

Labour Department
Concise Investigation Report for the
Fatal Accident in Hong Kong-Zhuhai-Macao Bridge Project
on 29 March 2017

1. Introduction

- 1.1 At around 1500 hrs on 29 March 2017, an industrial accident happened in a construction site of the Hong Kong – Zhuhai – Macao Bridge (“HZMB”) Projects: Hong Kong Link Road – Section between HKSAR Boundary and Scenic Hill (Highways Department Contract No. HY/2011/09). The accident involved the collapse of a temporary working platform (“TWP”) beneath the deck of the bridge under construction, causing two workers to be killed and three injured.
- 1.2 The TWP was an integral part of a temporary support structure (“TSS”) which was originally supported by sea piles. Prior to the accident, the bottom parts of the sea piles had been removed. The TWP had then been suspended by two sets of lifting systems on the deck of the bridge through sets of lifting gear (“LG”) (Please refer to Figure 1 at Appendix).

2. Background Information

2.1 Contractorship

- 2.1.1 Dragages Hong Kong Limited, China Harbour Engineering Company Limited and VSL Hong Kong Limited, after having entered into a joint venture called Dragages – China Harbour – VSL (“DCVJV”), became the principal contractor responsible for construction of the section of Hong Kong Link Road between HKSAR Boundary and Scenic Hill in HZMB Projects. The works mainly referred to the construction of a bridge over the sea that was supported by piers, viz. Pier 0 to Pier 114. The first injured person (hereafter called “I/P(1)”) was employed by one of the DCVJV partners.
- 2.1.2 The first deceased person (hereafter called “D/P(1)”) and the second injured person (hereafter called “I/P(2)”) were employed by a scaffolding subcontractor, namely WSS Engineering Systems Limited (“WSS”), as scaffolders,

whilst the second deceased person (hereafter called “D/P(2)”) and the third injured person (hereafter called “I/P(3)”) were employed by a general labour-supply contractor, namely United Construction & Manpower Service Limited (“United Construction”), as scaffolder and rigger respectively.

2.2 Consultancy

2.2.1 Ove Arup & Partners Hong Kong Limited (“ARUP”) was engaged by the Highways Department (“HyD”) as the consultant of this project (Contract No. HY/2011/09).

2.2.2 ARUP was responsible for contract administration and supervision of the contractors’ work.

2.3 The Place of the Accident

2.3.1 Two TSSs were erected above the sea surface between Pier 0 to Pier 1 to provide support for the installation of pre-cast bridge segments to form the bridge surface (Photo 1 - taken by ARUP prior to the accident on 28 March 2017). Each TSS was supported by eight sea piles as footing.

2.3.2 Since the installation of the bridge segments had been completed, the TSSs were to be dismantled.

2.3.3 One day before the accident (i.e. on 28 March 2017), the bottom parts of all eight sea piles of the TSS involved had been removed. Without support by these bottom parts, the TSS involved (including the upper parts of the sea piles, the TWP and the upper structures) had since been suspended by two sets of lifting systems, with one on the right hand side (“RHS”) and the other on the left hand side (“LHS”), which were set up on the deck of the bridge (Figure 1).

2.3.4 Each set of the lifting system consisted of a lifting beam, two hydraulic jacks, temporary supports for both the lifting beams and hydraulic jacks, and a set of LG (i.e. fibre rope slings connected by shackles)(Photo 2) connected to the centre of the lifting beam. The LG passed through the holes of the deck of the bridge to suspend the TSS/TWP underneath. Photo 3 showed the lifting system on LHS whilst Photo 4 showed the collapsed lifting system on RHS after the accident.

3. Circumstances

- 3.1 On the day of the accident, the TWP in question was scheduled to be dismantled and sent away by a barge. D/P(1), D/P(2) and I/P(2) formed a team that was responsible for the dismantling of the TWP on RHS, while I/P(1) and I/P(3) were members of another team working on the bridge deck for operating the lifting systems.
- 3.2 At the material time, the lifting beam on the RHS was being jacked up by the hydraulic jacks on the bridge deck, which in turn raised up the suspended TWP to make clearance for a barge to moor underneath.
- 3.3 During the lifting, the lifting beam on RHS on the bridge deck collapsed, causing breakage of two fibre rope slings which constituted the two sets of LG suspending the TWP on both sides (Photo 4). Given the failure of the LG, the TWP plunged into the water. D/P(1), D/P(2) and I/P(2) were dismantling a metal scaffold erected around the TWP concerned during the lifting. Whilst their safety harnesses were anchored to the guard-rail of the TWP, the three workers were dragged into the sea together with the collapsed TWP. At the same time, the collapsed lifting beam hit I/P(1) and I/P(3) who were working on the bridge deck. They were injured with bone fractures on their right legs.
- 3.4 I/P(2), who was rescued from the sea, sustained multiple bodily injuries. D/P(2) and D/P(1) were certified dead after their bodies were recovered from the sea by divers of the Fire Services Department (“FSD”) at around 1900 hours on 29 March 2017 and 1900 hours on 30 March 2017 respectively.

