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Impact of design and durability monitoring strategies on the electrochemical and microenvironmental behavior of the substructure of a reinforced concrete stilt house exposed to marine tropical microclimates for seven years.

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ABSTRACT
The objective of this work was to analyze the impact of design and durability monitoring strategies on the internal electrochemical and microenvironmental results, at the level of the reinforcement of some columns, obtained during seven years in the fifth generation of the substructure of a prefabricated stilt house, according to criteria that gave rise, at the time, to the NMX-530-ONNCCE-2018 and NMX-569-ONNCCE-2020 standards on durability. The results showed that, although the elements are completely passive, the design, construction, and monitoring strategies allowed us to clearly see the influence of each microenvironment on electrochemical trends. This will allow the design of ad hoc and economical strategies for preventive maintenance, as well as facilitate the recalibration of service life projections according to each microenvironment.
Keywords: corrosion; durability; infrastructure; design; stilt house.

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Contribution from each author
In this work, the author JABM contributed with experimentation (60%), data analysis (50%), writing the first draft (100%), and discussion of results (40%). The author AATA contributed with the original idea (30%), the development of specifications and structural design of the stilt house (70%), data analysis (10%), discussion of results (20%), and manuscript review (20%). Author MTCB contributed the original idea (20%) and manuscript review (30%). The author PCB contributed the original idea (50%), specification development and structural design (30%), experimentation (40%), data analysis (40%), discussion of results (40%), and revision of the paper (50%).

Impacto de las estrategias de diseño y monitorización de la durabilidad en el comportamiento electroquímico y microambiental de la subestructura de una casa sobre pilotes de hormigón armado expuesta a microclimas tropicales marinos durante siete años.

RESUMEN

El objetivo de este trabajo fue analizar el impacto de las estrategias de diseño y monitorización de la durabilidad en los resultados electroquímicos y microambientales internos, a nivel del refuerzo de algunas columnas, obtenidos durante siete años en la quinta generación de la subestructura de una casa prefabricada sobre pilotes, según criterios que dieron lugar, en ese momento, a las normas de durabilidad NMX-530-ONNCCE-2018 y NMX-569-ONNCCE-2020. Los resultados mostraron que, aunque los elementos son completamente pasivos, el diseño, la construcción y las estrategias de monitorización permitieron ver claramente la influencia de cada microentorno en las tendencias electroquímicas. Esto permitirá diseñar estrategias ad hoc y económicas para el mantenimiento preventivo, así como facilitar la recalibración de las proyecciones de vida útil según cada microambiente.

Palabras clave: corrosión; durabilidad; infraestructura; diseño; casa sobre pilotes.

Impacto das estratégias de projeto e monitoramento da durabilidade no comportamento eletroquímico e microambiental da subestrutura de uma casa de estacas de concreto armado exposta a microclimas tropicais marinhos por sete anos.

RESUMO

O objetivo deste trabalho foi analisar o impacto das estratégias de projeto e monitoramento de durabilidade nos resultados eletroquímicos e microambientais internos, no nível do reforço de algumas colunas, obtidos durante sete anos na quinta geração da subestrutura de uma casa pré-fabricada sobre estacas, segundo critérios que deram origem à época, até os padrões NMX-530-ONNCCE-2018 e NMX-569-ONNCCE-2020 sobre durabilidade. Os resultados mostraram que, embora os elementos sejam completamente passivos, as estratégias de design, construção e monitoramento permitiram ver claramente a influência de cada microambiente nas tendências eletroquímicas. Isso permitirá o desenho de estratégias ad hoc e econômicas para manutenção preventiva, além de facilitar a recalibração das projeções de vida útil de acordo com cada microambiente.

Palavras-chave: corrosão; durabilidade; infraestrutura; projeto; casa sobre palafitas.

Post-Publication Discussions and Corrections

Any discussions, including the authors' reply, will be published in the first year 2017 issue as long as the information is received by the close of the third year 2016 issue.

