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# THE RISK OF TECHNOLOGICAL DISASTER IN THE NEWTON NAVARRO BRIDGE, NATAL - RIO GRANDE DO NORTE STATE, BRAZIL

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**Abstract**

The present work deals with the technological risks associated with bridge structures. The study area in evidence was the Newton Navarro bridge and the ships collision risks in the bridge pillars due to the absence of safety devices. The work methodology was based on newspapers bibliography research, public database of the Public Ministry of the Rio Grande do Norte State, and the Secretary of Environment and Urbanism of Natal city. The analysis of the researched material resulted in the images processing of the executive design projects of the bridge, cartography, and the on-site visits with the Brazilian Navy, to verify the bridge pillars. According to the main results, the absence of safety devices since the bridge's executive process was found.

**Keywords:** Technological risk; Structural vulnerability; Cable-stayed bridge.

**O RISCO DE DESASTRE TECNOLÓGICO NA PONTE NEWTON NAVARRO, NATAL – RN, BRASIL**

**Resumo**

O presente trabalho discute a temática riscos tecnológicos associados a estruturas de pontes. A área de estudo em questão foi a ponte Newton Navarro e os riscos de colisões de navios nos pilares em função da ausência dos dispositivos de segurança. A metodologia do trabalho deu-se por meio de pesquisa bibliográfica documental em jornais e banco de dados públicos do Ministério Público do Rio Grande do Norte e da Secretaria de Meio Ambiente e Urbanismo de Natal. A análise do material pesquisado resultou no tratamento de imagens de plantas do projeto executivo da ponte, cartografia e as visitas *in loco*, com o suporte da Marinha do Brasil, para verificar os pilares da ponte. De acordo com os principais resultados foi constatada a ausência dos dispositivos de segurança desde o processo executivo da ponte.

**Palavras-chave:** Risco tecnológico; Vulnerabilidade estrutural; Ponte estaiada.

**EL RIESGO DE DESASTRE TECNOLÓGICO EN EL PUENTE NEWTON NAVARRO, NATAL - RN, BRASIL**

**Resumen**

Este artículo analiza los riesgos tecnológicos asociados con las estructuras de puentes. El área de estudio en cuestión fue el puente Newton Navarro y los riesgos de colisiones de barcos en los pilares por ausencia de dispositivos de seguridad. La metodología del trabajo se llevó a cabo mediante la búsqueda bibliográfica documental en periódicos y bases de datos públicas del Ministerio Público de Rio Grande do Norte y la Secretaría de Medio Ambiente y Urbanismo de Natal. El análisis del material investigado resultó en el tratamiento de imágenes vegetales del diseño ejecutivo del puente, cartografía y visitas in situ, con el apoyo de la Armada de Brasil, para verificar los pilares del puente. Según los principales resultados, se constató la ausencia de dispositivos de seguridad desde el proceso ejecutivo del puente.

**Palabras-clave:** Riesgo tecnológico; Vulnerabilidad estructural; Puente atirantado.

## 1. INTRODUCTION

The Brasil possesses a huge hydrographic network that consists of both rivers and seawater. And with that, the waterway transport is one of the most important ways of cargo transport in the country. The port traffic of import and export contribute to exponential economic growth as well as an increase in the flow of ships in the estuaries.

In the face of a high rate of circulation of vessels in port areas of Brazil, there is a massive worry regarding the vulnerability of the bridges because those don´t possess safety devices. Therefore in the attempt to mitigate the risks associated with the collisions of vessels on bridges is needed that the waterways own adequate structures offering more safety on the traffic of ships and crafts.

Bridge are complex edifications, which requires an excellent executive project. For that is necessary substantial financial support, those in which are coming from a public purse hence is presumed that those structures have a high level of durability. therefore, in the case of a bridge project not having important elements as security devices, in the future that infrastructure might lack additions on the project, or for big maintenance, encumbering even more public state coffers. (VITÓRIO, 2008).

According to Consolazio et al., (2008), on average it occurs at least one grave collision per year of vessels in bridge pillars in the world. those collisions occur due to bad conditions of time and weather which cause low visibility, aside from heavy currents and wind and the lack of safety devices, as well as navigation instruments on the canal and mechanical issues.

To Ferreira (2000), it is common to have accidents that involve ships in Brazilian waterways. the accidents happen due to a lack of adequate signaling on maneuvering channels and also for a lack of defense on the bridge pillars. The high traffic of shipments enables the possibility of collisions within those structures, which may cause disastrous events like environmental impacts, structural impacts, and casualties. That way, the addition of implementation devices of security on bridges, are fundamental to avoid higher risks.

