

Gwaii Haanas Mooring Buoys

Dive Inspection Report Oct, 2013

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Dive Inspection Report Gwaii Haanas Mooring Buoy's

Contract # GHNPSL13040

Oct. 15, 2013

Purpose of report: The purpose of this report is to outline the condition of the various mooring buoys outlined in the contract, to determine what, if any maintenance needs to be done to maintain the safe function of the buoys. In addition suggestions will be made to improve the mooring setups to enhance the safety to the boating public and increase the longevity of the materials in use.

Designed purpose of Buoys: The purpose of the buoys is to provide a convenient tie-up at various anchorages for vessels visiting the Gwaii Haanas National Park Reserve. The orientation given to boaters visiting the park is that the Buoys are not for foul weather tie-up and that all boaters should deploy their anchors in such an event. There was no limit to vessel size as of the writing of this report.

Materials used for anchors: The majority of anchors were 5ton cement blocks, some with a steel eye and some with a hole through block. 2-3 ton blocks were used in Rose Harbour, Huxley. Small cement blocks were used at the North buoy on Sgaang Gwaii. A pile of chain was used on the South buoy of Sgaang Gwaii and 1/3 of a cement filled 170litre(45gal) drum was in use at the North east Buoy of Hotsprings.

Materials used for mooring lines: The majority of the mooring line from anchor to buoy was 2.2-2.54cm(7/8"-1") amsteel rope. Combinations of chain were in use with some mooring lines having rope to chain to anchor, others used rope straight to block and others namely Burnaby Narrows, Murchison Isl., and Shuttle Island were all chain. Other rope in use was 2.54cm(1") to 3cm(1.25") 3 strand poly and poly steel.

Materials in use for buoy's: The buoys consisted of old D.F.O steel buoys (consisting of foam filled tires sandwiched between steel plates). Dragger balls (hard plastic round floats with one or two eyes, foam crab trap floats and the newly added inflatable buoys with tie up eye and swivel.

Methodology used for inspecting chains: Chains are simply measured to determine the thickness remaining from their original size. Example: a chain link which when new was 2.54cm(1") and now is 1.27cm(0.5") would be considered at 50%. It is recommended to change chain at 50% or less in most mooring applications.

Methodology used for inspecting ropes: Ropes are harder to inspect, compared to chains, when trying to determine remaining strength. A rope with 50% remaining size, may have only 10% or less of its original strength. Any significant fraying in a rope is considered grounds for replacement. Knots can cause a rope to lose as much as 50% of its original strength. It is recommended to use spliced eyes where possible, especially with rope such as amsteel which doesn't hold knots well (see note 1). Rope colour is important especially when inspecting poly. Poly rope which is discoloured from chemical or U.V exposure can be less than 50% of its original strength and is recommended for replacement. Amsteel rope strength is much less affected by damage causing external decolourization and is not recommended for replacement unless significant fraying is also present.(see note(1))

Skedans: N 52 57.755 W 131 36.408 Two Buoys. North buoy (closest to beach) consisted of a dragger ball buoy to amsteel rope to a 5ton anchor with a hole through it in approx. 7.6m(25ft) water. No observed defects in rope from the buoy to the block, the rope goes through the hole in the block and is tied back to itself The loop through the block has minor fraying where it rubs on the comers of the block (see middle picture below). Last picture below shows divot in tie up tail, probably from a prop (see arrow).



Recommendations: Put boom chain through hole in block and attach min. 6m(20ft) chain or replace rope through block.

Comments: Rope too short to retie past wear points. Buoy was replaced with new parks float. Length of mooring rope is marginal.

2"d buoy consists of a foam crab pot float to amsteel rope to a 5 ton anchor with a hole through it in 7.62m(25ft) of water. Tail on surface is frayed, is also badly frayed on the comers of the anchor block (see middle picture below). There was not enough slack in rope to re-tie. The anchor block is laying on it's side (see picture on left below). In order for the mooring line to be changed the block needs to be flipped over to access the hole in the block. Buoy is not serviceable until repairs made.



Recommendations: Replace float and minimum 12m(40ft) rope and flip upright the anchor or add 6m(20ft) piece of chain to anchor and replace float.

Comments: Mooring buoy not serviceable until repairs made.