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1. INTRODUCTION

The coastal regions of the Gulf of Mexico have become critical scenarios due to the intensification of extreme weather events (Hurricanes - Corescam, n.d.). Hurricanes, tropical storms, and flooding caused by rising tides ("Increased Temperatures," 2019) represent constant threats to the safety and economic well-being of the communities that inhabit these areas. In this context, the coastal areas of the Gulf of Mexico present a natural laboratory for the study of construction pathology and quality control, where the constant interaction between structural materials and a highly aggressive marine environment characterized by high chloride concentrations, relative humidity levels above 80 %, and daily thermal oscillations promotes aggressive electrochemical processes, demanding technical solutions based on scientific evidence. (Torres-Acosta & Martínez-Madrid, 2003)

Faced with the challenge of modern construction, in which natural phenomena threaten their integrity, the community of San Crisanto in Yucatan has been a pioneer for more than 20 years in implementing innovative construction solutions (Briceño-Mena et al., 2024; Castro-Borges et al., 2011). In response to the environment's aggressive conditions, a project was developed in which reinforced-concrete stilts were designed and built, with designs perfected over five generations. This project, promoted by Cinvestav-Unidad Mérida, in collaboration with institutions such as Cemex, Galvex, and the Faculties of Architecture and Civil Engineering of the UADY, sought not only to resist corrosion induced by the environment but also to optimize the durability of these structures through engineering strategies.

Although it is known that the elements of a structure are subject to tropical marine microclimates of this area, to date, no studies have been carried out that unmasks the contributions of each microclimate to these elements. This information, if available, would enable the implementation of ad hoc damage-prevention strategies that are specific to the influence of each microclimate and each type of structural element, allowing clear economic savings in preventive maintenance through materials and systems that control the effects of each microclimate.

The design of these stilt houses is based on the use of boxed footings, piers, columns, slabs, and reinforced concrete beams, elements subject to constant aggressions from tropical marine microenvironments. Therefore, it is essential to understand and evaluate the electrochemical and environmental behavior of its components, particularly regarding corrosion rate, corrosion potential, and electrical resistivity. (Broomfield, 2023; Cao et al., 2019), as well as the temperature and internal humidity at the level of the reinforcement.

The stilt houses were designed and built in accordance with what are now the NMX-C-ONNCCE 530 and 569 standards. To obtain a comprehensive view of the performance of these structures, a monitoring system was implemented over seven years, including periodic measurements of the relative humidity and internal temperature of the concrete at the level of reinforcement, as well as critical environmental parameters. This approach allowed us to analyze in detail the structure-microenvironment interaction in relation to degradation processes, as well as the effectiveness and efficiency of the construction strategies applied to prolong the service life of stilt houses. Some of these strategies included the type of prefabrication, the thickness of the coating, the orientation of the structural elements, and the monitoring of climatic and electrochemical variables in defined sections, with respect to the geometry, heights, and positioning of beams and columns.

In summary, the objective of this work was to analyze selected electrochemical and microenvironmental results from some columns of the fifth generation of the prefabricated stilt substructure, based on specific design strategies for durability.

2. METHODOLOGY

2.1 Construction details.

The project's substructure is made up of prefabricated elements such as beams, columns, and foundation blocks, manufactured in an industrial plant located in Mérida, at 30 km from the coastline. This prefabrication approach allows for quality control at every stage of production, which is essential to ensure good structural performance in harsh marine environments. Industrial production, combined with on-site planning, ensures that each component meets the technical and durability specifications required to withstand the Gulf of Mexico's adverse environmental conditions.

2.1.1 Installation of integrated devices (fitters).

To accurately monitor the internal conditions of concrete, devices called "fitters" have been developed and integrated. These devices, designed in-house, were strategically incorporated into the columns and beams of the substructure without altering the elements' physical properties or structural integrity. These devices allow critical parameters such as temperature, relative humidity, and corrosion activity to be evaluated without the need for destructive procedures, providing fundamental data for durability analysis.