The Pontengi river is the main hydrographic basin that crosses the city of Natal, its estuary is located in between the beaches of Redinha and the Beach of the Forte the location is known as Boca da Barra. In that area, it was constructed the Bridge Newton Navarro, being the biggest bridge of the estate of Rio Grande do Norte, and the gateway for the Natal port. (Figure 1).

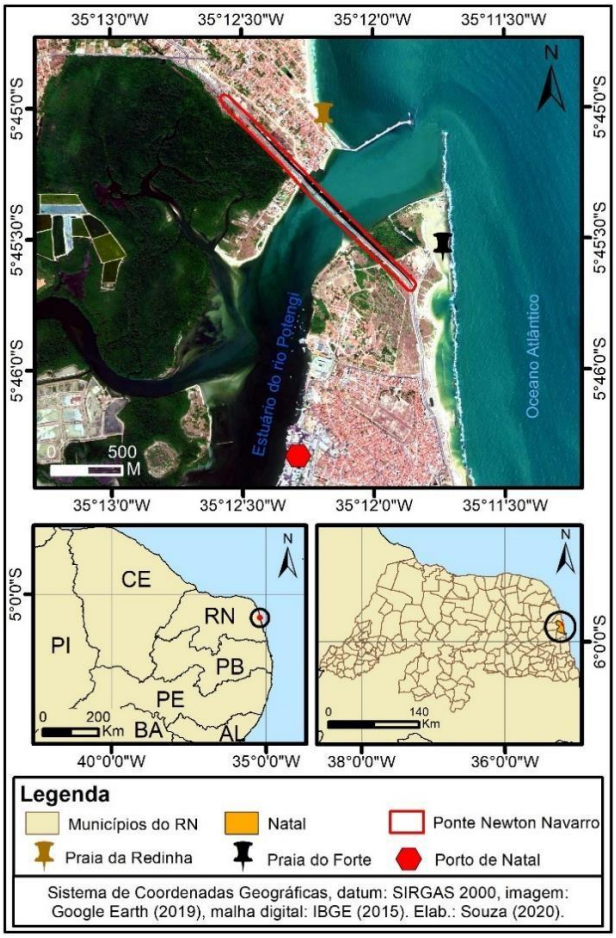


*Figure 1 - Newton Navarro bridge location map. Source: author's collection (2019).*

The Newton Navarro Bridge was designed as demand for the flow of an average of 60 thousand vehicles per day, currently, an average of 39 thousand vehicles in which they travel daily in its structure. That is an essential way for the mobility of the Natal county and the remaining counties of the metropolitan north region, in its structure, there are 13 urban bus lines in the county(SEMURB, 2008; TRIBUNA DO NORTE, 2018).

In Brazil, it was recorded a diverse number of cases regarding the collision of shipmen in bridge pillars, as for a recent event there is the example of the craft in the mesostructures of the bridge of Rio Moju in the state of Pará in 2019. The happening of an event of that magnitude requires some attention to the Newton Navarro Bridge, seen that in its structure there is no adequate safety device against collisions or for the protection of the bridge pillars.

Regardless of it being build in cable-stayed molds and with a complex executive project the Newton Navarro Bridge doesn´t possess defenses to the protection of pillars against nautic collisions. In projects of the company Docas do the Rio Grande do Norte - CODERN(2019) it is possible to add the construction of “dolphins” in that bridge, this safety mechanism is formed by

a circular structure with foundation piles anchored on the riverbed, which is localized in the surroundings of the bridge pillar. Silva (2016) highlight that the "dolphins" are structures for protection against collisions from shipments, its role is to protect the pillars and cushion the impacts. Figure 2 shows the floor plant of the project that shows an absence of the "dolphins" device.

