

Puffin Island Lighthouse: Then and Now

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ABSTRACT

Harsh weather conditions in Newfoundland and Labrador have often been the governing factor for many infrastructure projects across the province, particularly along its coast line. Lighthouses have served the purpose of guiding and warning sea-traffic for centuries and are privy to the most destructive elements as they are typically isolated on coastal land points. The *Puffin Island Lighthouse* is no exception to this standard and this paper will address the changes made to this particular lighthouse since its original construction in 1872.

Puffin Island is less than three quarters of a mile from the south entrance to the Greenspond Harbour. During the mid 1800s the small outpost community of Greenspond was well known for being a plentiful fishing area, prominent supply center for the Labrador fishery and seal hunt, as well as a major import/outport harbour for trading goods between Newfoundland and Europe. The need for a lighthouse on Puffin Island to navigate traffic through adverse weather conditions was originally petitioned for in 1866.

The original lighthouse was mainly constructed using granite that had been quarried from the site location. Due to incessant maintenance the structure was eventually reconstructed using timber which is still standing today. The following article will outline the various elements and challenges to be considered when designing a lighthouse and provide information on technologies used to instantly navigate mariners through the seas during dynamic weather.

1 INTRODUCTION

Located in Bonavista Bay, the outpost community of Greenspond has been inhabited since the 1690's with it's largest poplation peaking at approximately 1800 people. Often referred to as the "Capital of the North" for its prominence in the seal hunt and fishing industries and its easy

accessibility to sea traffic, most of its inhabitants past and present have made their livelihood from the sea. Due to its hub status a lighthouse was proposed to help navigate the many fishing vessels and trading ships through the waters and coastline of Greenspond.

Originally a square-shaped granite structure, the Puffin Island Lighthouse construction commenced in 1872 approximately 400m off Greenspond on Puffin Island, which is only accessible by boat. Operating since March 1st, 1873 with a fixed red light emitting from the tower until 1912 when a diaphone fog alarm was added to the station at which time the light was changed to a white occulting light lasting 2.5s. In 1951 the structure was torn down and superseded with a wooden lighthouse built to emit a 0.2s flashing light every five seconds as well as a three second horn blast every 30 seconds as necessary for fog conditions [1]. The replacement of the lighthouse was essential due to recurring tedious maintenance required on the granite walls. This lighthouse and its respective sequential characteristics are still utilized today as one of the 23 remaining staffed lighthouses in Newfoundland and Labrador.



(a)



(b)

Figure 1: Puffin Island Lighthouse (a) original granite structure, (b) current wood structure

2 MAINTENANCE

Newfoundland's weather is famous for being diverse, the most extremes of which would occur along the coastline. Due to the nature of lighthouses and where they are constructed to effectively serve their purpose they are exposed to harsh weather conditions on all sides of their structure. Weathering is an in-situ process that causes the break down of rocks and other materials by the atmospheric elements interacting with the material, without the material itself moving. Lighthouse maintenance is inevitable; however, it can be reduced depending on the properties of the building materials and their ability to withstand the effects of weathering.

2.1 Granite Weathering and Maintenance

The Puffin Island lighthouse was originally designed with stone walls made from locally quarried granite, and mortar. Most granite is comprised of quartz, mica and feldspar, the latter of which increases granite's susceptibility to both chemical and physical weathering. Chemical weathering includes effects from hydrolysis, oxidation and hydration while freeze-thaw, insolation, salt crystal growth and pressure release weathering are considered physical. The two main elements to be considered in the case of Puffin Island, and other coastal structures, are freeze-thaw weathering and salt crystal growth.

Freeze-thaw weathering occurs in areas that contain a high moisture content with temperatures fluctuating above and below zero degrees. Although the granite used for the building blocks is not particularly porous, moisture can still seep in to the blocks when the temperature is in the positive causing the blocks to expand when it drops to negative temperatures again. This freeze-thaw cycle can repeat itself indefinitely in a climate like that of Newfoundland's where moisture is always present. Each time the blocks expand and then contract when the ice crystals melt, they weaken, which over time can cause the blocks to physically break down. This same process can also occur in the mortar between the blocks and cause cracks which will allow for shifting of the blocks within the structure.

