

Incident Summary #II-1169032-2021 (#21353) (FINAL)

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| SUPPORTING INFORMATION | Incident Date | | March 25, 2021 | |
| | Location | | North Vancouver | |
| | Regulated industry sector | | Passenger ropeways - Above surface ropeway | |
| | Impact | Injury | Qty injuries | 0 |
| | | | Injury description | N/A |
| | | | Injury rating | None |
| | | Damage | Damage description | <ul style="list-style-type: none">The bull wheel axle was observed to have migrated 4” up from its normal working position.Cracking indications identified in the bull wheel support structure (F Frame). |
| | | | Damage rating | Major |
| | Incident rating | | Major | |
| Incident overview | | Maintenance staff determined that the top return station bull wheel axle had migrated up and out of its normal working position by approximately 4”. | | |
| INVESTIGATION CONCLUSIONS | Site, system and components | | <p>Damage occurred to the top return station bull wheel assembly of a fixed grip double seat carrier chairlift.</p> <p>This ropeway was manufactured and installed at its original site in 1970. It was relocated to its present site in 1987. Other than the relocation, no modifications were performed to the return station equipment since its original install.</p> <p>The return station bull wheel assembly configuration consists of (See Photo 1 and Diagram of Bull Wheel Hub Assembly):</p> <ul style="list-style-type: none">A sleeved bull wheel center axle supported on the upper and lower end by an upper and lower horizontal hollow structural steel section framework (F frame). The horizontal hollow structural sections are connected (welded) at the front of the station to short vertical steel structural member (See Photo 2).The bull wheel axle is fixed in a bore (providing end play control) at the upper end (of the upper horizontal hollow structure section) and is free floating in a bore at the lower end (of the lower horizontal hollow structural section).The lower end axle support bore (located in the lower hollow structural section of the F frame) was not provided with a drain hole that would allow captured water to escape.The bull wheel hub bearing configuration is that of a single row ball bearing at the upper position and a double row spherical roller bearing at the lower position. | |
| | Failure scenario(s) | | | |

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| | Return station bull wheel axel and bull wheel assembly had migrated upward (approximately 4" from its original working position). |
| Facts and evidence | <p>Narrative of events based on reports provided by the manufacturer and discussions had with the operator and manufacturer's representative:</p> <ul style="list-style-type: none"> Initially maintenance staff became aware of a misalignment condition of the return station bull wheel guide sheaves (guide sheave were no longer in contact with the haul rope) At a later date, maintenance staff became aware that the same guide sheave misalignment condition had occurred again. At that point maintenance staff and manufacturer's representative conducted further on-site inspections. It was at this time, that it was determined that the bull wheel assembly (main axle and bull wheel) had migrated upward from its normal working position by approximately 4". Crack indications were also identified in the F Frame where the upper horizontal hollow structural section connects to the short vertical section (See Photo 2, 3 & 5). Return station components (F frame, bull wheel and bull wheel related components) were partially dismantled and then transported to the manufacturer's shop to be fully disassembled for review. During the process of de-tensioning the haul rope (to allow for the disassembly and transportation of the return station components) it was observed that the bull wheel axel partially dropped back down and into the lower bore <p>Additional in shop observations. Based on manufacturer's reports and discussions with manufacturers' representatives:</p> <ul style="list-style-type: none"> It was observed that no drain holes were provided for in the bore of the lower horizontal hollow structural section. It should be noted that a hole can be observed in the bottom of the lower bore. This hole was determined to be a blind hole and did not provide a drainage feature. (See Photo 4) Rust was observed in the bore of the lower horizontal hollow structural section. The height of the rust marking was approximately equivalent to the height that the bull wheel assembly had migrated from its original working position (4"). (See photo 4) Manufacturer's representative indicated that porosity was observed in the original welding at the lower bore and that this condition may have provided an ingress point for moisture to enter the lower bore. <p>In discussions with the operator's representative, it was indicated that the bull wheel hub bearings were greased annually as per manufacturer's recommendations.</p> |

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| | <p>The manufacture did provide a report that indicated the probable failure mode which is reflected in the "Causes and contributing factors" section of this incident summary report.</p> |
| <p>Causes and contributing factors</p> | <p>Rust observed in the lower horizontal hollow structure section bull wheel axle bore provides evidence that it is very likely that water had collected at the bottom of the axle bore (between bottom of the axle bore and the bottom free-floating end of the bull wheel axle). The absence of drain hole(s) would have certainly prevented the egress of accumulated water. The accumulation of water at the bottom floating end of the bull wheel axel would very likely be subject to freezing resulting in a likely ice jacking condition.</p> <p>Porosity observed in the original welding of the lower axle bore may have provided an ingress point for moisture to enter the lower bore.</p> <p>With the bull wheel axle and bull wheel having migrated upward into the upper fixed end in the axle bore (bore situated in the upper horizontal hollow structure of the F frame) the upper horizontal hollow structure of the F frame is not only subjected to the intended horizontal loading but also an upward vertical force. This factor was the very likely cause of the cracking indication identified in the upper horizontal hollow structure of the F frame.</p> |

Photos or diagrams (if necessary)



Photo 1, Top Return Station



Photo 2, Bull Wheel F Frame Labeled, Guide Sheaves Shown in Photo



Photo 3, Crack Indication in F Frame. See Photo 2.



