CJ TECHNICAL UPDATES

Bulletin on:
Launching of Precast Bridge Girder

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INTRODUCTION

One of the key important activities in bridge construction is the launching of the precast beam or girder onto its position. Although it seems like a simple task but it results in catastrophic consequences if it is not planned and technically managed properly. The process of installing a precast beam or girder involved a sequential heavy lifting during the launching and accuracy of placing onto the position. This process may pose a risk of hazard and safety issue. Heavy, tall and slender beam or precast element may result in stability risk prior to the deck slab casting. Inaccurate positioning and levelling onto the position may also worsen the situation. Therefore it is imperative that this process to be addressed and managed thoroughly.

Method of statement of beam launching prepared by the specialist contractor shall addressed the key tasks from the early up to the completion of the launching process. There are several methods of launching and installing the precast beam on to its final position as below:

a) By means of launching girder (Figure 1a)
b) By means of overhead gantry (Figure 1b)
c) By means of heavy lifting by using mobile crane (Figure 1c)

This technical document addresses the key important element involved during the beam launching by using mobile cranes as this is the most common method utilized in our bridge construction locally.

1(a)

1(b)

1(c)

Figure 1 (a), (b) and (c) : Methods of precast beam launching

SCOPE OF WORKS

Erection of the precast concrete girders must be done accurately and carefully, as shown on the Drawings and in a manner that will prevent damaging the girders. The erection proposal is to be submitted for review and approval by the S.O. and must not allow any erection work to begin until approval of the erection scheme has granted. This approval does not relieve the Contractor of his responsibility for safety and for ensuring that the work is done in accordance with the plans and specifications.

Method statement (including safety rules/procedures) which shall made available and to be passed around to all relevant parties involved in the launching process. The method of statement must be comprehensive and clear enough to be understood by all relevant parties. The method statement of work should be formulated and endorsed by specialist contractors and Professional Engineer (PEPC). The method statement should cover but not limited to the following:

a) All measures for avoiding or mitigating the hazards identified in the risk assessment
b) Step-by-step procedures supplemented with diagrammatic illustrations
c) Safety procedures and instructions
d) Procedures for avoiding hazards to personnel working adjacent to the operations
e) Clear delineation of role and tasks of members of the working crew by written statements
f) Arrangement for effective communications.

a) Machineries

The machineries involved in bridge launching are low loader trailer and mobile cranes. The capacity of the cranes will depend on the weight of the beam to be launched. Cranes and all machineries involved must be inspected before mobilization and gain re-inspect after demobilization.

Figures 2 (a): Mobile cranes for beam lifting

Figure 2 (b) : Low-loader for transporting the beam

It is highly recommended that the cranes used for the purposed of launching to be operated by experienced and qualified crane operators. In case of

novice operator, initial training and demonstration must be carried out prior to actual launching works. A proper documentations on the inspection of tools and equipment on the cranes or machineries must be in-place and approved by site supervision team. All these documents must be recorded and kept by the supervision team on-site.

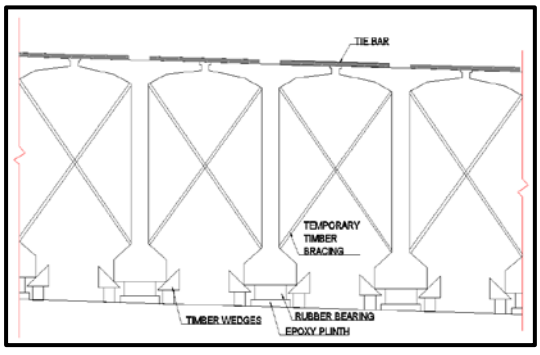
b) Launching stage

The launching of the precast beam is the primary step of placing the beams onto the position. It involved the lifting of the beam from the casting position or from the low-loader to the top of pier or abutment. Site manager must ensure all steps prior to the placing of beams are prepared and mitigated. Listed below (Table 1) are the items that required attention of the site manager as well as the contractor. The list can be adopted as the compliance approval prior to the beam launching. The route or pathway of the cranes during the launching process must be determined prior to the work. Contractor and site supervision team must ensure that this route or pathway is cleared from any obstruction or hazard during the launching process.

c) Temporary support and bracing

Precast beam by itself is susceptible to stability issue particular with tall and slender section. Small and narrow base of the beam merely seat on the rubber bearing intensify the stability problem. Rubber bearing is designed to allow movement in longitudinal as well as the rotation of the beam and therefore there is no restrained offered by the bearing. Prior to deck casting, the beam stability only relied to its self-weight. To maintain the verticality, the centroid of the bearing must be in-line with the centroid of the beam. Tilted beam results in deviation of the centroids and may pose the beam to fall aside.

Figure 3, shows a typical bracing system installed upon completion of beam launching prior to the deck slab casting.



Figures 3 (a) : Typical bracing system designed to be installed upon completion of launching.