The installation of the fitters was carried out in two main stages: first, they were fixed directly to the reinforcement of the structural elements before being placed in the formwork. This procedure ensures optimal contact with the reinforcing steel, enabling accurate measurement of the electrochemical behavior. Once installed, the prefabricated elements with the incorporated fitters were placed in shoring, and the concrete was poured, ensuring that these sensors were perfectly encapsulated, without generating voids or interference. After setting, the correct integration of the devices was verified (Briceño-Mena et al., 2024). The use of fitters has not only made possible to understand the behavior of structures in tropical marine environments but has also laid the foundations for continuous real-time monitoring strategies. This approach can be replicated in other coastal infrastructure projects, ensuring a more resilient design adapted to the specific conditions of each environment. Figure 1 shows the final arrangement of the fitters in a standard column.

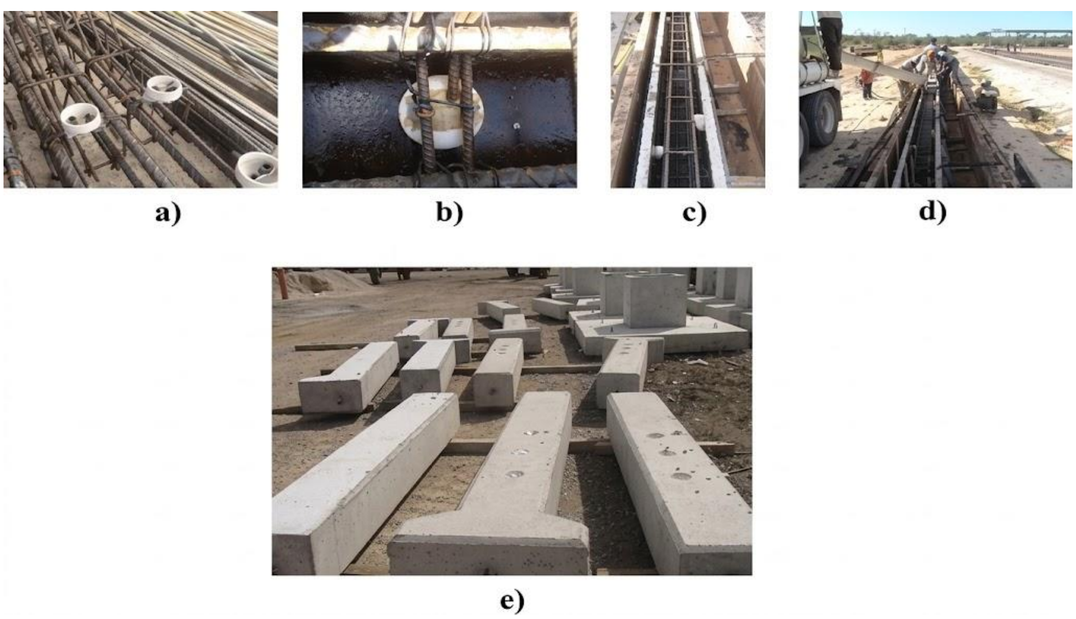


Figure 1. Fitters' installation.

To ensure that the measurements are representative, the fitters were placed at heights of 40 cm, 80 cm, and 110 cm above the Finished Floor Level (NPT in Spanish). In addition, six measurement points were located in each column: three in the West bar and three in the East bar. These strategic points allow a profile of corrosion variation along the structure to be obtained, which is crucial for identifying the most vulnerable areas and applying preventive measures. In this paper, the case of columns is presented. Figure 2 shows the locations of the fitters. It is important to note that the study faces of columns A, B, and C were protected by the structure's slab, whereas the study faces of columns D, E, and F were exposed to the rain and sun.

