

Workplace Health and Safety Queensland - Pile Driving Incident – Tully – Preliminary Brief
25/9/2008

Purpose

The purpose of this report is to inform you of a serious incident involving a mobile crane with a piling rig attached, and to advise on action that should be undertaken on pile driving rigs of a similar design.

The incident

On 19 September 2008 a serious incident occurred near Tully in North Queensland when a 30 metre tower of a pile driving rig became detached from a lattice boom crawler crane and fell with a 12 metre long concrete pile. One worker, located on the ground in front of the crane, was fatally injured. The crane operator was critically injured when one end of the pile became embedded in the crane cabin as a result of the fall. It is understood an attempt was being made to lift the pile into position under the hydraulic hammer, with the auxiliary hook on the mobile crane.

A photograph of the incident scene is shown in Photograph 1.



Photograph 1- Incident Scene



Photograph 2 – Swivel which connects the piling rig tower to the boom head of the crane

Plant Items Involved

The pile driving rig is manufactured by Guandong Liyuan Machinery and is also known by the brand name “Storke”. The pile driving tower was attached to a mobile Fushun crawler crane, Model QUY 80, with 19 metres of boom rigged on the crane. Figure 1 shows a diagram of the crane and piling rig configuration.

Both the mobile crane and piling rig have had minimal use, being introduced into service in 2008.

Issues

A preliminary examination of the incident scene has been undertaken. The exact sequence of events is still being investigated and the piling rig has been extensively damaged. However, the examination has revealed that the flange on the main structural pin connecting the piling rig to the boom head on the crawler crane has failed. This has permitted the pin to become dislodged and has resulted in the piling rig falling away from the boom tip and striking the ground along with the concrete pile.

The pin has a diameter of approximately 140 mm and passes from the piling rig tower into a large swivel connector mounted on the boom head of the crane. The swivel can be seen in photograph 2, but it should be noted that this connector is rotated downwards in the photograph. The position of the swivel connector is indicated in the elevational view of the rig (Figure 1). The flange on the pin has been fabricated by welding a steel ring on to the end of the pin. Photographs 3 and 4 show views of the pin and flange ring respectively, following the incident. The weld between the pin and flange ring, located at the end of the pin, has failed. Figure 2 shows a sectional view of the pin and the location of the weld between the pin and flange.



Photograph 3 - Main structural pin connecting the piling rig to the boom head on the crawler crane



Photograph 4 - Flange on the main structural pin connecting the piling rig to the boom head on the crawler crane

The other end of the pin, which passes into the piling rig tower, is prevented from becoming dislodged by a 16 mm diameter bolt that passes through the pin. This bolt is held in place with a nut and a split pin to prevent the nut loosening.