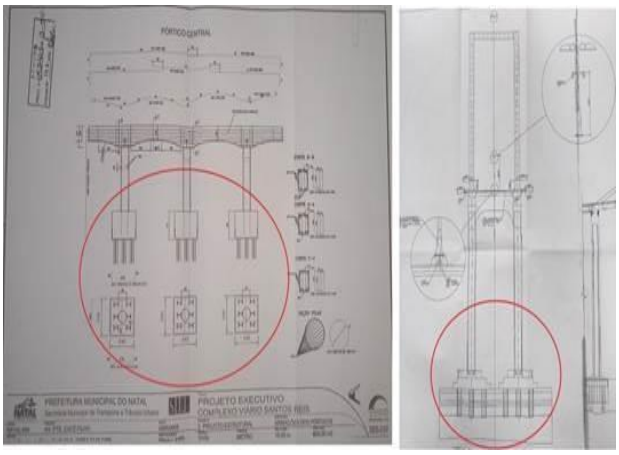

*Figure 2 - Newton Navarro bridge executive design without security fenders. Source: Modified by the authors from SEMURB (2008).*

As a consequence of the lack of safety devices and the risk due to that reason for the transient, the Public State Ministery(MPE) condemn the State of Rio Grande do Norte and the city hall for the no realization of structural adequations, therefore after a judicial decision, the installation of the defenses weren´t made, conditioning the risk of a disaster in the bridge through the possibility of a nautic collision in the pillar structure.

Amidst that exposed issue, in this article, the goal is to discuss matters related to the technological risks on bridges with a focus on the Newton Navarro Bridge in Natal, Rio Grande do Norte. This article has the goal to act as a resource to the promotion of the problem, seen that the Newton Navarro bridge is an important gear to the internal traveling within the city.

## 2. METHODOLOGY

The research was made by theoretical procedures and empiric procedures. for the theoretical procedures, it was made a bibliographic gathering about the technological risks with an approach to civil engineering. to give a direction of matters related to risks in general it was utilized works from Veyret (2007), Almeida (2010) e Souza et al. (2018). to the analysis of risk in a technological approach, it was used the work of Lieber e Romano-Lieber (2005).

The empiric procedures were composed by the delimitations of the issue using a sample of the area studied. For that, it was consulted files From the Secretary of the Environment and Urbanism of Natal, to have access to the plant floor projects regarding the study of environmental impact/report of environmental impact (EIA/RIMA) and the executive project of the Newton Navarro bridge. Aside from that, it was also consulted the projects of public civil action on the state public ministry, and also the process of condemnation for the city hall and also from the government of the estate of Rio Grande do Norte and scientific articles that were used in a way of help to develop the study of that problem. and later in this project, was produced cartography and the treatment of images from the project of the construction, and at last the realization of visits in loco with the support of the Brazilian marine to have a look at the structure (Figure 3).

*Figure 3 - Inspection on the pillars of the Newton Navarro bridge. Source: collection of authors (2017).*

## 3. RESULTS AND DISCUSSION

### 3.1. The second bridge over the Potengi river

In 1986 it was made studies by the Brazilian company of Urban Trafic (EBTU), to implement a crossing of ferry and automobiles in between margin of the Potengi River, with the idea of decreasing the traffic from the bridge of Igapó.but only in 1995 the city government authorized the transport of water vehicles in between Santo Reis e Redinha (SEMURB, 2008).

To cross the Pontegi river going from the neighborhood of Santo Reis to Redinha, the transport utilized were the old ferry or fishing boats, which would do that service in an irregular form.in 1994, the state made available the crossing by from the use of boats specifically used for the transport of passengers (SEMURB, 2008).

With the increase of the automobilist fleet in natal, the state saw a necessity to construct a second viaduct in the estuary of the Pontegi river, with the hopes of lessening the flow of the Igapó bridge. After that, it was made the first studies to make feasible the construction of a second bridge.

the first bidding was in the year 1996, but it wasn´t implemented, seen that the only company that ran for the project couldn´t execute it due to irregularities in the project. at the end of the same year, it was made second bidding, although the contract was made with the winning company, the construction wasn´t started.

The third process of bidding was in 1998 and had a public/private partnership in a way that the construction and the operation of the bridge were going to be made by the winning company of the process. with toll taxes of the construction the company the return of the money invested in the engineering of the bridge. On that occasion, the company CEJEN engineering

was the only one that participated in the process being the one responsible for the operation of the second bridge on the estuary of the Potengi river (SEMURB, 2008).

The construction of the second bridge on the estuary of the Potengi river had as a goal to fulfill the demand of the traffic of the population´s transport, in between the central areas of the city and the neighborhood of Redinha.In that sense, with the construction of the bridge, the access of the east and north regions would become easier, as well as the nearby counties to the north zone of Natal. and it also had an important role in coastal tourism (SEMURB, 2008).

The initial project of the construction of the second bridge estuary of the Pontegi River, the future Newton Navarro Bridge, date from the year 1992, but due to a lack of definition in the project the work was not initiated until 2003, the government assumed the responsibility for the construction, like that, the project was continued and in 2004 it was initialized the process. The companies Protende, Enescil, Construbase e construction company Queiroz Galvão all partaken in the construction of the viaduct which had an initial budget of R$ 170 million e reached a total of R$ 195 million at the end of the construction (MAZARIM, 2011).