4. Investigations

- 4.1 Summary of site investigations and tests/examinations
 - 4.1.1 Investigation at the accident scene was immediately carried out by officers of the Labour Department on 29 March 2017 upon receipt of the referral from FSD.
 - 4.1.2 Site investigations and tests and examinations of the lifting system and LG were conducted afterward.
 - 4.1.3 Experts were invited to provide opinions on the technical issues of the case.

4.2 Witnesses

- 4.2.1 In total, 54 witnesses were interviewed, including I/Ps, related workers and management staff of DCVJV, its subcontractors, ARUP and HyD.

5. Findings and Observations

5.1 The TSS and the TWP

- 5.1.1 After the accident, the TSS (including the TWP) on RHS had sunk into the sea.
- 5.1.2 Neither independent lifeline nor suitable anchorage point was found at the scene of the accident for workers attaching their safety harnesses.

5.2 The Lifting Systems

- 5.2.1 Two broken fibre rope slings suspending in the mid-air were found underneath the bridge deck after the accident (Photo 2).
- 5.2.2 Two sets of the lifting systems for lifting up the TWP were found on the bridge deck. The lifting system on the RHS was found collapsed (Photo 4), with the lifting beam, hydraulic jacks and their supports scattered on the deck of the bridge, whilst the lifting system on the LHS was found remained intact (Photo 3).
- 5.2.3 The support for the jacks was made up of some makeshift metal blocks. LD's investigation revealed that their integrity as jack support had not been assessed. In particular, the strength of each block under various loading conditions was not known. Also, when stacked together, the overall stability was not assessed.
- 5.2.4 There was no temporary works design certificate issued for the lifting system.

5.3 Method Statement

- 5.3.1 Although a Method Statement for "Pier 0 Temporary Works Dismantling" ("MS") had been prepared, it was yet to be approved as at the day of the accident. Apart from a schematic drawing on the set-up of the lifting system, no

detailed drawing of the lifting system was included in the MS.

- 5.3.2 No risk assessment regarding the jacking up operation of the TWP had been conducted, and the associated safe working procedures had not been devised.
- 5.3.3 No safe working procedures for dismantling of the metal scaffolds erected around the TWP were included in the MS.
- 5.3.4 The risk assessment in the MS only included general fall-from-height hazard. No details on fall protection measures, such as the location and number of independent lifelines or anchorage points of safety harnesses required, were specified in the MS.
- 5.3.5 The original design of the lifting systems and the LG arrangement proposed in the MS were not followed. Due to the unavailability of the required LG, LG having lower safe working load (“SWL”) was eventually used for the suspension of the TWP. The SWL of the LG being used was lower than the design lifting load stated in the MS.
- 5.3.6 The actual load of the TSS including the TWP being dismantled was higher than the SWL of the LG being used.
- 5.3.7 On the day of the accident, no safe working procedure on the dismantling works was made known to workers for them to follow. The MS for carrying out the dismantling work, though still pending approval, was not followed.

5.4 Direct Causes of Accident

- 5.4.1 It is suspected that the accident was mainly attributable to the unstable temporary supports of the hydraulic jacks at the RHS lifting system which fell, resulting in the collapse of the lifting beam.
- 5.4.2 The jerking force, that resulted from the collapse of the lifting beam and exerted to the LG, caused the breakage of two fibre rope slings. Eventually, the TWP suspended by the slings plunged into the sea.
- 5.4.3 At the material time of the accident, D/P(1), D/P(2) and I/P(2) were dismantling the metal scaffold erected around

the TWP. They were wearing safety harnesses attached to the guard-rail of the TWP under dismantling, and hence, the workers and the TWP plunged together into sea. The guard-rail of the TWP was not considered a suitable anchorage point to prevent them from falling into the sea when the TWP collapsed.