Figures 3 (b) : bracing system by using steel member erected in between beam

Additional cable to prevent the beam from fall aside may also be employed in the case of high bearing seating as shown in Figure 4. Care must be taken while removing the cable just before the casting of deck takes place. Contractor must endure to expedite the construction of diaphragm upon completion of all beams launched onto the position. Site supervision team shall ensure the planning of diaphragm and deck slab construction to be commenced without substantial delay.

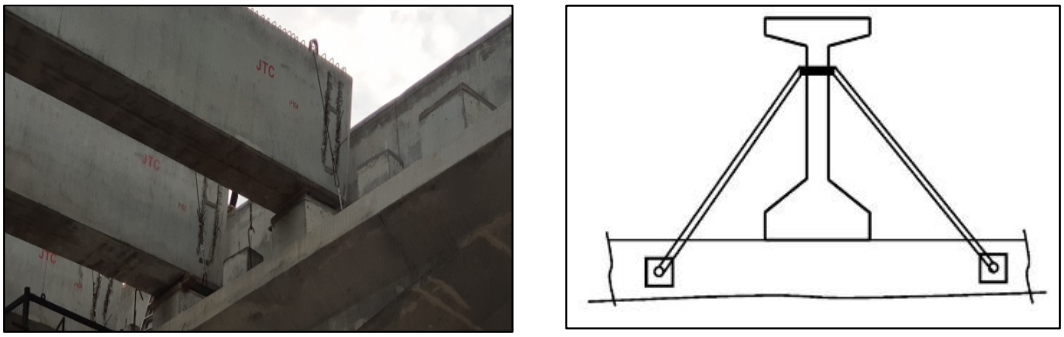


Figure 4: Additional cable may be used to secure the beam in-place

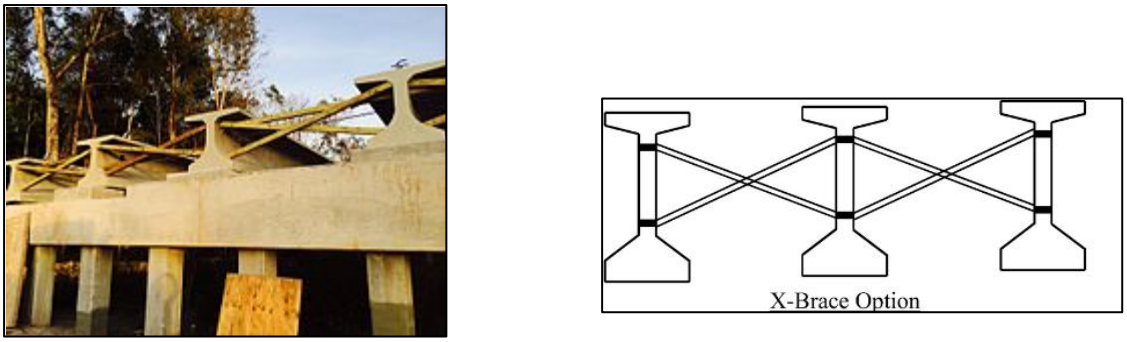


Figure 5 : Timber bracing

d) Bearing seating preparation and positioning

The base of the precast beam is seat on the rubber bearing which is in turn supported by the concrete pedestal. The arrangement of these seating that consist of concrete pedestal and rubber bearing must be confirmed and constructed precisely. Figures 6 (a) and (b) show the base of precast beam placed right on top of rubber bearing. Approval from the consultant or designer must be obtain to re-confirm the size and dimension of the bearing used. Every bearing must be thoroughly inspected with regards to its position, level, orientation and skew angle by the site supervision team and approved accordingly.

Figures 6 (a) : Position of base of precast beam, rubber bearing and concrete pedestal

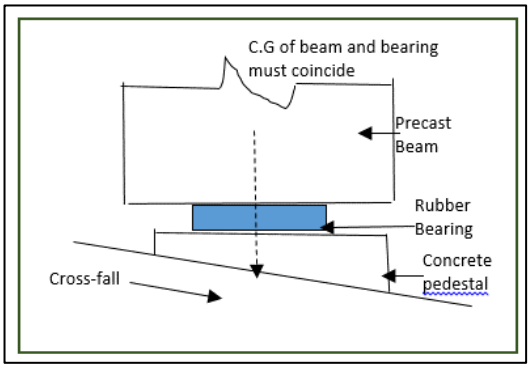


Figure 6 (b) : Typical schematic arrangement of bearing seating

Typical error may come while constructing the concrete pedestal laid on the cross-fall pier or abutment. The surface of the concrete pedestal must be constructed as flat as possible to receive the bearing and eventually the precast beam. Slight angular change will induce torsion to the beam and may cause the beam to fall sideway.

e) Checklist

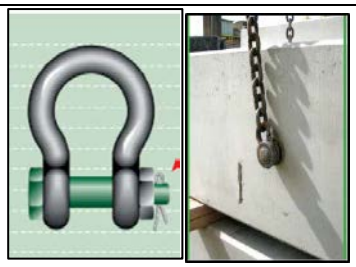
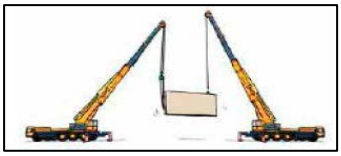
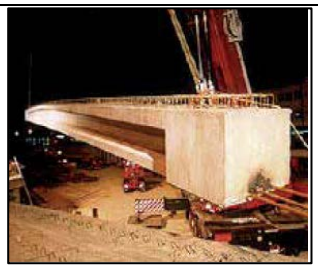
The process of placing the precast beam onto the position is carried out in a series of sequential steps. Every step required a proper planning and specific equipment.