For those who idealize the project the construction of the second bridge over the Potengi river, the structure had as secondary goals enabling the local economies, regional and national, with the implementation of the increasing of port activities, revitalizing the neighborhood of Ribeira, incrementing a network of hotels for the incentive to tourists activities, and to the real state valuation of beaches of Redinha, Genibpabu and others around, as a phenomenon of the nightlife in the region (SEMURB, 2008).

The Newton Navarro bridge (Figure 4), also known as Bridge Forte-Redinha or Ponte de todos, is located in between the neighborhoods of Redinha and Santos Reis. it was inaugurated in the year 2007 and currently has a flow of 60 thousand vehicles per day designed by the engineer Mario de Mirando the structure posses an extension of 1.780meters and 400 meters in the center. the bridge of the cabled-stayed model it´s sustained by 4 pillars of 140 meters of height taking into consideration the surface of the water and 56 meters from the central gaps to its slab. due to its monumental characteristics, the bridge attracts the attention form both locals and tourists daily (MAZARIM, 2011).

*Figure 4 - Newton Navarro Bridge - Natal / RN. Source: CODERN (2019).*

**3.2. Technological risks associated with roadwaystructures**

It should be taken into consideration that every activity that has human involvement in it has some sort of risk associated. on bridge structures, the risks are involved since the development of the project passing through and followed by the construction and operation. To Almeida (2010), the advent of technics allowed the construction of a series of frameworks. And with that the huge quantity of those types of equipment the risks only increased as a consequence of the huge run of people and automobiles.

From a conceptual point of view Castro et al., (2005), the risks are divided into 4 categories: environmental risk, technological risk, social risk, and biological risk. amidst that, the approach of the risk thematic needs to be utilized according to the respective areas of the study.

According to Field et al., (2012) in an intergovernmental panel about climatic changes -IPCC, the concept of risk remits to a determined period, in which happens an abrupt alteration in the normal running of a community over the effect of natural events, which interact with vulnerable areas, allowing adverse effects over humans, materials, economy, and the environment.

And still, within the debate Veyret et al., (2007) says that the risk is a given function of R(f) = P x V, in which P is the danger of the potential event and V is the vulnerability of the being or the group in that sense we can highlight that the concept of disaster, being the event in it of itself that we have acknowledged

About the concept of a disaster from Field et al., (2012) he defines it as the alteration in the functionality of a determined community, in virtue of a vulnerability, softening, or engraved by the lack or not of a capability to handle a certain event by the community.

So it is needed to highlight according to the office of the united nations to reduce the risks of a disaster _ UNISDR (2016), the difference between the risk and the disaster, the first remits to the possibility of loss, which would be: human lives, material damage, environmental damage, economical losses, that could happen in um place at a certain time. Now the disaster refers to the damaging event in which exceeds the capability to deal with people in that event, resulting in human damage, environmental damage, material and economic, to Lavel (2003) this concept is defined by a critical situation directly linked to the losses of human lives and material in a considerable manner.

In this work, the point of the discussion is about the risk of its technological category. The technological risk is categorized by the lack or the negligence of capacity of the usage technique utilized in the construction or framework. if that disaster has a risk linked to a technological stamp it will also be characterized as a technological disaster (LIEBER; ROMANO-LIEBER, 2005).

All around the world, there are reports of technological disasters related to bridges and viaducts. for example, the collapse of the bridge of the Mississippi River in the state of Mississippi in The United State of America, in which resulted in ten death sixty people injured: in 2016 that happened due to a collision of a ship on a cruise with a bridge on Canal Meno-Danúbio, in Baviera Germany two people died; the Italian bridge collapsed in a highway A14, in the city of Cameranom, in the province of Ancona, in which it collapsed in march of 2017; the bridge collapsed twenty-two people died in 2018, also in Italy, in the street A10 in Genova; still in 2018, a boat hit a bridge passage of

Jebi typhoon in Japan.(VITORIO, 2008; G1, 2016; SOUZA et al., 2018; EM, 2018; G1, 2019).