5.5 Root Causes of Accident

5.5.1 The root cause of the accident was the alleged failure to provide and maintain a safe system of work for the dismantling of the TSS, including the TWP.

5.5.2 The key deficiencies of the system of work in question would include:

- No adequate risk assessments on major work processes, such as the jacking up of the TWP, were conducted;
- No safe working procedures were devised for the workers to follow;
- The MS prepared was not yet approved; and even if approved, it was incomplete; and
- The lifting system had not been certified safe before being put into use.

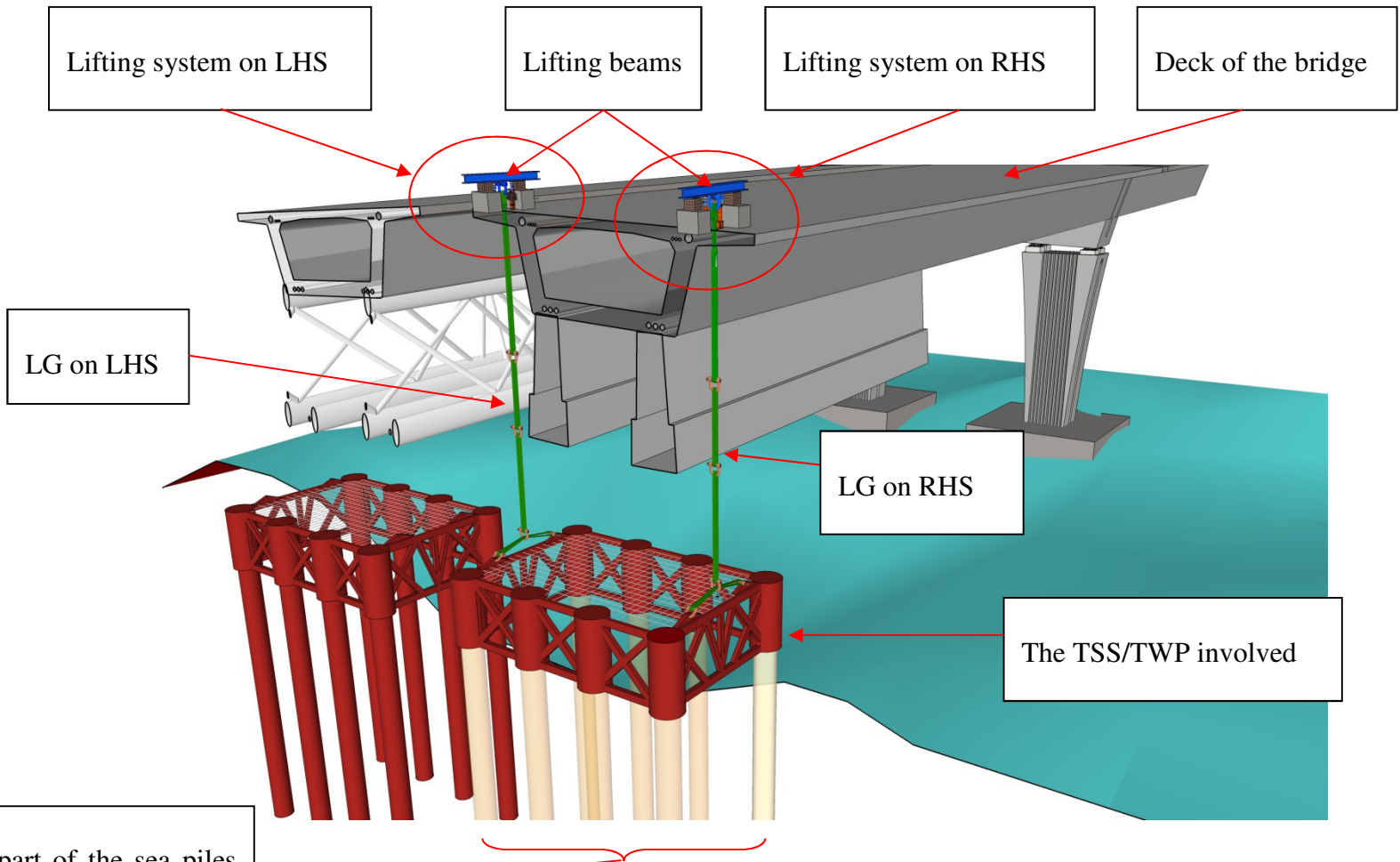
5.5.3 Another major contributing factor could be the lack of adequate information, instruction, supervision and training for the workers and other personnel to ensure their safety at work.

