Degradation of Estonian Lighthouses in Surrounding Environment

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The long and winding coastline of Estonia is washed by seawaters from the West and the North. The coastline is approximately 1500 km long, coastal waters are rocky and shallow. Due to such conditions around 50 lighthouses have been built along the coast, not to mention beacons and other seamarks.

In the year 1998 a joint project between Estonia and Norway was carried out that aimed at making a survey of Estonian historic lighthouses. During the project special attention was paid to the technical condition of the lighthouses. It is well-known that lighthouses everywhere around the world are located in extreme natural conditions, in close vicinity of seawaters and exposed to heavy winds. This makes them excellent examples of how the surrounding environment affects buildings. Lighthouses, due to their specific function, are high slender constructions that are constantly exposed to rainfall, winds, temperature fluctuations and salty seawaters. The building materials of lighthouses have traditionally included stone, brick, steel, cast iron, reinforced concrete, wood.

The table below illustrates the materials Estonian lighthouses have been built from:

	NAME OF LIGHTHOUSE	DATE OF BUILDING	HEIGHT OF BUILDING	BUILDING MATERIAL
1	Kõpu	1531	36	stone
2	Suurupi upper	1760	22	stone
3	Keri	1803	31	stone
4	Tallinna lower	1806	18	stone
5	Vilsandi	1809	37	stone
6	Pakri	1889	52	stone
7	Tallinna upper	1896	40	stone
8	Mohni	1852	27	brick
9	Sorgu	1904	16	brick
10	Laidunina	1907	24	brick
11	Vormsi	1864	24	cast iron
12	Kihnu	1864	32	cast iron
13	Vaindloo	1871	17	cast iron
14	Tahkuna	1875	43	cast iron
15	Ristna	1874	30	steel
16	Ruhnu	1877	40	steel
17	Viirelaid	1881	11	steel
18	Suurupi lower	1859	15	wood
19	Käsmu	1892	5	wood
20	Kunda	1909	19	wood
21	Kübassaare	1924	18	concrete
22	Abruka upper	1931	36	concrete
23	Paralepa upper	1932	34	concrete
24	Norrby upper	1935	32	concrete
25	Paslepa upper	1935	14	concrete
26	Viimsi upper	1939	13	concrete
27	Osmussaar	1954	35	concrete
28	Narva	1957	30	concrete
29	Naissaar	1960	45	concrete
30	Sõrve	1960	52	concrete
31	Virtsu	1951	18	concrete

Stone as a natural building material has endured the effects of the surrounding environment rather well. A common problem with the conical walls that are not protected from rainfall is that lime mortar is being washed out. Throughout the 20th century engineers have tried to reinforce the walls of stone lighthouses with cement plaster. However, this has often resulted in even more intensive decay of the walls as cement plaster prevents the secretion of moisture. This problem caused the oldest Estonian lighthouses in Kõpu (built in 1531) and Keri (built in 1803) to fall into extremely bad condition.

Kõpu lighthouse (1)

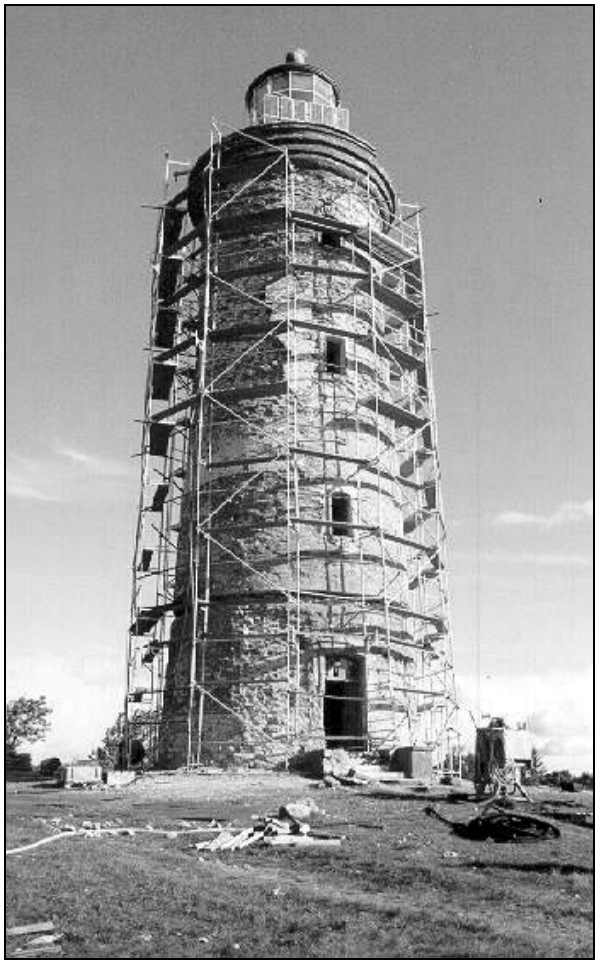
Keri lighthouse (2)