Brazil posses a history of technological disasters caused by roadway structures and to illustrate cases like The bridge of Remédios over Tietê, in the sate of São Paulo, that collapsed in 1997; the bridge over the dam of Capivari on the road of Regis Bittencourt, in Paraná, collapsed and two people died in 2005; the viaduct of Pompeii in São Paulo had its structure compromised after burning in 2012, in the year of 2014 one shipment collided against the bridge of Rio Três Forquilhas, in BR-101 on the Rio Grande do Sul and four people felt on the water; still in 204 one viaduct in Belo Horizonte fall out. in 2015 a bridge of Tamanduateí River in São Paulo also collapsed; in 2016 over issues regarding structural problems it happened an interdict of the viaduct Santo Amaro also in São Paulo; the year of 2016 was marked by the collapse of a waterway in Rio de Janeiro during the Olympics. In Fortaleza, the bridge of the neighborhood Aerolândia felt in 2016; as well in the year 2016 the viaduct over the River Moju in the state of Pará collapsed after a collision of a ferry in the pillars structures. The viaduct of Marginal Pinheiros in São Paulo Collapsed in 2018; in the same year, the viaduct of the north axis of Brasília crumbled; still, in 2018 the viaduct of Rio Madeira in the county of Abunã in Acre was hit by a ferry that was doing the crossing of vehicles GAUCHA, 2014; TVI24, 2016; SOUZA et al., 2018; ECOS, 2018; G1, 2018; OCP, 2018). Aside from that the cases mentioned, according to Vitório (2008), the state of Pernambuco showed a total of 18 structural flaws in the bridges on its railroad segment.

These cases show that there is a huge fragility in the treatment of preservation of technological disaster in Brazil and around the world, in special the maneuvering of bridges in some states of the country. this shows that there is a lack of maintenance added by a lack of safety devices on the viaducts that helps to increase the risk of collapses in its structure.

Amongst this the high number of cases regarding the collapse of roadway structures, its noticeable the necessity of bigger attention in a way that the structures that are built, seen that in the majority of the time it occurs due to a lack of safety devices against a collision of pillars. this matter can be resolved in the bridge Newton Navarro in Natal, the Rio Grande do Norte in which it doesn't possess defense and security of pillars that is a risk for the transit of port shipment during the night or the day with the “seasick”.

### 3.3. Strutual vulnerability on the Newton Navarro bridge

To conduct the discussion is necessary to have a clarification regarding the concept of vulnerability. to Almeida (2010), the concept remits in its meaning to another key term like resilience adaptation, insecurity, adjustment, exposition, and susceptibility.

The vulnerability could be defined by Cardona (2004) as a segment of risk in a community in which finds itself exposed to danger, with that corresponding to a possible reception of damages, in a way that, the susceptibility of a dangerous event of the physical, economic, political or social stamp may cause some sort of community damage. yet, for UNISDR (2016) vulnerability embrace conditions pre-established by elements or regimes of a physical, social, economic, and environmental stamp, that may increase de susceptibility for a population or dangerous events.

As stated by Field et al., (2012 the vulnerability is a possible predisposition that a given community could be adversely affected. the vulnerability is directly linked to the risk, this means that, since there is a distinct number of risks, there are a different number of vulnerabilities too. here we highlight the technology that Marchezini (2016) approaches in which were the vulnerability occurs by the inadequate usage of a technique in the construction of a framework.

In Brasil there is no policy regarding the creation of construction, that requires maintenance and equipment already established, to Souza et al., (2018) there is a lack of interest over political power, in which this one only takes action when a disaster happens. with every modern technology expertise on big structure executive projects like the viaduct ones, are still liable of collapse like any other structure build in regard of factors like technical fail or maintenance fail; civil engineering structures are like to show a huge lifespan, although it is needed to give huge importance to the monitoring of those buildings and evaluate what is necessary to be done to correct or add there weren´t present in the project.

Into that matter, there is the case of the Newton Navarro bridge that in its original and executive project there weren´t devices of safety for the pillars, against collisions of boats. Years after the construction of the bridge the channel for the Natal port started to receive bigger size boats, representing a bigger risk in terms of structural vulnerability of the equipment, that in any moment could have a direct impact provoked by a collision of a port shipment.

It is seen that in Figure 5 the lack of “dolphins” of protection on the pillars of the Newton Navarro bridge. it’s noticeable the construction of “defenses of plastic and wheel” against the impact of shipments, although those structures are not appropriated the red sign shows the wheels utilized to cushion the impact. The Captaincy of Ports consider such actions as unsatisfactory, the ideal being the construction of “dolphins to protect it, just like it was made in the Rio-Niteroi Bridge in Rio de Janeiro, as seen in Figure 6.