6. Criminal Proceedings

6.1 In the meantime, each of the DCVJV partners faced 16 summonses under the Factories and Industrial Undertakings Ordinance (Cap. 59) or the Occupational Safety and Health Ordinance (Cap. 509), ARUP faced two summonses under Cap. 59 whereas WSS and United Construction each faced one summons under Cap. 509. On the other hand, a Foreman and a General Site Manager of Dragages, and a Senior Engineer of ARUP were each summonsed for an offence under Cap. 59.

6.2 According to the latest information, the abovesaid summonses will be brought up for mention in West Kowloon Magistrates' Courts on 9 November 2017.

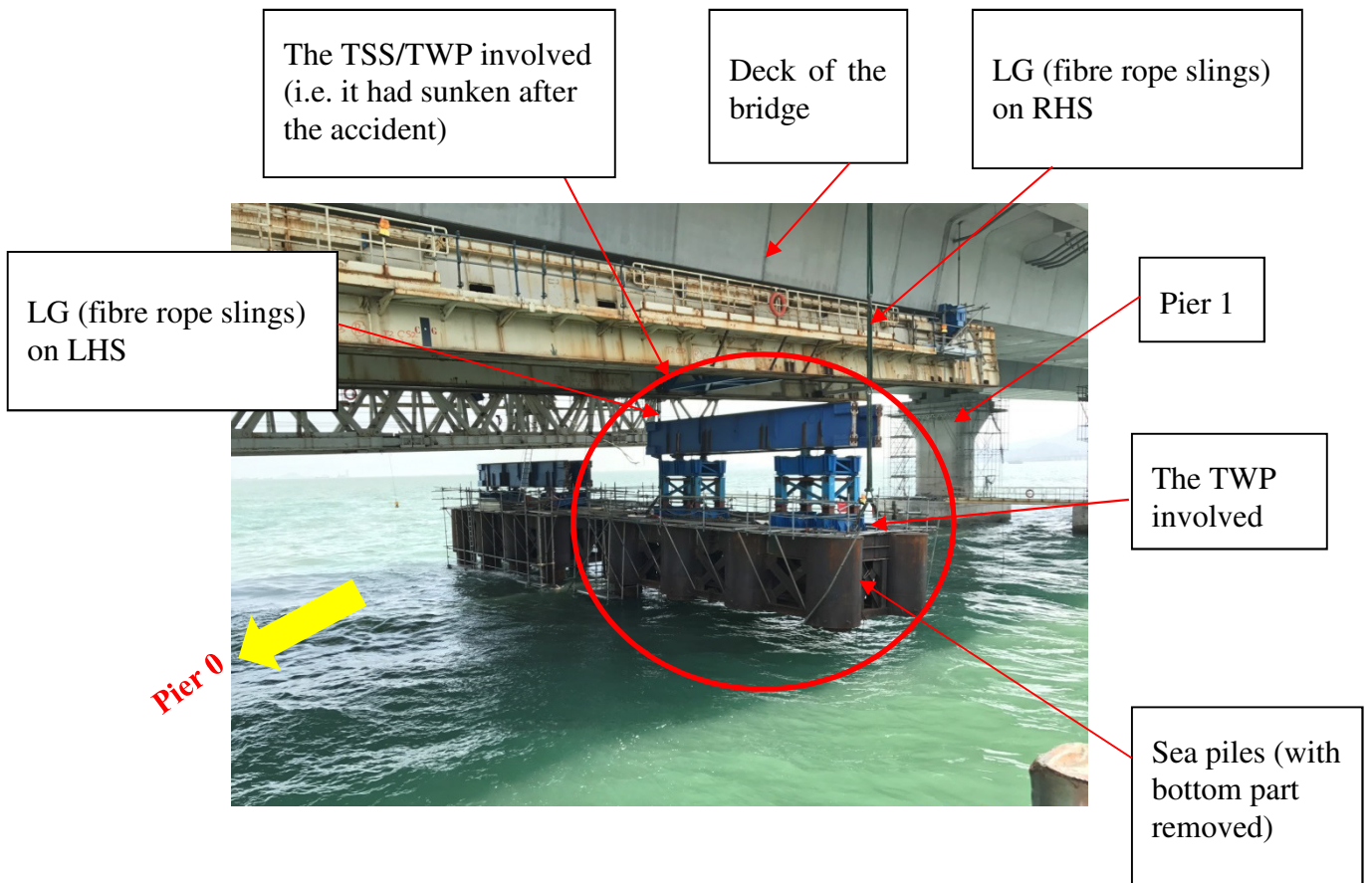
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Bottom part of the sea piles (i.e. see light beige colour line) of the TSS/TWP involved had been removed, and the TSS had since been suspended by the lifting system

