Incident Summary (II-899454-2019)(ID#14969) (FINAL)

SUPPORTING INFORMATION	Incident Date		August 24, 2019
	Location		Interior
	Regulated industry sector		Passenger Ropeways - Above surface ropeway
	Impact – Injury	Qty injuries	0
		Injury description	Not Applicable
		Injury rating	None
	Impact – Damage	Damage description	Rupture of sheave, inconsiderable wear on assembly frame.
		Damage rating	Insignificant
	Incident rating		Insignificant
	Incident overview		During operation for summer activities there was unusual noise coming from a tower sheave assembly. Upon investigation it was discovered that there was a cracked sheave.
INVESTIGATION CONCLUSIONS	Site, system and components		Circulating passenger ropeways transport passengers from the load station to an unload station by carriers (chair) attached to the main cable (haul rope). The haul rope is supported by towers along the length of the ropeway between stations. Towers are equipped with sheave assemblies, which allow travel of the haul rope. Sheave assemblies are comprised of a frame, suspension to tower and sheaves. See Figure 1 & 2. The sheave assemblies are designed and adjusted to have the haul rope travel along the centreline of each sheave. Sheave assembly tilt alignment is the angle required to maintain haul rope centreline travel as the haul rope position is manipulated sideward between towers and stations.
	Failure scenario(s)		There was unusual noise coming from a tower sheave assembly during operation. Upon investigation a cracked sheave was identified.
	Facts and evidence		Ropeway Summer Operation: • Ropeway was operating for foot passengers and transporting bikes uphill • Operation speed for foot passengers does not exceed 1.3 m/s • Date of Incident weather was a high 22C Location of sheave failure: • Second tower from top drive station • Uphill side ropeway travel • Lead out – last sheave of an 8 wheel assembly • Cracked on the inward facing side Technical Data of ropeway: • Ropeway installed in 1989 • Ropeway has fleeting line gauge at incident tower location. – Distance between uphill and downhill haul rope is 4.6m on towers and drive (top) bullwheel is 4.0m

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	• Tower sheave assemblies must have tilt angle alignment to accommodate fleeting gauge. See figure 3 • Sheave installed in June 2015 – 6740 hours of operating time – confirmed by contractor maintenance records • Tower was designed to accommodate a heavy load with an 8 wheel assembly on the uphill side and 6 wheel assembly on the downhill side • Contractor has other vintage of ropeways of the same manufacturer – sheave components may have been intermixed Manufacturer Documents - Sheave Service Bulletin: • Issued September 2002 as a result of growing experience and technical developments combined with aging of components. Revision of the sheave operation and maintenance manual for ropeways built before 2002 • Issued July 2016 requires all owner/operators that were in compliance of the previous service bulletin to perform any subsequent sheave rebuild according to sheave Inspection Specification dated July 2016. If not in compliance of the 2002 Service bulletin owner/operators must embark on a schedule to assure all sheaves are in compliance with the 2016 Sheave Inspection Specification. Manufacturer allows owner/operators 6 years (until July 2022) to complete. Manufacturer Inspection Report of sheave: • Older side plates (pre-1982) – no ID markings • Hub manufacturing year pre-1989 • Inner side plate poor condition of outside diameter • Liner wear – 4mm excessive lateral to the inside – depth ok – indicates incorrect adjustment of sheave assembly. • Recommend all tower uphill sheaves be replaced, as sheaves may have been solicited to unknown lateral loads • Check and correct sheave assembly alignment accordingly – tilt angle alignment
Causes and contributing factors	It is possible that inadequate sheave assembly alignment created unknown lateral load on the sheave and caused the sheave hub to rupture. The sheave not being assembled according to the manufacturers most recent Inspection Specifications may be a contributing factor.