A second contributor to granite block weathering is salt crystal growth. This type of weathering is most common along coasts as it requires the presence of saline solution (salt water). Similar to the freeze-thaw cycle, the solution seeps into the pores, cracks and joints in the blocks where salt crystals are left once the water has evaporated out. When the temperature rises the salt crystals expand. In the case of a stone wall, this expansion is enough to cause pressure within the stone and mortar cracks which will inevitably lead to the break down of the material.

When stone walls begin to visibly deteriorate, usually in the cracks, the maintenance required is called “pointing” or “repointing”. It is a very tedious task performed by a highly skilled mason. With the advancements in mortar and finishing on stone walls, the need for pointing is minimal for modern designs. However, this is not the case for the Puffin Island bridge constructed with the technology available in the 1870's. Repointing is a process that begins by stripping the damaged mortar back to a depth slightly greater than the width of the joint, careful not to damage the blocks themselves. New mortar is then filled in to bond with the remaining mortar and mason unit. If the damaged mortar to be removed is more than four centimeters it will have to be filled back in in multiple applications, allowing 24 hours of curing time to pass between each application until the pointing is complete. Due to issues with water leakage, the Puffin Island lighthouse had to be pointed six times between 1880 and 1913.



Figure 2: Chipping out damaged mortar

2.2 Wood Weathering and Maintenance

Wood is a common building material used for both interior and exterior structures. While most modern lighthouses are constructed of either steel or concrete, lumber is not an unsuitable alternative. Given the location of the Puffin Island lighthouse and the fact that it is only accessible by boat, wood was the most economical and practical material choice for the new structure. Most wood species used for outdoor construction, if coated with a water sealant, need minimal effort to maintain: oxidation of wood causing it to discolour would require the most attention. Scraping and repainting the sides of the lighthouse every couple of years would be the most maintenance required of a wood structure.



Figure 3: Discolouring from oxidization

3 LIGHTHOUSE TECHNOLOGY

Each lighthouse is given a set of characteristics as outlined by the *Department of Fisheries and Oceans Canada* to describe its rhythm, colour, period, focal height and nominal range. The first three characteristics for the Puffin Island lighthouse are as previously described in the introduction section of this article. The focal height is simply the structure's height in meters above the water and the nominal range is given for the light itself and is, “its luminous range in a homogeneous atmosphere in which the meteorological visibility is 10 nautical miles” [2].

The nominal range is used as an aid to marine navigation, and depending on the meteorological visibility of any given day, seamen can use the graph in *Figure 3* above to determine the distance of visibility of a light at night in nautical miles. Since all nominal ranges are given at a meteorological visibility of 10 nautical miles, if a line is drawn straight up from that range until it intersects with the 10 nautical miles line, the corresponding value on the horizontal margin should be the same. The Puffin Island lighthouse has a focal height of 21.3m and a nominal range of 16.