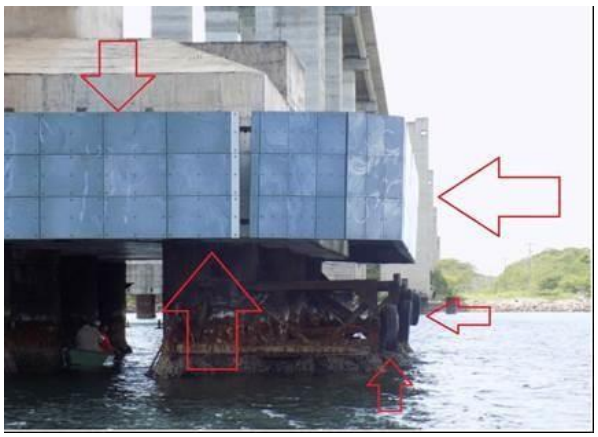

*Figure 5 - Pillars of the Newton Navarro Bridge. Source: collection of authors (2017).*

*Figure 6 - "Dolfins" on the Rio-Niterói bridge. Source: Studio Franchetti (2019).*

To Silva (2016) "dolphins" are a circular structure with a huge diameter, n which is constructed over the spiked pile in the riverbed its inside is filled with sand, gravel, or bitter concrete (Figure 6). it needs to be said is that there is no initial project of the construction of "dolphins "in Newton Navarro in which was supposed to be projected before the execution of the construction show the red marker in the final plant floor of the executive in Figure 7.

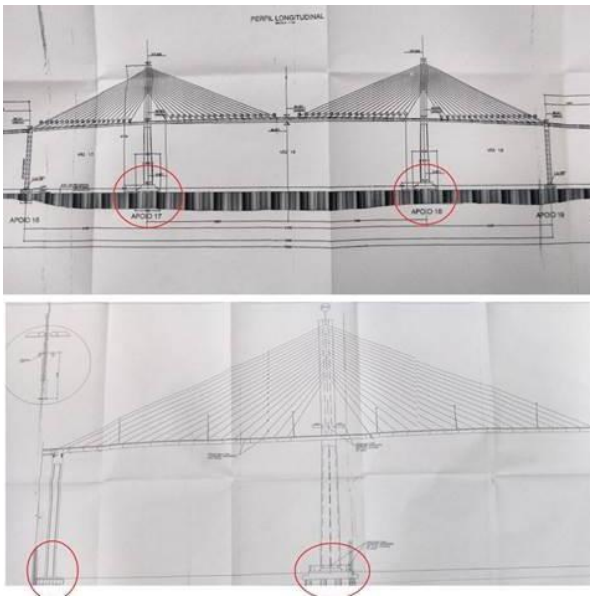

*Figure 7 - Plan of the bridge execution project without the "dolfins". Source: modified by the author from SEMURB (2008).*

With regard to the Newton Navarro bridge, due to the broadcasting of news made by the Captaincy of the Ports of Natal, the 41st Prosecutor's Office filed a public civil action against the state of Rio Grande do Norte, due to the urgent need to install adequate protection devices of the bridge, with the objective of reducing the risks of the bridge collapsing due to possible collisions of ships (MPRN, 2012).

After being processed in court, the Companhia de Docas de Natal carried out in 2015 the study of the construction project for the "dolfins" of the bridge. The construction of this safety device would occur in parallel with the expansion works of the port of Natal and the maritime passenger terminal, whose value of the work was estimated at 90 million reais, being a work in consortium of the State Government, Natal City Hall and the Christmas Dock Company (CODERN, 2015).

Figure 8 shows the plan for the construction of the "dolphins" on the Newton Navarro bridge, prepared after years of operation of the structure. In the mesostructures, that is, in the two central pillars of the bridge, highlighted in red, the construction of ten devices is foreseen, five for each central pillar and for those highlighted in orange, the adjacent pillars, with the provision of construction of four devices, two in each of these pillars.

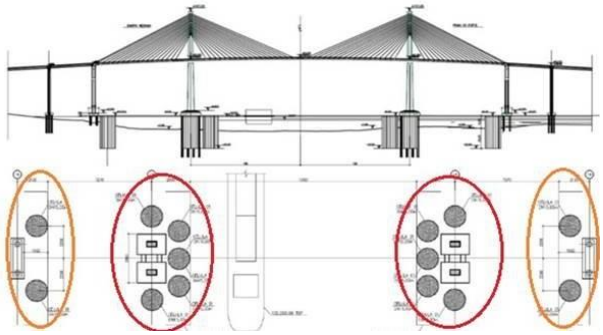

*Figure 8 - Plan of the construction project for the "dolphins" of the Newton Navarro bridge. Source: modified by the author from CODERN (2015).*

About the procedural pending of the Public State Ministery stated the possibility of accidents of medium or high complexity, in which consequences may be natural structural, patrimonial, environmental, and human. Among those facts, the prosecution of the environment stated the inquiry n° nº 06.2012.001027-9 that replaces a public civil action (MPRN, 2012).