Figure 1 – Schematic diagram showing the TSS/TWP and the two lifting systems involved

Note: Not to scale and for illustration only



**Photo 1 – Overall view of the place of the accident
between Pier 0 and Pier 1
(Photo taken before the accident on 28 March 2017)**

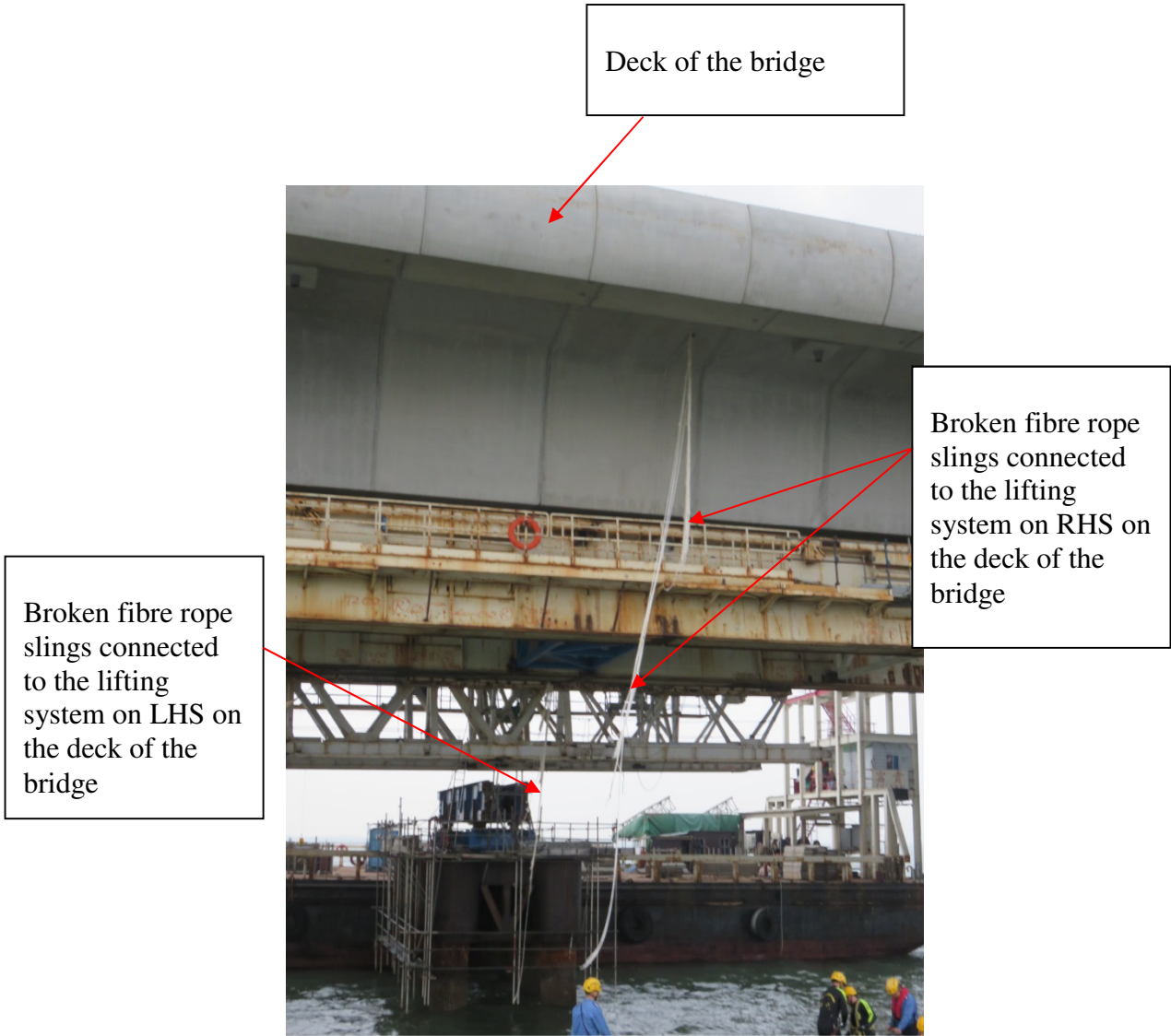


Photo 2 – Showing broken fibre rope slings beneath the deck of the bridge after the accident