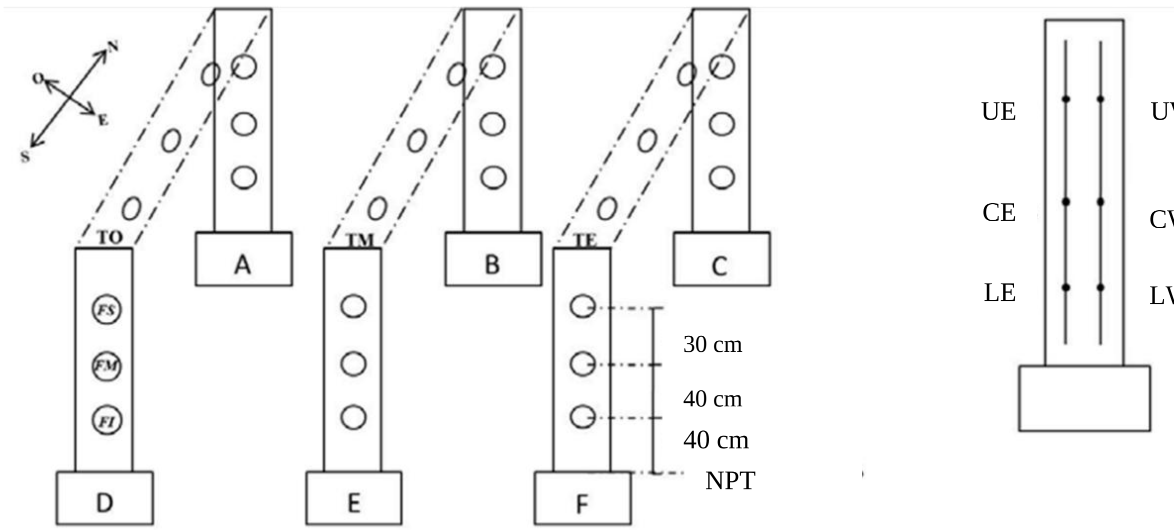


Figure 2. Sketch of the stilt house substructure

2.2 Measurement techniques

Systematic monitoring of both electrochemical and environmental parameters is critical for understanding the condition of the reinforced concrete substructure and for the early detection of corrosion processes induced by the marine environment. For this purpose, a periodic measurement plan was established, with measurements generally conducted every three months, although intervals were sometimes extended due to external conditions. Before evaluating the electrochemical indicators, the environmental parameters were recorded, as humidity and temperature directly affect the corrosion rate. In addition, the measuring surfaces were pre-wetted to prevent dryness from affecting the results. To carry out these measurements, a commercial corrosimeter, the Gcorr 6, was used, which uses the polarization resistance technique (Andrade & Alonso, 2004; Feliu et al., 2007; Troconis de Rincón et al., 1997). This team strategically positioned itself on each structural element, ensuring that the data was representative.

2.2.1 Electrochemical parameters

The set of electrochemical measurements allows precise information to be obtained on the behavior of reinforcing steel and the integrity of the concrete (Ramón et al., 2021; Xia et al., 2022).

2.2.1.1 Corrosion potential (E_{corr})

The corrosion potential (E_{corr}) is a key parameter for assessing the probability of corrosion in the reinforcement embedded in concrete. This potential, measured relative to a reference electrode, provides information about the condition of the reinforcing steel, although it does not, by itself, indicate the corrosion rate. It is a critical diagnostic tool that must be interpreted with consideration of environmental conditions, such as humidity, contamination, and concrete quality. In coastal environments, where structures are exposed to high salinity and temperature fluctuations, E_{corr} is an essential indicator for identifying critical areas requiring preventive maintenance. The evaluation criteria for E_{corr} can be seen in Table 1:

Table 1. Corrosion Potential (E_{corr}) Evaluation Criteria (NMX-C-495-ONNCCE-2015, Reapproved in 2021)

E_{corr} (mV vs $Cu/CuSO_4$)	**Description**
> -200	10% chance of corrosion
-200 - -350	Uncertainty
-350 - -500	90% chance of corrosion
< -500	Severe corrosion