The body of Kõpu lighthouse is built without using mortar, only the outside layer of the walls is supported by lime mortar. Already in the beginning of the 20th century problems emerged regarding the structure of the massive body. As a possible solution walls were plastered with cement mortar. During the 1980ies part of the walls came down. In order to stop the lighthouse from crumbling down tha lower part was cast into concrete. Small air channels were left into concrete to allow the lighthouse to breathe.

Keri lighthouse, located on a small islet without any port in the middle of the Finnish Gulf, is on the verge of falling into pieces even today. Metal strips placed around the body of the lighthouse prevent it from immediate decay. Preservation and repair of this historic lighthouse will cost a lot and is at the moment not affordable for the state.

Brick as a building material for lighthouses in Estonia has in most cases proved to be improper. It is not strong enough under extreme weather conditions and decays easily, especially on the sides facing south and west, where temperature flactuations are the greatest. Later attempts to cover brick walls with plaster have also not given the expected results.

Mohni lighthouse (3, 4)



One of the reasons why the cement palster has not improved the situation may be that cement in the plaster has created a layer that does not allow the building to breathe anymore.

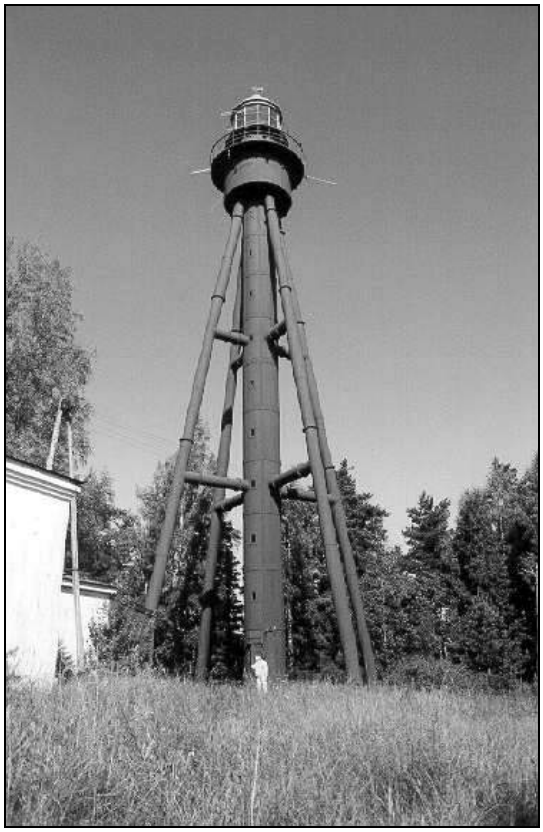
Brick tiles have also presented problems during the last decades in Estonia. Whether the intense decay is caused only because of technological mistakes during the production, changes in climate or greater environment pollution remains to be investigated. The causes seem to be complex, though. The production technology that was used for centuries until

quite recently did not guarantee a standard good quality. Both the material and burning process varied to a considerable degree. One of the reasons why bricks tend to decay fast may be the comparatively warm winters in Estonia during the past decades, which cause frequent freezing and melting in our humid maritime climate. Having said that, I may also note that during the last couple of years some companies in Estonia have started to produce high quality tiles ("Wiekor") and facade bricks ("Optiroc") using local clay. Their production has been reliable and has not caused any problems for the customers.