Tanu: N 52 45.682 W13136.643, One Buoy, (Co-ordinates given were N52 45.763 W131 39.396) Consists of a large oblong dragger float (see picture on right below) lashed to heavy poly rope 3cm(1.25") to 5m(15ft) of 2.54cm(1") chain to a 5 ton cement anchor in approx. 20m(65ft) of water. Eye on block is serviceable. Mooring rope is faded, brittle and slightly frayed on the surface. Rope is attached to plastic float with lashings which were frayed. We attached some heavy plastic ties to repair the frayed lashings. Chain at block is about 30% (see left picture below).



Chain and shackle at less than 50 percent. Tanu anchor

Recommendation: Change chain and rope for 2014 season. Min. 20m(65ft) rope and 6m(20ft) chain. Use minimum 2.54cm(1") shackles when attaching rope.

Comments: Didn't change buoy as chain is marginal and the float is a good one (see picture above). Shackles attaching chain to block are welded. Shackle attaching rope to chain is about 30%. Chain 30-40%.

Shuttle Island, two buoys: N52 3990 W1314370 East/West buoys are old D.F.O floats, steel with foam filled tires sandwiched between steel plates. The East buoy has a single 2.54cm chain going down to 6m(20ft) then splits (see picture on right below) and goes to two cement anchors that are buried (see left and middle pictures below) at approx. 18m(60ft) water. Eye & swivel are good on buoy, single chain to 6m(20ft) where it splits is less than 5000. Remainder of chain is marginally serviceable 40-50%. West anchor is buried. The East anchor has its eye exposed & in good condition.



Buried anchor block, East buoy at shuttle Isl. West anchor block

Buried anchor with eye showing, easy buoy, east block

East buoy chain splitting to east and west anchors.

Recommendations: Mooring buoy is not safe to tie-up to until top section of chain changed. Suggest changing all the chain. Change chain from buoy to east block. 30m(100ft) of chain or rope required.

2nd buoy (shuttle Island) anchor is in approx. 15m(50ft) water and is buried. Mooring chain is less than 10 % in sections (see picture below), Mooring eye and swivel are good.



West buoy anchor chain at Shuttle Island. Shows totally unserviceable chain

Recommendation: Replace chain immediately as it is unsafe to tie- up to. Min. Chain length or rope 19m(65ft).

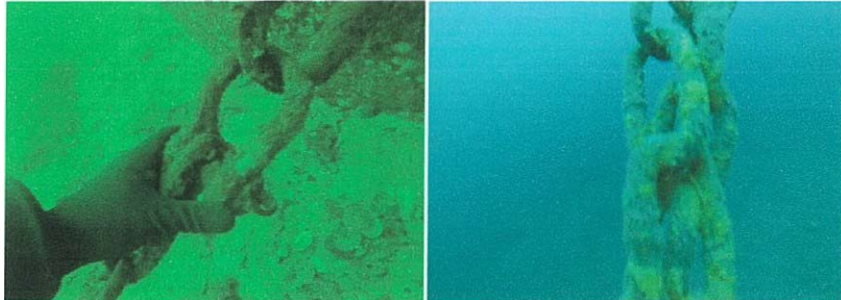
Comments: The unserviceable condition of these buoys was communicated to Marvin Pearson by phone (Asset Manager) on Sept. 24. The West buoy is unlikely to survive the winter and once lost will make finding the anchor very difficult.

Murchison Island: N52 35.59 W13128.23 Two buoys, steel with foam filled tire floats. S.E Buoy has two chains to two 5 ton anchors. South chain is 2cm($\frac{3}{4}$ ") and is at about 60percent, some evidence of galvanic action, as some chains had welds corroded (see picture to left below). Anchor in approx. 21m(70ft) water. North chain 50% remaining to about 18m(60ft) and from 18m to 5 ton block is 40 percent (see picture middle). Cement anchor is in approx. 24m(80ft) water. Eye on Buoy and swivel are good (see picture below, right).



Recommendations: Change North chain, Min. 42m(140ft) of 2cm($\frac{3}{4}$ ") chain or rope.

2nd Buoy (Murchison), North buoy has 2 old chains hanging off it (see right hand picture below). One is old, unserviceable chain. The other has 50% remaining to 18m(60ft). From 18m(60ft) to 5 ton cement anchor it goes to a single chain which is 30-40%. Shackle and eye at the 5 ton block have less 50% remaining. (see picture below) Shackle pin is welded. Buoy eye is good.



