Incident Summary (Final # 5612654)

SUPPORTING INFORMATION	Incident Date			*January 31,2017*
	Location			*Vancouver*
	Regulated industry sector			*Elevating*
	Impact	Injury	Qty injuries	*none*
			Injury description	*none*
			Injury rating	*none*
		Damage	Damage description	*Driving machine brake arm broke*
			Damage rating	*major*
	Incident rating			*major*
	Incident overview			During operation the elevator car was at the top floor and suddenly moved in an uncontrolled manner and came to rest on the stops. Upon inspection, the brake arm had broken.
INVESTIGATION CONCLUSIONS	Site, system and components			*The braking system consists of a brake drum that has two brake shoes on either side. The brake shoes clamp onto the drum to stop and hold the elevator. The brake shoes are connected by a spring and rod which require spring tension adjustments. See Figure 1. This elevator machine and brake design is approximately 80 years old, made of cast iron. It is a high usage elevator in an industrial setting.*
	Failure scenario(s)			*The brake arms have a portion that were thin and under stress. The material used was cast iron and fails in a brittle manner. The cast iron began to crack and then fractured all the way through. See Figure 2. Acuren Group Inc. also found indications of cracking on the (right) or non-failed brake arm. See Figure 3. It is probable that the spring tension adjustment may have increased and applied added stresses to the brake arms. The addition of flat washers to assist with the spring tension adjustment are visible in Figure 4.*
	Facts and evidence			*An examination of the brake arms conducted by Acuren Group Inc. and photographs taken of the components illustrate the failure. Figure 5 shows a pre-existing crack in the cast iron. The report also suggested that the failed brake arm "exhibited a brittle appearance which is as expected for a grey cast iron component failure." See page 2 section 2.2 of Acuren Group report.*
	Causes and contributing factors			It is highly probable brake usage surpassed the brake components fatigue life. The tension on the thin and stressed section of the brake arm began to crack over the years and finally fractured all the way.