Photos or diagrams (if necessary)

Figure 1, Tower and Sheave Assemblies

Figure 2, Sheave Components

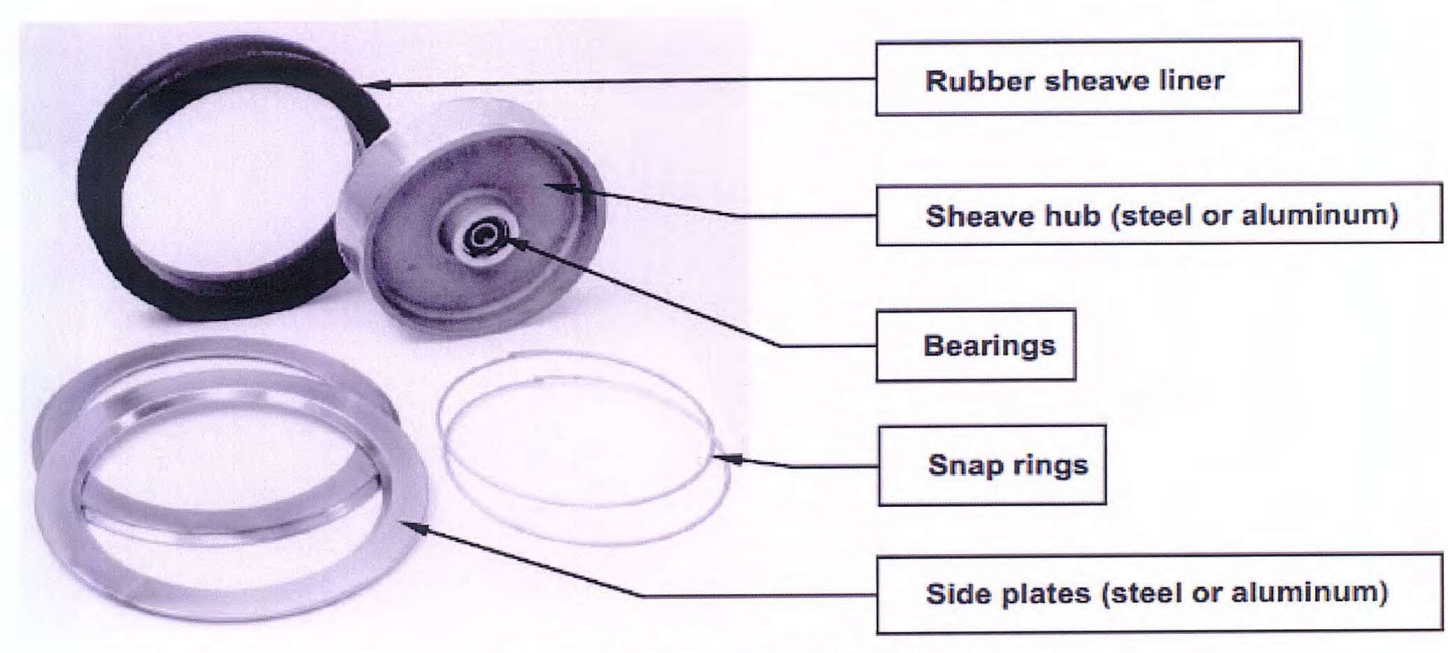


Figure 3, Sheave Assembly tilt Angle