Recommendation: This Buoy is not serviceable for 2014. Min.27m(90ft) chain should be replaced.

Comments: A 2.54cm(1") poly safety was tied from the block to the buoy as the float camp was dependent on this buoy. As the rope was attached to a much corroded, sharp eye on the block, the staff was notified that the rope would be very temporary if the chain broke. This information was phoned into the Asset Manager on Sept .24/13.

Hot Spring Island: Two Bouys: one on the North side and one on the south side. North buoy: N52 34.735 W 131 26.586. Consists of a Dragger float, with 2cm(3/4") poly rope (see right hand picture below) spliced directly to an anchor, consisting of 1/3 of a 170litre(45gal) drum filled with cement in approx. 4m(13ft) water. The rope is brittle and faded. The anchor can be moved by hand underwater and it would be difficult to change rope with such a small eye (see left hand picture below)



Recommendations: Replace rope and anchor. Min.7.6m(25ft) rope and at least a one ton anchor.

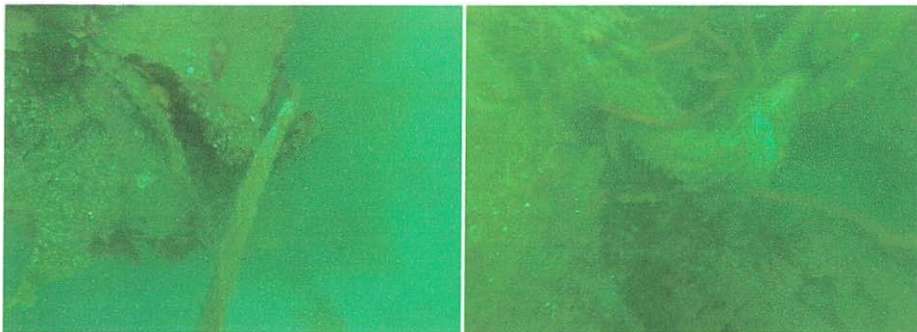
Comments: Didn't put new float on as anchoring not adequate.

2nd **Buoy** (South side of Hot Spring Island) N52 34.468 W131 26.744. Consists of a dragger ball buoy to amsteel rope to 2cm($\frac{3}{4}$ ") chain to a 5 ton block in approx. 9m(30ft) water. Chain: less 40% (see middle picture below), worst chain was last 3m(10ft) to rope. Re-tied rope past the worst of the chain. Rope was quite twisted. Block is lying on the chain so couldn't assess the eye or tie to it (see left picture below). Picture to right shows accumulated kelp on mooring line.



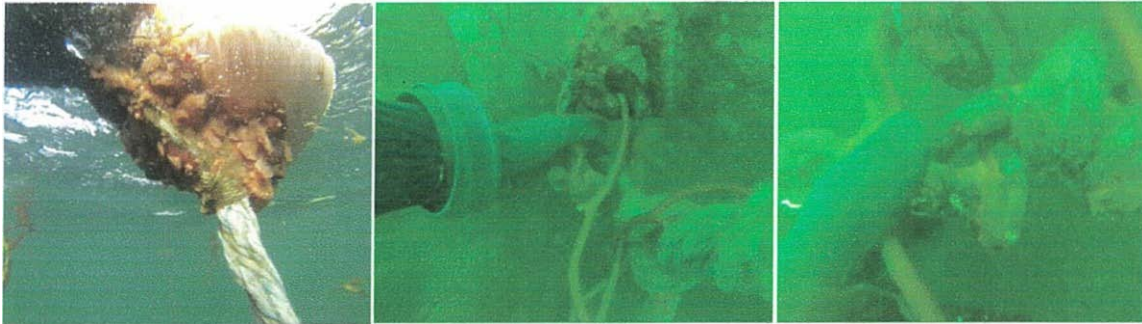
Recommendations: Replace chain on block for 2014 season. Block must be flipped to do this. Min. 6m(20ft) chain. Use min. 2.54cm(1") shackles where rope ties to chain. Swivel on buoy will help with twisting rope, swivel at chain rope connection would be better.