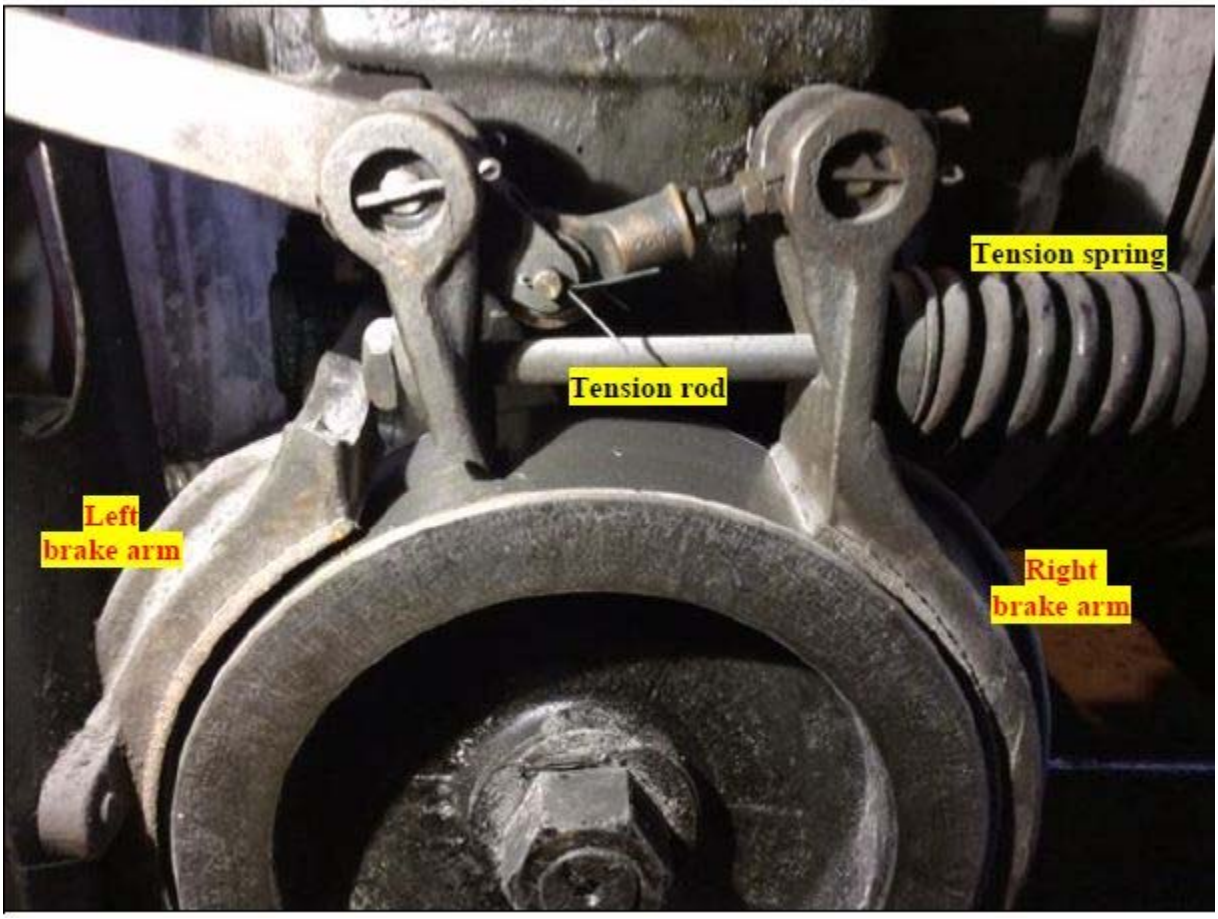

Figure 1 General design. Broken brake shoe, spring for tension adjustment. Photo edited by Acuren Group Inc.

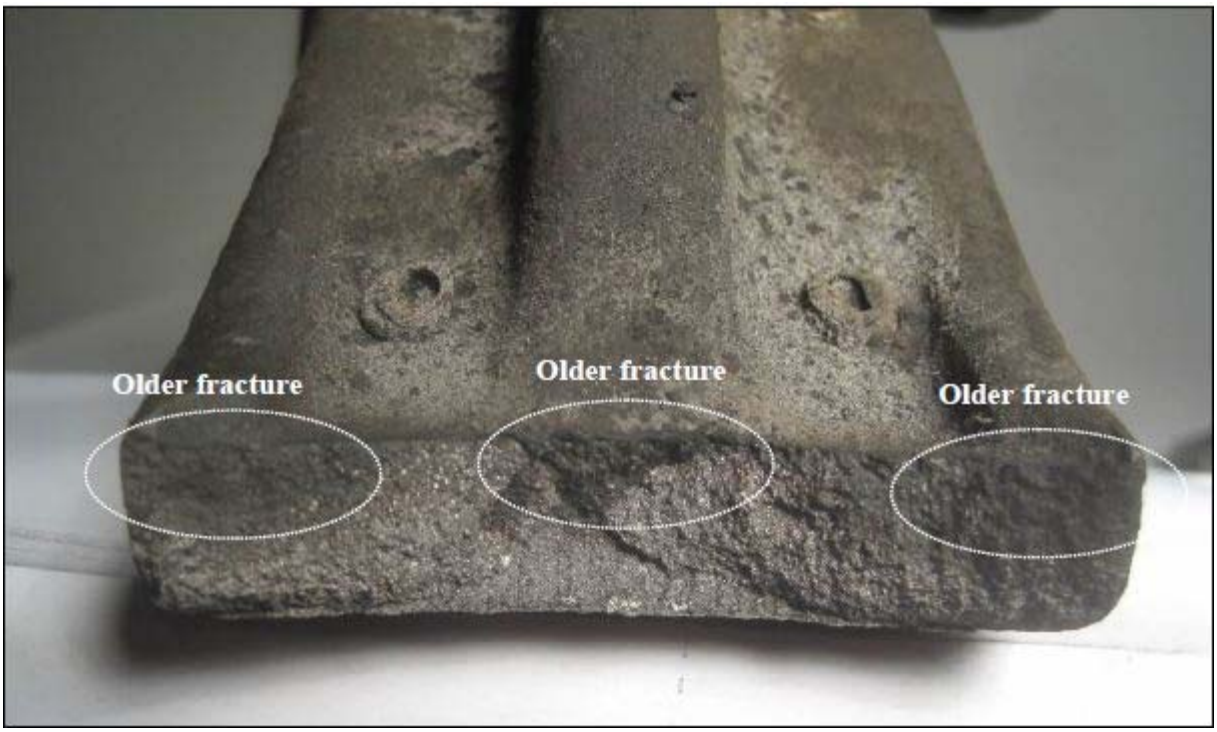

Figure 2 Cross section- darker areas show previous cracking. Photo courtesy of Acuren Group Inc.

