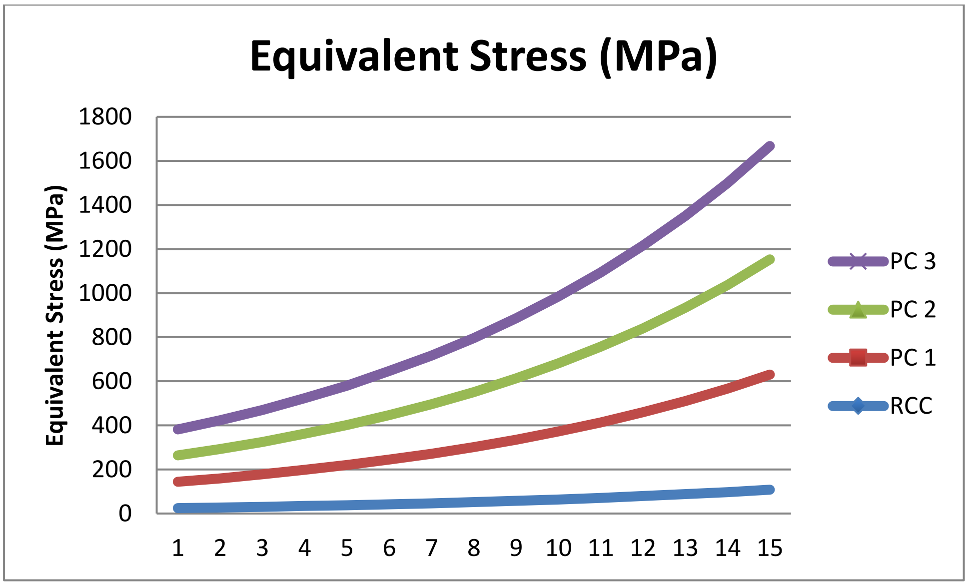


Fig 15 Precast 3 Equivalent stress

Table 2 Equivalent stress

Equivalent Stress (MPa)			
RCC	**PC 1**	**PC 2**	**PC 3**
24.573	119.62	119.68	117.7
27.31	132.64	132.7	130.54
30.383	147.25	147.32	144.93
33.9	164.03	164.11	161.44
37.641	181.9	181.98	179.03
41.934	202.47	202.56	199.28
46.56	224.67	224.77	221.13
51.739	249.57	249.69	245.65
57.58	277.73	277.86	273.36
63.973	308.6	308.74	303.75
71.029	342.71	342.87	337.34
78.859	380.63	380.8	374.66
87.572	422.87	423.06	416.26
97.281	470	470.21	462.66
108.07	522.44	522.67	514.29



Graph 2 Equivalent Stress Mpa

From above Table and above graph Equivalent stress for RCC model is less than precast models because of fix beam column joint but for precast models the Equivalent stress for model PC 1 and model PC 2 is less than model PC 3 by 5-10%.

IV. CONCLUSION

The seismic performance of the design of precast concrete depends very much on the ductility of the joints framed by beams and columns that are precast. The purpose of this analysis was to decide the most appropriate type of beam-column connections. The dimensionless hysteresis models of two types of joints were proposed and the rationality of the monolithic precast joint model was confirmed. The models will serve as an important method for the seismic performance review and investigation of design parameters of pre-cast links, claim the researchers.For static analysis compare the result for Equivalent Stress as shown in graph 1.According to the graph, the Equivalent Stress for RCC is less than that of precast models due to the fixed beam column joint, but for precast models, the Equivalent Stress for models 1 and 2 is less than that of model 3. From Table 2 and graph 2 Equivalent stress for RCC model is less than precast models because of fix beam column joint but for precast models the Equivalent stress for model PC 1 and model PC 2 is less than model PC 3 by 5-10%.

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