Ramsey Island: 3 buoys at N52 34.40 W131 24.00 Buoy closest to shore consists of a Dragger ball buoy lashed to amsteel rope to a few links of chain to a 5 ton block. Block is lying on its side (see picture below) in about 7.6m(25ft) water. Rope is good. Chain remaining is 70%. Eye of block is good.



Recommendations: Replace chain with min. 6m(20ft) of 2cm($\frac{3}{4}$ ") or larger **or** flip block up to prevent rope from abrading on corner of block.

2nd buoy (Ramsey Island) Consists of dragger ball lashed to amsteel rope (see picture of lashings) to a 5ton block. Block is on its side in about 11m(35ft) water and the rope is tied to a ring at the block. The ring has 50% remaining . (see pictures below).

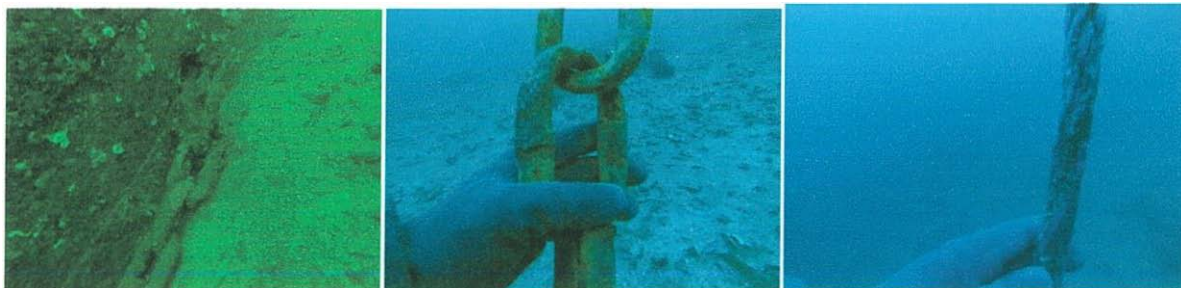


Recommendations: Attach piece of chain to block **or** flip block upright to prevent rope abrading on corner of block.

3rd buoy (Ramsey Island) Consists of a dragger ball buoy to amsteel rope to a 5 ton anchor in about 14m(45ft) water. Rope was frayed near the block so it was retied at block. Block is on its side. Rope is too short and would be submerged on a big high. (pictures missing)

Recommendations: Attach a min. 6m(20ft) of chain to block **or** min. 18m(60ft) rope and flip the block upright.

Huxley Island Ops: Two Buoys, N52 25.987 W13122.232, East Buoy consisted of a low floatation foam float to amsteel rope to 2cm($\frac{3}{4}$ ”) chain to a 5 ton block with a hole through it in approximately 26m(85ft) water, with a boom chain through the hole. The chain is less than 50% remaining about 5m(16ft) from block(see middle picture). The amsteel rope is very stretched but has no obvious defects (see right hand picture below)



Recommendations: Replace a min. 6m(20ft) chain from block to rope for 2014 season.

Comments: Buoy was replaced with a new parks float as the float in use was in danger of being sunk with accumulated growth and Kelp.

2nd Buoy (Huxley Island). The West buoy consists of a blue rubber float attached to Amsteel rope to a shackle with welded pin (see middle picture) to 2.5cm(1") chain to two small anchors (see left picture below) connected with chain in approx.24m(80ft) water. The amsteel rope is very compressed but with no defects, the chain is 60%, eyes on blocks are good.



Recommendations: Inspect in two years.

Burnaby Island (N.Dolomite Narrows): One buoy at N52 34.40 W B121.11, Anchor lies in approx. 6.7m(22ft) of water. Consists of steel buoy with tire filled foam floats, anchor is a 5 ton with a hole through it with a piece of 2cm(¾") boom chain through the hole. A 6m(20ft) section of chain adjacent to the block is less than 50 percent remaining (see middle picture below). Eye on buoy and swivel are good (see picture on left below)



Recommendation: Replace 6m(20ft) section with worst wear. Consider replacing all of chain from block to buoy for 2014 season. Minimum 11m(35ft) of chain to replace all.