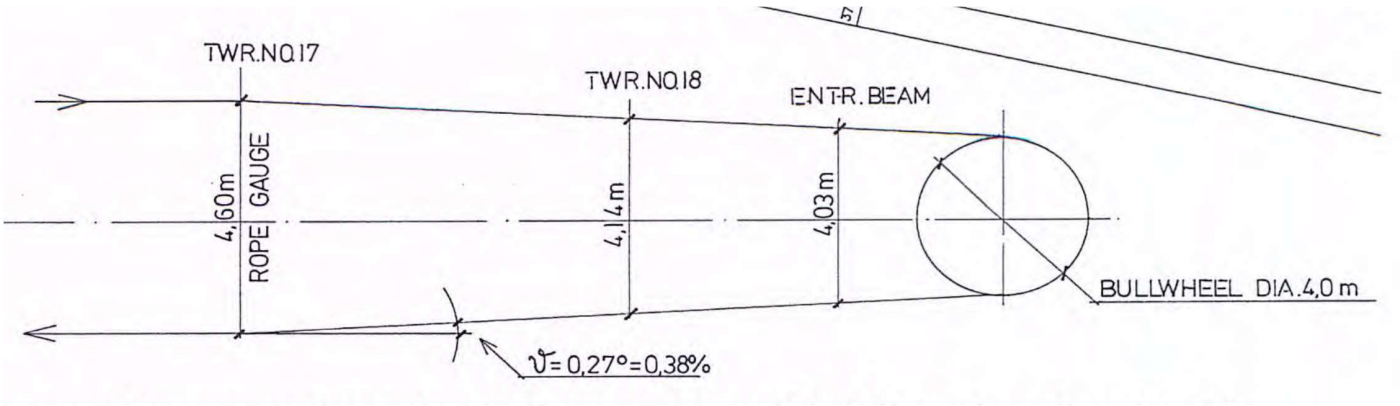
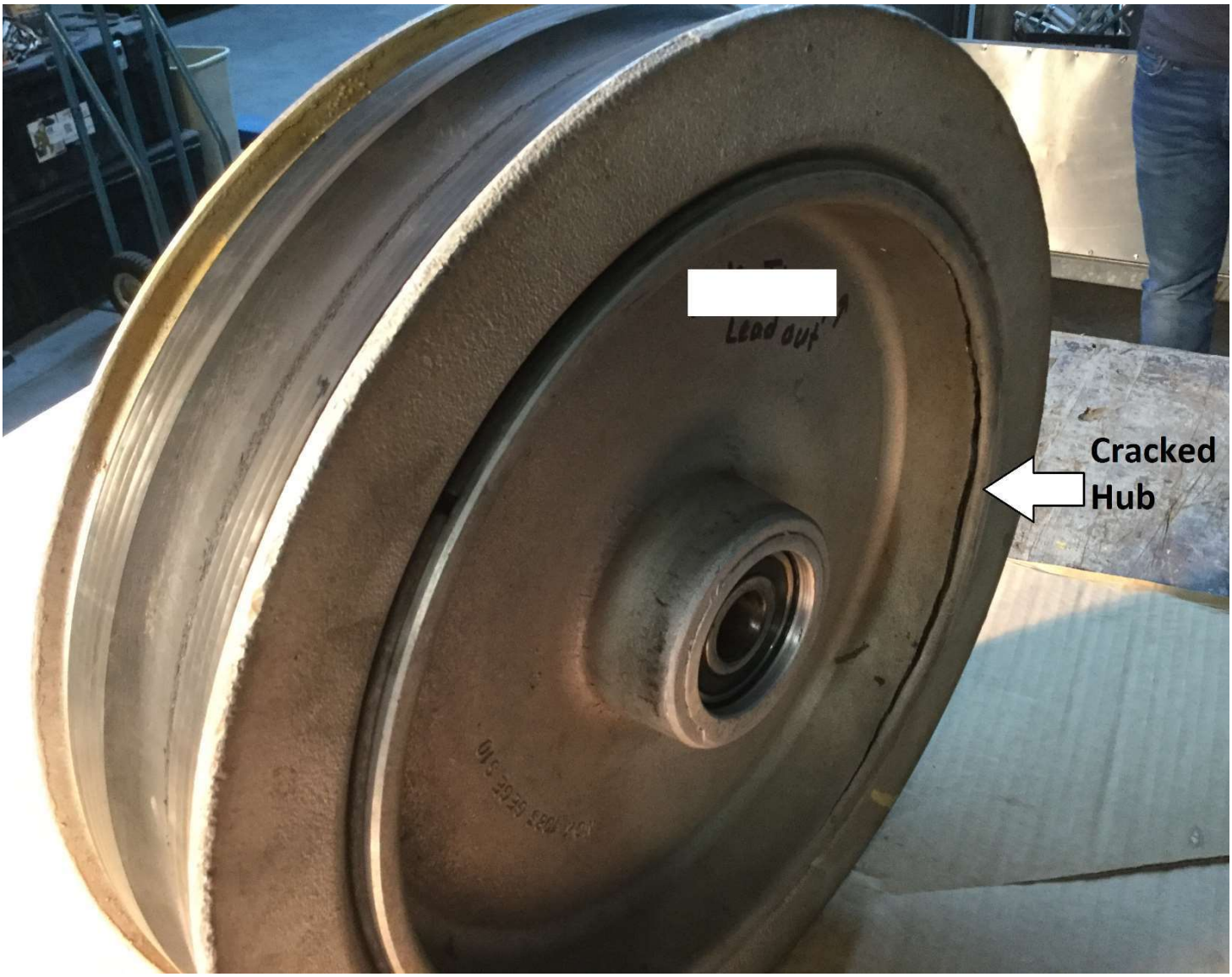


Figure 4, Ruptured Sheave



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