NOMINAL RANGE DIAGRAM

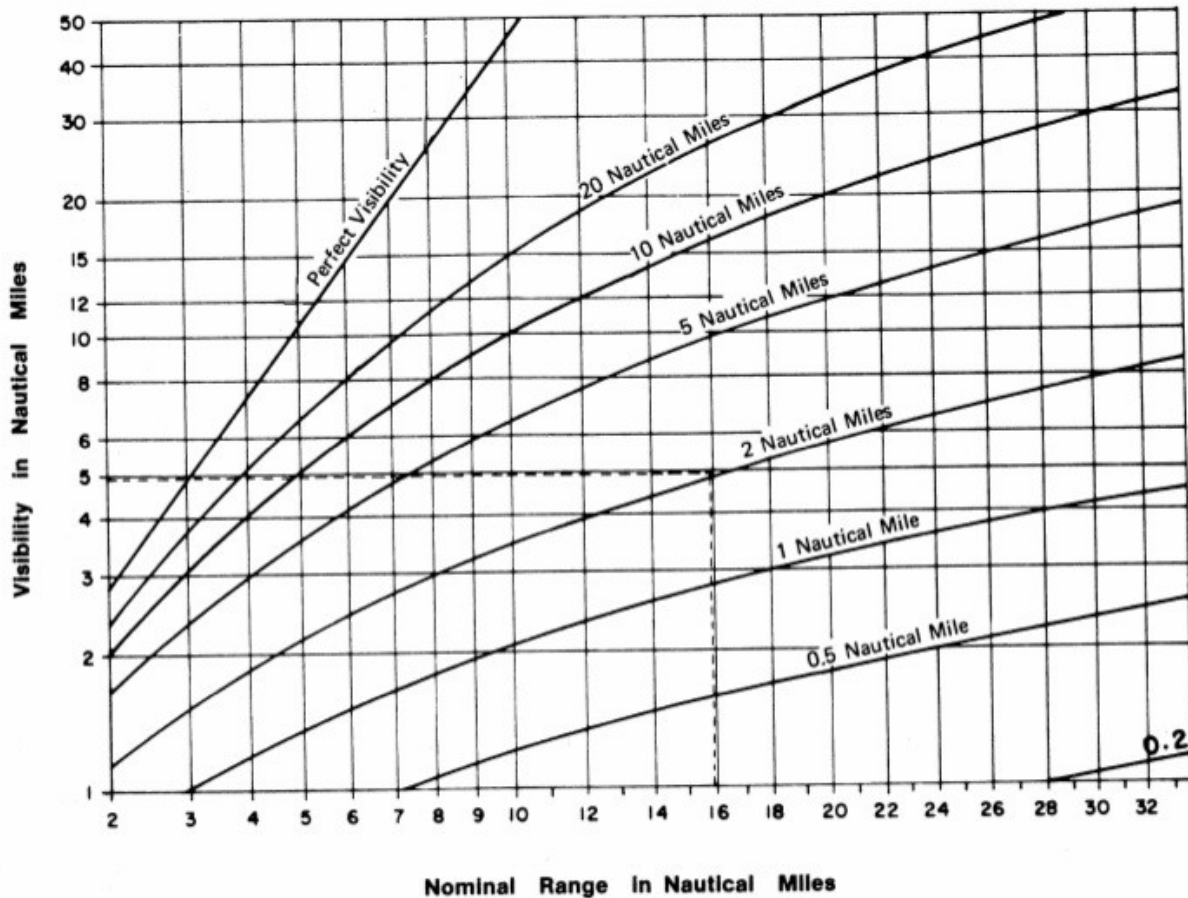


Figure 3: Nominal Range Diagram

Along with light characteristics, each lighthouse is given a daymark so that no two lighthouses look the same. Daymarks are the paint pattern or colour scheme specific to each lighthouse and provide a geographical marker to passing ships, white with a red horizontal stripe for the Puffin Island lighthouse. Although technology has advanced significantly and a ship's location can be tracked with a GPS system, visible markers still provide reassurance that a vessel is on the right course, and are never inaccurate.

Although lighthouses and their navigational functions to safely guide sea traffic around coastlines is still important, their need to be manned is less so. It can be argued that applied science cannot compare to the reliability of an on-site light keeper but, regardless of this, the implementation of modern technologies as they have progressed have taken over most light keeping positions. The light sequence of a lens continues through daylight hours; however, automated radar beacons have replaced light keepers in most lighthouses to trigger the fog alarm as it detects it is necessary.

4 CONCLUSION

Lighthouses and their services may not be a thing of past, and might not ever be, but their construction from granite stones certainly are. The Rose Blanche lighthouse in Newfoundland is the only remaining granite lighthouse in Canada. This paper has highlighted the history of the Puffin Island lighthouse and the transition from its former granite, to current wood structure. The increased rate at which granite stone walls deteriorate due to coastal weathering is detrimental to the decision of its discontinued use as a material for lighthouse construction. Even though maintenance of stone walls may still be required less frequently than that of wood, it is far more labour intensive and costly to carry out. Although wood structures may not be the optimal choice to withstand inclement weather conditions, given the constraints of the location and material accessibility it proved to be the best option for the Puffin Island lighthouse.

REFERENCES

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