Rose Harbour: Two Buoys, N52 09 020 W131 05 196 (Position given in contract, N52 09.00 W131 21.11). South Buoy consists of a large buoy with a steel tie up eye on top attached to blue amsteel rope to chain links sticking out of a 5 ton block in approx. 14m(45ft) water. Rope has a steel weight (counter weight) attached part way down to prevent rope floating up on a low tide. At time of inspection on a high tide the rope was very tight. No obvious defects on rope, however it was severely twisted (see left hand picture below) from counterweight to anchor block (see middle picture below). Right hand picture shows rope above counterweight with no twist.



Recommendations: Mooring line needs to be lengthened. Attach 6m(20 ft) piece of chain to anchor or replace rope with min .20m(65ft) rope. Attach swivel to bottom of buoy or to chain at block to prevent excessive twisting of rope.

Comments: Zinc on buoy was at about 60%.

2nd Buoy, N52 09 189 W13104822 Is around point of small island to North east of South Buoy. Consists of small dragger ball for a buoy (see picture below) connected to 3 different pieces of rope, one piece being white multi-braid poly (old D.F.O rope) and two separate pieces of amsteel, attached to a 5 ton block on its side (see picture below) in approx. 14m(45ft) water. No obvious cuts or fraying on rope to block, knots appear tight, minor fraying on rope where rubs on the corner of the block. Eye on block is good (see picture below).



Recommendations: Flip anchor upright or attach piece of chain to anchor, min 6m(20 ft). Consider replacing 3 pieces of rope with one piece.

Comments: G.P.S co-ordinates didn't match with those specified in contract.

Sgaang Gwaii: Two Buoys, South East location N52 05.773 W131 12.840, consisted of dragger ball buoy connected to two pieces of amsteel rope, with one end tied into a pile of 2cm(¾") chain for a anchor (see middle picture below) in approx. 7.6m(25ft) water. Pile of chain had some links at 40% and others 60-70%. Could not really tell if rope was attached to good chain or to rotten chain. Rope appeared in good condition and anchor /chain seemed solid when pulled on. Minor fraying where rope goes into pile of chain. Rope was minimal for length. Buoy is serviceable for small boats.



Recommendations: Replace chain-anchor with a cement anchor.

Comments: Attached new float/buoy (see picture above)

2nd buoy(Sgaang Gwaii), N52 06.138 W131 13.517 (Contract says N52 06 171 W131 13.616) consisted of a small dragger ball buoy attached to 2cm(¾") poly steel rope with a hard eye shackled to a swivel to ¾" chain to 3 small cement anchors approx. 113kg (250lbs) each in 6m(20ft) water (see pictures below). Swivel, Chain and shackles are good 80% plus, rope has no obvious signs of wear or deterioration.



Comments: Replaced dragger ball with new buoy.

Recommendations: Consider adding a little more weight to anchor.

Comments: G.P.S Co-ordinates didn't match those in contract.

Louscoone Inlet water-line: One Buoy N52 11.64W131 15.37. Buoy was a steel (former D.FO float) attached to three, 2.54-2.84cm(1"-1 1/8") poly steel ropes, one rope with 3 floats attached along it, goes to a 5 ton block with a zinc on the eye of the block (east block) in approx. 24m(80ft) water. The 2nd rope goes to a short piece of chain attached to a 5ton anchor in approx. 23m(75ft) water, this anchor also has a piece of chain leading towards the beach attached. The 3rd rope goes to a short piece of heavy chain to a beach rock anchor. The last 7.6m(25ft) of the rope is sheathed with plastic pipe to prevent rope abraiding on beach rocks and from U.V breakdown . This plastic pipe is broken and a minor amount of fraying was observed on the rope at that point. The beach rope also has some minor fraying where it attaches to beach chain. No other signs of deterioration was observed on either of the anchor ropes. Eye on buoy was good, eye on blocks good, chain on West block 60%. Minor wear observed on rope attachment points on anchor and buoy.



Recommendations: Attach another length of chain at least 7.6m(25ft) to replace plastic sheathed rope and get the attachment point of rope past possible points of abrasion. Consider attaching lengths of chain to anchors to give more spring. Replace tied eyes of rope with spliced eyes. Remove old ropes when they are replaced, the middle picture above shows some of the clutter (there should only be three lines).

Louscoone Inlet Mooring: One buoy. N52 10.05 W131 15.37. Buoy not found.

Comments: G.P.S Co-ordinates put us a kilometre or more on land.