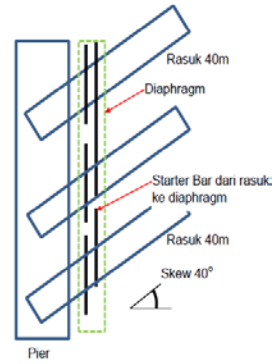
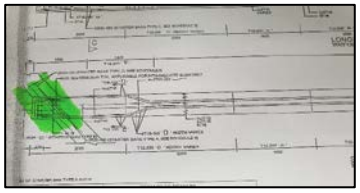
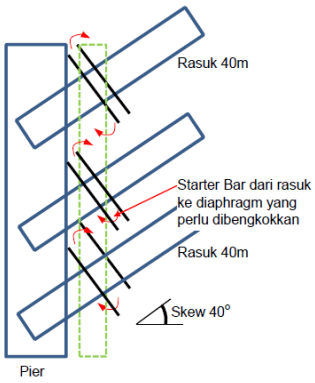
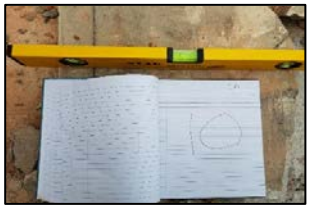
Table 1: Item related to the beam launching process as a compliance checklist

No	**Items Descriptions**	**Acceptable**	**Rejected**	**Remarks**
PRE-LAUNCHING				
1	Beam inspection record and approval			
2	Bearing position / seating survey and setting out approval			
3	Method of statement of beam launching approved by P.E			
4	Approved bracing systems by consultant			
5	Sequence of lifting/ launching including diagrams			

6	On-site safety plan			
7	Approved and calibrated equipment and machineries			
8	Check on the ground condition stability, level and treatment if any.			
ON LAUNCHING				
9	On-site safety preparation			
10	Machineries positions			
11	Recording and Communication tools			
12	Beam marking			
POST- LAUNCHING				
13	Position inspection			
14	Crane Mobilization			

TECHNICAL AND SAFETY ASPECT – DO'S AND DONT'S

Do's	**Don'ts**
Always asses any potential risk that may occur at every steps of launching.	Do not use winch to move the beam around the position.
Always ensure all machinery and equipment are calibrated and certified for site used.	
Always secure ties, shackle, bolt and nuts while in lifting process. 	Do not cut-short any steps in handling the beam in anyway.  
Ensure proper lighting while launching at night. 	Do not allow any uncertified workers within the launching area. 

Do's	Don'ts
Always ensure that the detailing involving rebar positions, diaphragm are as in the approved construction drawings.  	Do not attempt to modify any detailing of rebar or diaphragm without any approval from the designer.  
Always ensure all tie-rod are fully welded and attached adequately between beams.  	Do not use improper timber as a temporary support. 
Always check right position and level of bearing seating prior before and after beam positioning.  	

CONSEQUENTIAL OF FAILURE

Improper planning, mitigation, inadequate design and safety measure may result to the catastrophic collapse of the beam. The cause of the potential failure may be due to the following:

a) Faulty of the machinery and equipment used during the launching
b) Inadequate measure of temporary support and bracing
c) Accidental knocking between beams during lifting and positioning due to very close beam spacing
d) Excessive ground settlement to the temporary support or shoring
e) Inadequate bearing size to resist rotation of the precast beam
f) Improper levelling of concrete pedestal or bearing seating that may cause the beam to tilt sideways.

Figures 7 (a), (b) and (c) show the failure of the precast beam prior to the deck slabs construction. The launched beam may fall aside and hitting adjacent beam resulting in dominos effect collapse.

Figures 7 (a): Precast beam collapse in domino effect due to the stability issue

Figure 7 (b) : Aerial view of the total collapse of the beam

Figure 7 (c) : Precast beam collapse at construction site

CONCLUSION

It is imperative that the process of beam launching to be taken with full attention in view of its technical requirement and safety aspects. Lacking of anticipating and probing potential risk hazard during the activity may result to the collapse of the beam and cause of loss of life in certain cases. This guideline provides prime elements involved during the process of beam launching and should be treated on the case to case basis. Additional treatment shall be deemed necessary depending on the site conditions and project requirements and to be approved by the site authority.

REFERENCES:

[1] BS5400 Pt 4: Design of Concrete Bridge to British Standard
[2] Design Checklist: Launching or Precast Beam. JKR/BRJAM/ Criteria-01
[3] JKR Term of Reference for Bridge and Viaduct Structure 2018
[4] JKR-SPJ-Section 9: 2018; Concrete Specification