After the indagations from the MPE, the State Secretary of Infrastructure stated that there is no resource regarding the hiring of a company to make a technical study, a well as to begin with the bidding process(MPRN, 2012).

That way the prosecution ordered the regional counsel of engineering and agronomy -CREA, info regarding the real situation of the risks of the pillars from the bridge. On CREA there are 16 notifications regarding the oversight of the council over the Newton Navarro bridge. The process filed on the counsel are against the entrepreneurs of the construction, see that the security device wasn´t added in the project seen in Figure 7 previously.

Keeping in mind this situation, the Captaincy of the Port from Natal chose to increase the restrictions of the shipments in the estuary while the "dolphins" and the signs are not installed. aside from this, there is another problem with the Pontengi canal since this one can´t be dredged until the safety devices are installed in the bridge, seen that the high flow of dredge on the estuary. The resources for the construction of the "dolphins" would be taken

out from the Acceleration of Development Program 2. (MPRN, 2012).

In the year 2018, the federal government of the city hall of Natal was condemned by the prosecution in which there was urgency regarding the creation of the "dolphins" and the installation of signs on the Newton Navarro bridge. In Figure 09 it can be seen that there is no nautic signalization on the pillars of the bridge aside from a lack of maintenance in the stair of access to the bottom of the pillar. in the convictions made by the jury, it was established that in case of not being fulfilled the determinations from the prosecution both public and private entities would be notified by a fine of R$2 million and R$1 million respectively (MPRN, 2018).

*Figure 9 - Lack of maintenance and absence of signalling equipment. Source: collection of authors (2016).*

With the conviction, it was established that the State Government would install the defenses(dolphins) on the Newton Navarro Bridge within the next three months which were oriented by CODERN and the Captaincy of the Portes, with their resources or with the help of the Federal government. aside from that, the state should make the maintenance of the screws that sustain seal in the splice of the bays. the deadline for this was in about 60 days and if not followed it would result in a fine of R$ 500 thousand (MPRN, 2018).

The secretary of the infrastructure of the state must immediately restore the panels and the nautic signalization both for daytime and for the night, indicating the best spot for the passage and a white rhythmic light indicating the safe zones, that measure should be taken within 30 days and if not followed it will too cause a fine of R$ 500 thousand (MPRN, 2018).

The prosecution stated that the county of Natal will have to stop the transit of the pedestrians, vehicles, and cyclists whenever there is a ship that weighs more the 1 thousand tons. and for each time this is not followed correctly the jury will follow a R$ 500 thousand fine (MPRN, 2018).

And lastly, the comarca condemn the city hall of Natal to promote an operation to conceal the holes from the bridge and also to install monitoring cameras. for the correction of the asphalt, the deadline is 60 days. for the cameras, it is 6 months in case this operation doesn´t happen within the deadline the fine is up to R$ 500 thousand and if the cameras are not installed it´s a fine of R$ 200 thousand (MPRN, 2018).

Even after the judgment from the civil action followed by condemnation in 2018 till the present moment in the year of 2020, the decision was not followed, making this negligence from the state and the city hall being very costly in case of the bridge collapsing aside from the burden the public purse putting the lives of those who cross it in danger.

The magistrate stated that according to the technical reports from the Newton Navarro bridge is necessary to have crucial works done to assure the safety of the user that the technical conclusion from the experts of MPE, said that there is an imminent risk of a collapse from the mesostructures that sustain the bridge that can be caused by a collision. that way there is a risk of lives lost that transit in the bridge as well as environmental risk on the river and in the ecosystem of the Maguezal in the surroundings of the bridge in a hypothesis of the leaking of toxic material carried by the ships that travel in the canal, therefore needing the high amount of financial costs in response to this disaster in which can be higher than the investment for the construction of the safety devices (MPRN, 2018).