Recommendations for improvements:

- Make sure the mooring line is of adequate length to prevent anchor from being lifted by a vessel tied up on a higher tide. Many of the mooring lines using ropes at the sites visited had minimal amount of line, some had so little slack on the tides we visited that the float could not be changed without submerging it. I think one of the reasons the mooring lines did not have a lot of extra length was because the mooring rope floats and gets fouled in props and is cut off by boaters. To prevent this I suggest attaching a length of chain to the anchor, approximating the height difference between a low and a high tide roughly 20ft.

- If the mooring rope is directly to the eye of the anchor, ensure the anchor is upright to prevent rope from chaffing on edge of anchor block.

- Consider reducing shock loads to the mooring line by adding a piece of heavy chain to each anchor say min. 1.5" and at least 20ft long. The heavier the chain, the less likely will be dragged around the block and allow the rope to come in contact with the corner of the block. This would also put spring into the anchor buoy system which cushions the mooring rope and anchor from high shock loads. Note: If the buoy is to lift the chain up and down with the tide, its floatation must be able to lift the weight of chain, other options should be employed with low floatation buoys.

- Consider using a short piece of heavy nylon that sinks attached to the buoy to prevent the rope getting fouled in props. This would also reduce or eliminate high shock loads as nylon will stretch. An alternative is to use small weights attached to the rope to keep it from floating to the surface.

- Consider only using spliced eyes where high loads are a possibility. Consider replacing those knots currently in use with spliced eyes, especially on the amsteel rope.

- Consider standardizing buoys. Using one colour or style to tell mariners whether the buoy is only for temporary or small vessel tie up and a different colour or style to indicate more significant anchoring for larger vessels and overnight tie up.

Summary: The main flaws encountered in the mooring setups, other than some wore out chains, was lack of length in the mooring lines, lack of any shock absorption (spring) and ropes attached directly to anchors on the side, allowing the mooring line to come into contact with the corner of the block. The consistent lack of adequate length in the mooring ropes can only be attributed to the fact that the amsteel mooring lines float and are possibly getting fouled in props and cut off or were installed short to prevent excess line from floating. The problem with a short mooring line is that a smaller vessel tied to the buoy can be pulled under on an extreme high or a larger vessel can float the anchor. Three solutions to this issue are;

(1) Weights attached to rope.

(2) Replacing a section of rope to buoy with nylon rope (which sinks).

(3) Attaching a length of chain to blocks with adequate length to accommodate tides.

Note: This would require the buoy to have enough buoyancy to lift the chain.

To maximize the strength of ropes and minimize potential for knots slipping under load, especially in the amsteel I suggest using only spliced eyes. To minimize wear of rope at attachment points I suggest using a minimum 2.54cm(1") shackle. For those anchors that have rope attached directly to it and the anchor is lying on its side I suggest pulling the anchors upright so that the eye is on top (this would only be necessary if no chain is to be attached). I strongly encourage all 1/2 inch or less sized chain to be replaced at 50% or less remaining of its original size.

Executive Summary: This is my first experience with amsteel rope as a mooring line. It appears to be holding up to its manufacturer's claims of strength and abrasion resistance. I think it has considerable potential in mooring applications where it can't float to the surface and become a hazard to navigation.

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Note (1): The main rope in use at the buoys inspected in this report was a blue rope called Amsteel-blue. The breaking strength of the 7/8" rope in use at most of the sites visited has a minimum strength of 81,700lbs or 41,200kgs. It has a specific gravity of 0.98 which means it floats. It is very resistant to U.V, abrasion resistant and doesn't stretch. The thickness of many of amsteel mooring lines was much less than 7/8" but according to an engineer at Samson ropes by the name of Dustin Hind this is normal and the rope has simply eliminated all the voids left in it from manufacturing. One weakness of Amsteel rope according to the engineer is that it does not hold knots very well. The bolon is the traditional knot of choice for ropes in these applications but would not be a good choice for Amsteel. The solution to eliminate the loss of strength and the possibility of a knot slipping, is to use spliced eyes. The splicing technique is available on the Samson rope website. High shock loads were also identified by the engineer as a possible cause of premature failure especially if knots were used. To eliminate this problem a short piece of nylon rope of equivalent strength will give the mooring line stretch (spring). A short piece of heavy chain attached to the anchor block would also mitigate shock loads and prevent the rope from abrading on the corners of the anchor block.