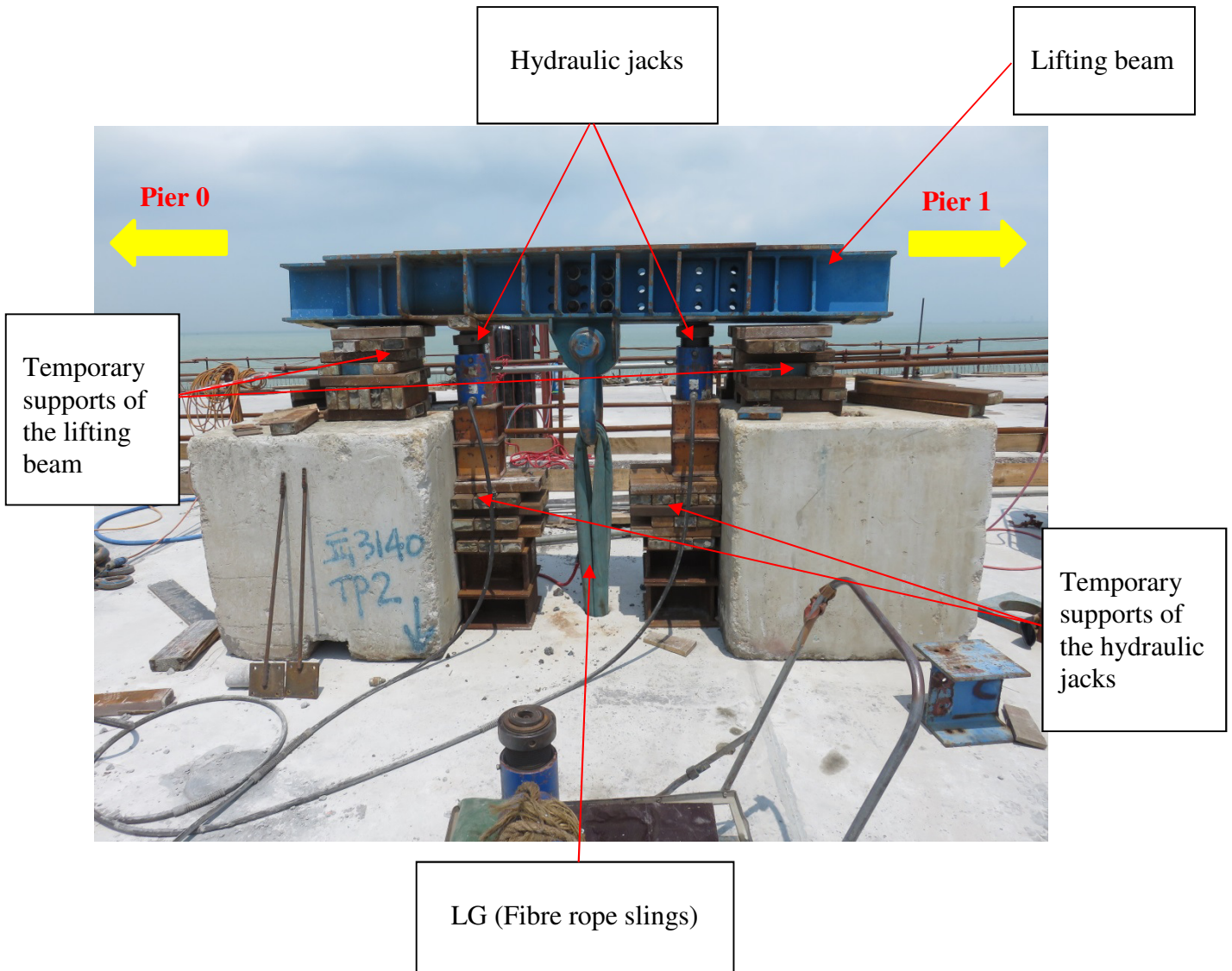


Photo 3 – No collapse of the lifting system on LHS on the deck of the bridge under construction

Collapsed lifting
beam on RHS



**Photo 4 – The collapsed lifting beam on RHS
on the deck of the bridge under construction**