Steel lighthouses need constant care all year round. If the paint layer gets harmed, the steel will start to corrode very fast. It is a major challenge to protect 19th century steel lighthouses made with rivet constructions from corrosion. It is very difficult to clean the junctions from rust before painting. This is why several steel construction beacons have been replaced with new ones, as corrosion there has been too extensive.

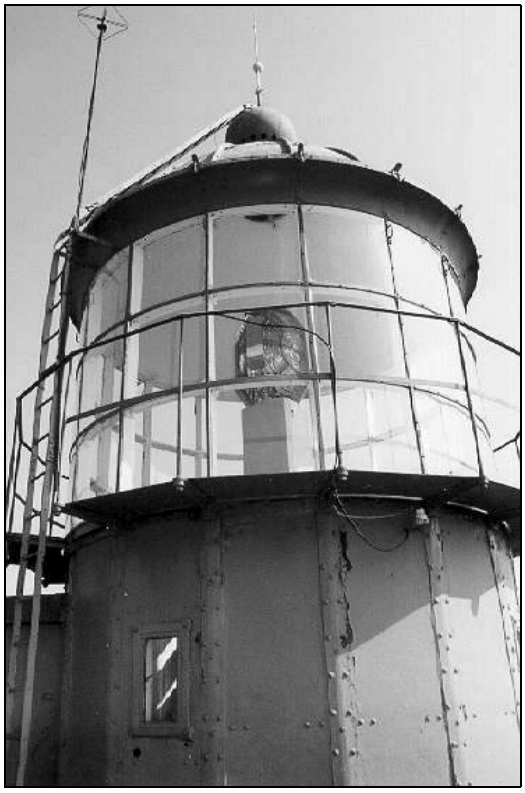
There are three boiler plate lighthouses dating from the II half of the 19th century in Estonia. All three have been greatly damaged during wars. Two of the lighthouses, Ristna and Viirelaid, were covered with concrete. The steel construction acted as a reinforcement in the concrete. The upper part of the third lighthouse in Ruhnu was completely demolished in war. An analogical upper metal construction was added to the lighthouse after the World War I.

Ruhnu lighthouse (5, 6)



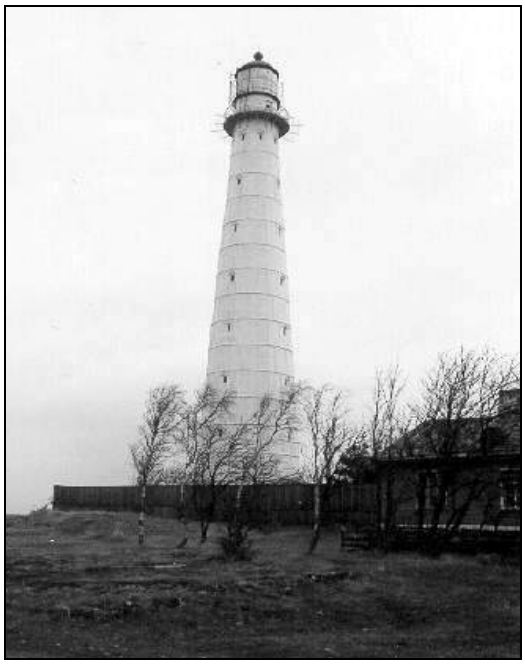
For the construction of lantern rooms different materials are used. Supporting pillars are made of cast iron; the body of sheet iron, glass and wood; the cupola from bronze. The contact points of different metals tend to corrode very intensly. During the 1990ies several lighthouses have been thoroughly repaired. It is very expensive to repair the lantern rooms. There is grounds to believe that the polluted moist sea air quickens the corrosion of metal constructions. Unfortunately no systematic long-term analyses have been carried out to monitor changes that affect lighthouses. This can partly be explained by the fact that until recently lighthouses were administrated by the Soviet Navy.

Lanter of the Kõpu lighthouse (7)



Maintenance of cast iron lighthouses is slighly cheaper, as cast iron does not corrode as easily as iron. Equally, it is also fairly simple to clean cast iron from old paint and corrosion. One of the problems, however, are the bolted joints of cast iron constructions that tend to let water in. Four cast iron lighthouses dating from the II half of the 19th century have survived in Estonia.