Photo 4, Photo of upper and lower bull wheel axle bore (axle and sleeve removed). Looking through both the upper and lower horizontal hollow structure sections (*note, rust in lower bore) (**note, the small hole in the lower bore did not provide a drainage feature).



Photo 5, Bull wheel (chains and load binders installed to prevent further lifting of the bull wheel assembly).

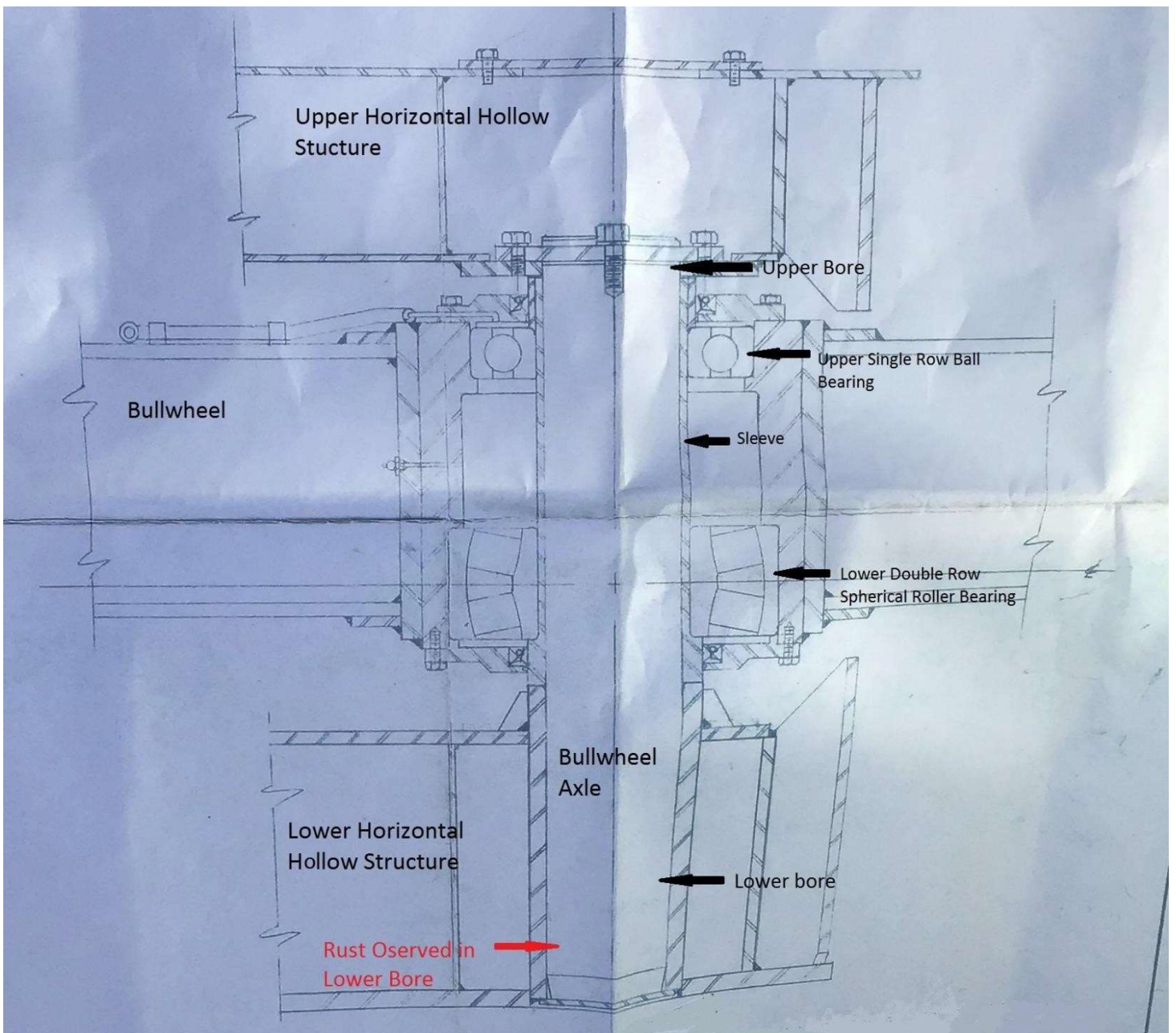


Diagram of bull wheel hub assembly