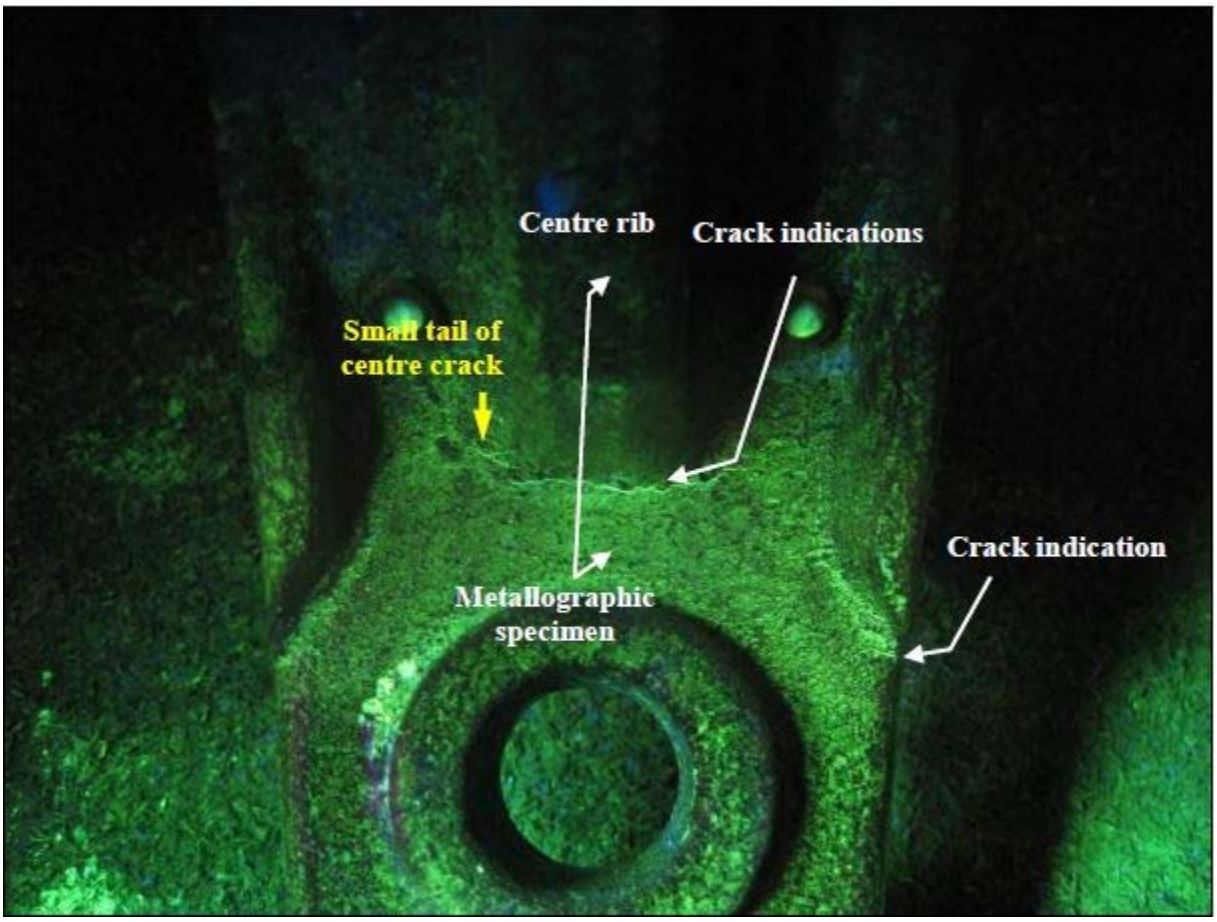

Figure 3 Shows the non-failed brake arm cracking, Photo courtesy of Acuren Group Inc.

Figure 4 Shows the addition of Flat washers for tension adjustment. Photo courtesy of Acuren Group Inc.