2.2.1.2 Corrosion Rate (i_{corr})

Corrosion rate (i_{corr}) is one of the most critical parameters for assessing the deterioration of reinforcing steel. This value, measured in microamps per square centimeter (μA/cm²), indicates how quickly the steel loses material due to corrosion, enabling estimation of the structure's remaining life. In marine environments, such as the Gulf of Mexico, the presence of chlorides and high humidity can significantly increase the rate of corrosion. Under real-world conditions, values above 1 μA/cm² are already considered high and can reduce the service life of the structure. Table 2 below presents the criteria for evaluating corrosion rate (Andrade & Alonso, 1996).

Table 2. Corrosion rate evaluation criteria (i_{corr}) (NMX-C-501-ONNCCE-2015, 2015).

Corrosion rate		**Level of corrosion**	**Concrete condition**
(μA/cm²)	**(μA/year)**		
< 0.1	< 1	Despicable	Dry or non-carbonated concrete
0.1 – 0.5	1 – 5	Low	Saturated or slightly wet, carbonated, or chloride concrete
0.5 – 1.0	5 – 10	Moderate	High-moisture, carbonated, or chloride concrete
> 1.0	> 10	High	Concrete heavily contaminated with chlorides

2.2.1.3 Electrical Resistivity (ρ)

The electrical resistivity (ρ) of concrete is another important indicator; it measures the ability of concrete to resist the flow of electric current. It is directly related to its porosity and ability to transport aggressive agents towards the reinforcing steel. A low resistivity indicates an increased risk of corrosion, as it facilitates the transport of chlorides and water to the reinforcement.

Although there is no general consensus on the exact limit of resistivity below which the risk of corrosion is negligible, in practice, the classification in Table 3 is used as a reference:

Table 3. Electrical resistivity evaluation criteria (ρ) (NMX-C-514-ONNCCE-2019, 2019) .

Resistivity (kΩ cm)	Probability of corrosion
> 100 - 200	Concrete is very dense, so its interconnected porosity is extremely low, as is the transport of aggressive agents to the reinforcing steel. The corrosion rates of the steel itself are very low, regardless of chloride content or carbonation level. There is no distinction between steel in an active and passive state.
50 - 100	Concrete has low interconnected porosity, making it difficult for aggressive agents to reach the reinforcing steel. The corrosion rates of the steel itself are low.
10 to 50	Concrete has significant interconnected porosity, allowing aggressive agents to reach the reinforcing steel rapidly. Corrosion rates of the same steel are moderate to high in carbonated or chloride-concrete environments.
< 10	Concrete has excessive interconnected porosity, allowing aggressive agents to reach the reinforcing steel extremely quickly. The corrosion rates of the same steel are very high in carbonated or chloride concrete. Resistivity is not the parameter that controls the corrosion process. The corrosion rate value obtained with NMX-C-501-ONNCCE-2015 reflects the upper level of the corrosion rate in that concrete for a given chloride content or carbonation level.

2.2.1.4 Environmental parameters of concrete

Evaluation of internal environmental parameters, such as relative humidity and concrete temperature, is indispensable for understanding corrosion dynamics. In coastal areas, these variables fluctuate significantly, directly affecting the stability of concrete and the integrity of reinforcing steel (Bouteiller et al., 2012; Chauhan & Sharma, 2019; Villagrán Zaccardi et al., 2013). For these analyses, a digital environmental sensor was used to accurately measure humidity and temperature at a depth of 6 cm within the concrete. The probe was inserted into the fitters so that the measurements reflect the actual conditions inside the concrete and are not affected by external conditions.

3. RESULTS AND DISCUSSIONS

Over seven years of monitoring the stilt substructure, the electrochemical and environmental parameters provided key data on its performance, revealing behavior consistent with high durability. The data obtained demonstrate the effectiveness of the design and materials in resisting the aggressive conditions of the tropical marine environment in the Gulf of Mexico.