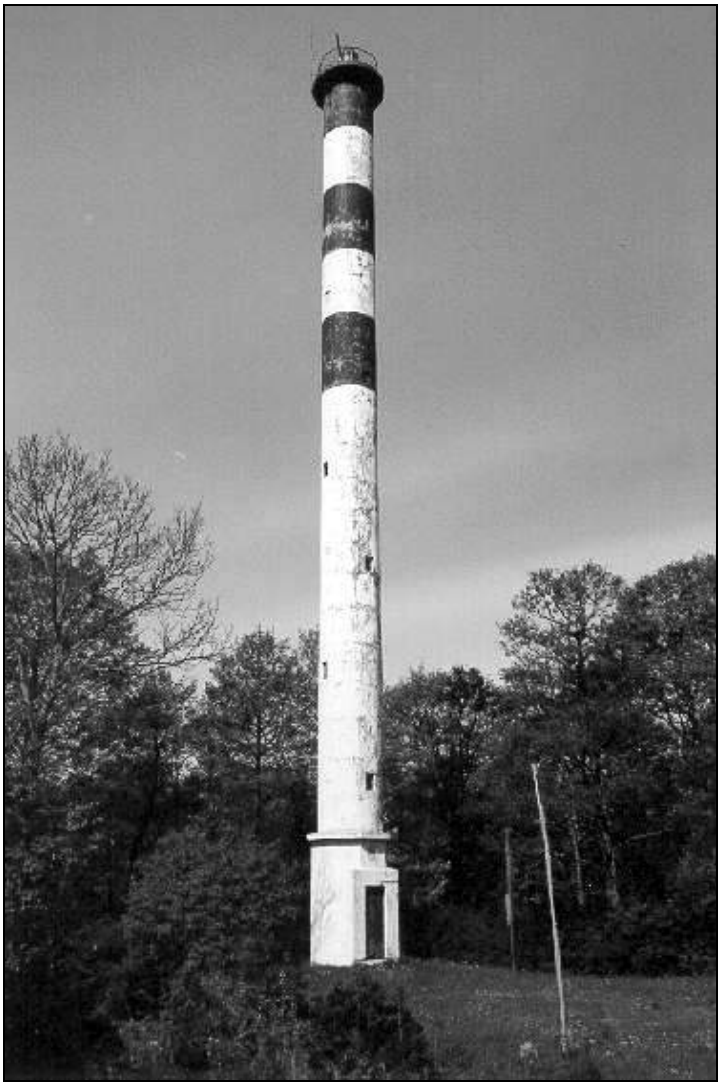
Tahkuna lighthouse (8)



During the 1920ies new reinforced concrete lighthouses started to be built in Estonia to replace the old lighthouses that were demolished in the World War I. By now it seems that

reinforced concrete is the most weather-resistant material, it requires minimum care. At the same time it is also true that the earlier reinforced concrete lighthouses already suffer from damages on the concrete surface and the reinforcement. The concrete surface has in some cases developed holes into it, steel reinforcement has uncovered and started to rust. The reason for that might be that water has invaded into concrete and the reinforcement has started rusting. This in turn causes expansion of the reinforcement, which will in time demolish concrete. Still, these processes are relatively slow and if detected in due time can be repaired with small effort and good maintenace.

Abruka lighthouse (9)



There are two wooden lighthouses in Estonia. Wood has laways been considered as temporary building material for lighthouses. But as the saying goes – nothing is more permanent than a temporary thing. The oldest wooden lighthouse in Estonia – Suurupi Lower Lighthouse - dates from 1859. This is apparently the oldest wooden lighthouse in the Nordic countries. Restoration work on the lighthouse was done in 1998. During restoration the support constructions of the lighthouse were repaired near the ground level, also exterior wooden boarding was renewed. As the lighthouse has a well ventilated construction, there was not much damage done to the wood. The tower has also seen regular repainting.

Suurupi lower lighthouse (10)

In conclusion I may say that most damage is caused by polluted environment to brick and metal lighthouses. Older stone lighthouses also suffer terribly from constant rainfall, that washes out lime mortar from the walls after plaster has come off.

It is of utmost importance to carry out research in order to find out the causes for quick deterioration of the construction materials and also remedies to stop further decay of lighthouses.