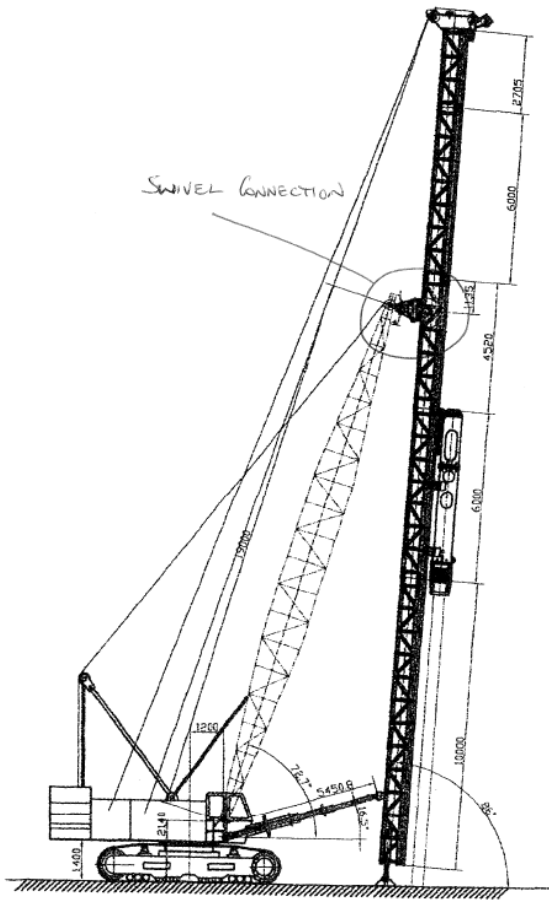


Figure 1 – Elevation view of the rig

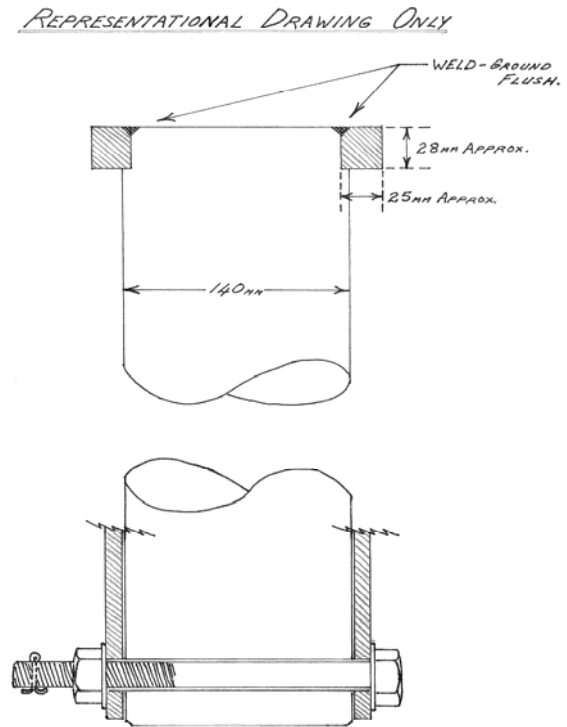


Figure 2 – Section view of pin showing welded ring as flange

The failed pin and flange ring will be independently examined for material specifications and weld characteristics. However, irrespective of these results WHSQ considers that welding a ring onto the pin to prevent the pin becoming dislodged is **unacceptable** for the following reasons:

- The pin is a critical structural item and failure of the pin flange will cause the piling rig to fall off the crane.
- The piling rig is exposed to severe cyclic loading from the hydraulic piling hammer and fatigue of the weld over time will be likely.
- The pin flange will be exposed to direct loading, acting along the length of the pin, when forward tilt is applied to the piling rig tower.
- Non-destructive examination of the weld will be difficult due to the pin's location in the swivel connector.

It is possible that the rig may have been exposed to additional lateral loading prior to, or at the time of, the incident. However, it should be noted that the rig is nearly brand new and piling rigs

should be designed for a harsh operational environment including additional lateral loading. While the failure of this connection may not have been the initial cause, it should not have failed.

At this stage there is no evidence to suggest that the mobile crane contributed to the incident. However, it should be noted that this comment is based on the fact that a close examination of the crane cannot be made as the crane cabin and controls were severely damaged in the incident and the operator has not been interviewed.

WHSQ is not currently aware of any piling rigs supplied by the same manufacturer to Queensland workplaces. However, as the pile driver itself does not require design or plant registration there may be other units operating in the State.

Recommendations

Should there be any other pile drivers manufactured by Guandong Liyuan Machinery (Storke) and operating in Queensland, WHSQ strongly advises the following steps be followed:

1. All units be immediately withdrawn from service.
2. The swivel connector between the crane boom head and piling rig tower be removed in compliance with a safe work procedure overseen by a competent person.
3. All pins on the swivel connector be removed and inspected to determine if the flange has been welded onto to the pin. If it has been welded the pin is to be replaced by a new pin that has a flange constructed by a method other than welding (i.e. forged or machined). This pin is to be inspected and certified by a suitably qualified professional engineer.
4. The method of restraint for any pin (e.g. bolt, flange, cheek plate) is to be assessed for its structural adequacy and suitability considering loading size and severity.
5. All pins in the swivel connector be examined for cracks by a suitably qualified testing organisation (i.e. NATA accredited).
6. Damaged pins be replaced with new pins inspected and certified by a suitably qualified professional engineer.
7. Following satisfactory inspection the swivel connector and rig are to be re-assembled and inspected by a suitably qualified professional engineer.

Documentation verifying that the above remedial action has been undertaken is to be maintained on site.