Amongst those facts exposed by specialists, the jury defers that the state should comply with this if it has resources to do so, and even like that the state can´t neglect the risk facto seen that the lack of safety devices put the life of people who traffic daily through the bridge in danger. making it imperative to the realization of the project to implement the "dolphins" to mitigate the risk associated with the structure.

As was mention above, it was possible to verify that there is the existence of many technological risks in a chronic matter on the Newton Navarro bridge since in the idealization of the project wasn´t added any signalization nor do defenses(dolphins) for the protection of the pillars, as so every time a ship goes in and out of the Natal port there is an imminent risk of a collision with the pillars since the inauguration of the bridge the structure is vulnerable to collapse due to that risk.

Should be highlighted here that another research made with a Souza et al. (2018) thematic about the risks of the Igapó bridge in the estuary of the Pontegi River(the same estuary localized in the Newton Navarro bridge), was an object of journalistic schedule in all newscasts and radio blogs social media from the city (TVU, 2017; GEORISCO, 2017; UFRN, 2017; 2018) in which cause a huge mobilization in the media and the city parliamentarians, hence it was filed the Publics Ministery a Public Civil Action demanding the igapó bridge renovations showed in Figure 10; after that session, the bidding procedures to the reform of the Igapó bridge were made and finalized as showed in Figure 10.

CÓPIA

MINISTÉRIO PÚBLICO DO ESTADO DO RIO GRANDE DO NORTE
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Ofício nº 0001/2019 - COORD/PmJDMA

Natal/RN, 10 de janeiro de 2019.

A Sua Excelência a Senhora
Clarisier Azevedo Cavalcante de Morais
Procuradora da República no Estado do Rio Grande do Norte
Avenida Deodoro da Fonseca, 743, Tirol, Natal/RN, CEP: 59020-600
Telefone: (84) 3222-3952/3914

Assunto: **Encaminhamento da Notícia de Fato nº 01.2019.00000017-4**

Senhora Procuradora da República,

Cumprimentando-a, encaminho a Vossa Excelência a Notícia de Fato nº 01.2019.00000017-4 (Apurar a falta de manutenção na Ponte do Potengi Presidente Costa e Silva - Ponte de Igapó), para as providências entendidas cabíveis, em razão de certidão exarada pela Assessora Jurídica da 28ª Promotoria de Justiça de Natal, informando que a questão foi encaminhada para o MPF.

Respeitosamente,

Gilka da Mata
Coordenadora das Promotorias de Justiça de Defesa do Meio Ambiente de Natal

*Figure 10 - Public civil action at Ponte de Igapó. Source: MPRN (2019).*

*Figure 11 - Construction site for the refurbishment of the Igapó Bridge. Source: collection of authors (2019).*

## 4. FINAL CONSIDERATIONS

Considering the facts described above in this work it should be stand out that there is a way since it was inaugurated. The Captaincy of the Ports from natal made some restrictions regarding navigation in the canal those restrictions were made with the goal of stop ships o big ports from traveling at night to avoid collisions on the pillars due to low visibility.

Even though The public state Ministery of Rio Grande do Norte had issued a jury condemnation to the county of Natal and the government of the state for no construction of the defenses(dolphins) and for not installing the signalization till the present moment, both entities didn´t take any action aiming to mitigate the risks of the bridge with that magnify the vulnerability of the bridge Newnton Navarro.

Since the Natal port has a high flow of boats being import and export of shipments to the state the company Docas from Rio Grande do Norte made a project for the “dolphins” of the pillars on the Newton Navarro bridge. but the construction that was previewed in the world cup of 2014, wasn´t initiated due to lack of resources, even though the jury instituted that the state should make such adequations in the year 2018, till now the year of 2020 nothing was done.

Given the statements, the study highlighted that there are risks in the Newton Navarro Bridge. thought this research it´s considered that new jury actions could be done in a sense to demand improvements in the structure of the viaduct.

Other than that there is a necessity to implement a sector of bridge management on the state, inside the State Secretary of Infrastructure with the cooperation of the Nacional Department of Transport Infrastructure. This sector should make inspections and evaluations also corrections in the regional bridges. to that is necessary the management of the sector to the realization of inquiry of data over the state structure; realization of geotechnical studies and traffic; or even a qualified engineering intervention. Is important to say that the implementation of this sector should result in the adding of new construction or projects to maintain the reduction of risks. That would cost less to the public purse.

So the sector of management of bridges is a way to manage in a better way the structure of the bridges in the area to avoid possible new disasters, mainly on the Newton Navarro bridge in which in case of collapse would cause major environmental, economic and human damage to the Potengi River estuary.

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