3.1 Corrosion potential (E_{corr})

The E_{corr} values in Figure 3 ranged from +150 mV to -150 mV (vs $Cu/CuSO_4$), consistently falling within the < 10 % probability of corrosion range according to the criteria of NMX-C-495-ONNCCE-2015 (reapproved 2021). The arrangement, as shown in Figure 2, corresponds to columns A, B, and C in the north and columns D, E, and F in the south. Column A presented the most negative point values (-150 mV) at the beginning of exposure and at the end of the period studied, while column C consistently recorded values between -50 mV and -120 mV, without exceeding the uncertainty threshold of the norm. Otherwise, column D, exposed to the weather, showed the highest point values, suggesting greater passivation of the steel, possibly due to prolonged exposure to the drying process (Bouteiller et al., 2012). Although the above could be associated with environmental conditions that favor the passivation of steel, such an association requires a joint interpretation of the corrosion rate and resistivity to more accurately observe the thermodynamics and kinetics of the corrosion process.

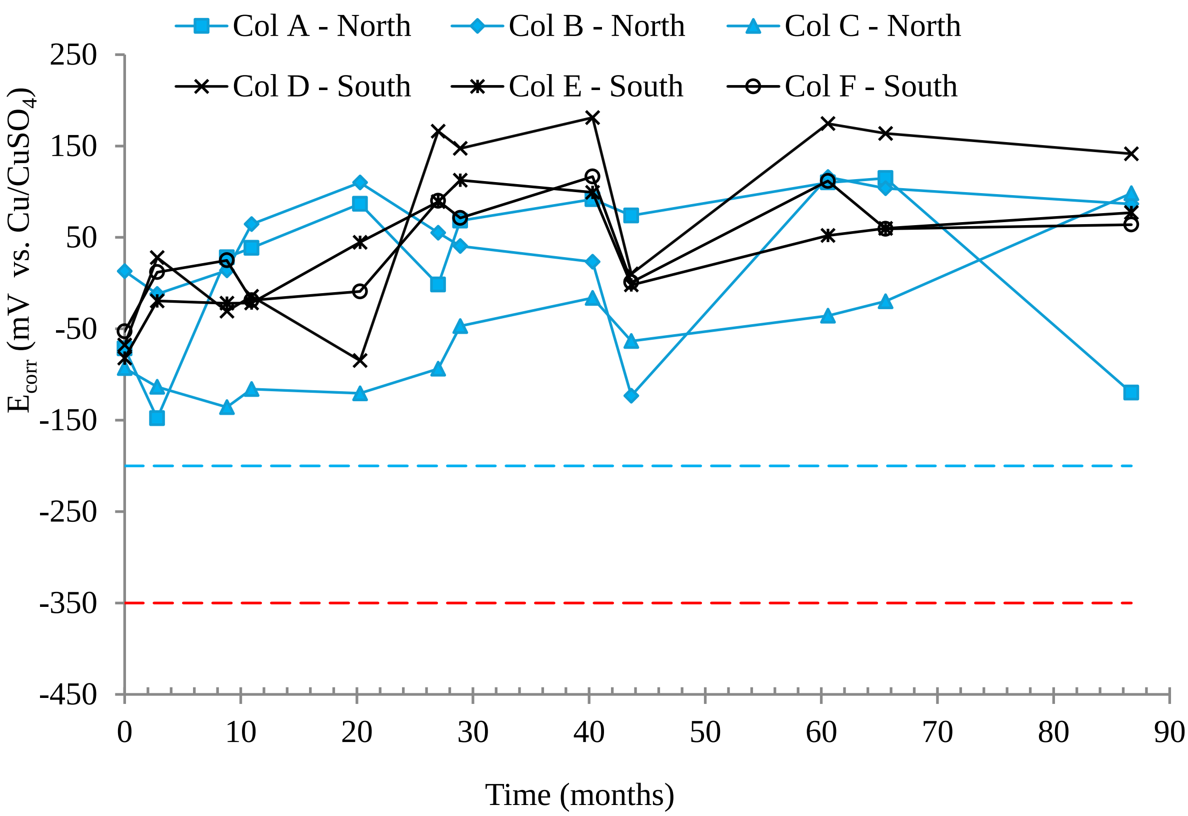


Figure 3. E_{corr} vs. time

Because corrosion potential is a parameter that indicates the probability of corrosion, spot measurements can provide insight into electrochemical behavior and should be complemented with other techniques or analytical strategies. To help us interpret the results, we used a cumulative graph (Figure 4), a qualitative tool (Briceño-Mena et al., 2025) that, with large amounts of data, could be used alongside statistical criteria such as those in the RILEM technical recommendation (RILEM TC-154 ECM, 2024). This figure shows that an element with a more negative point potential is less likely to corrode than those that exhibit uniform behavior over time (Chauhan & Sharma, 2019), such as column C, which shows a marked cumulative trend toward negative but stable values.

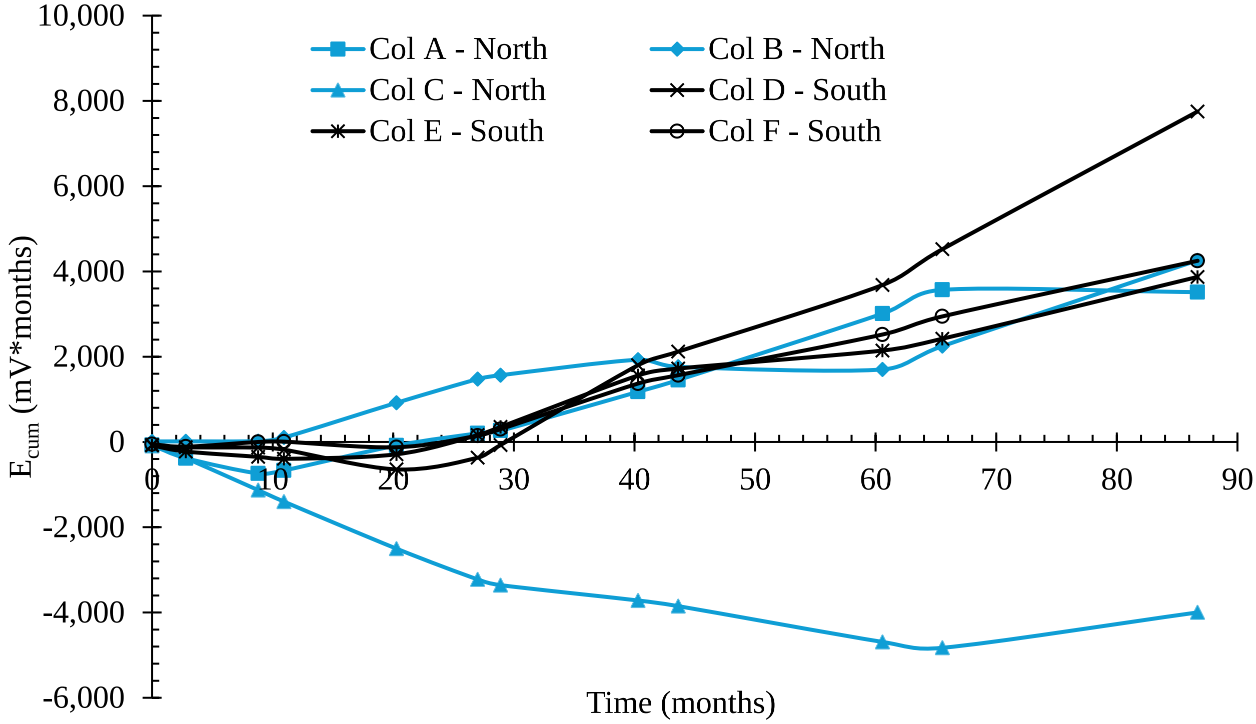
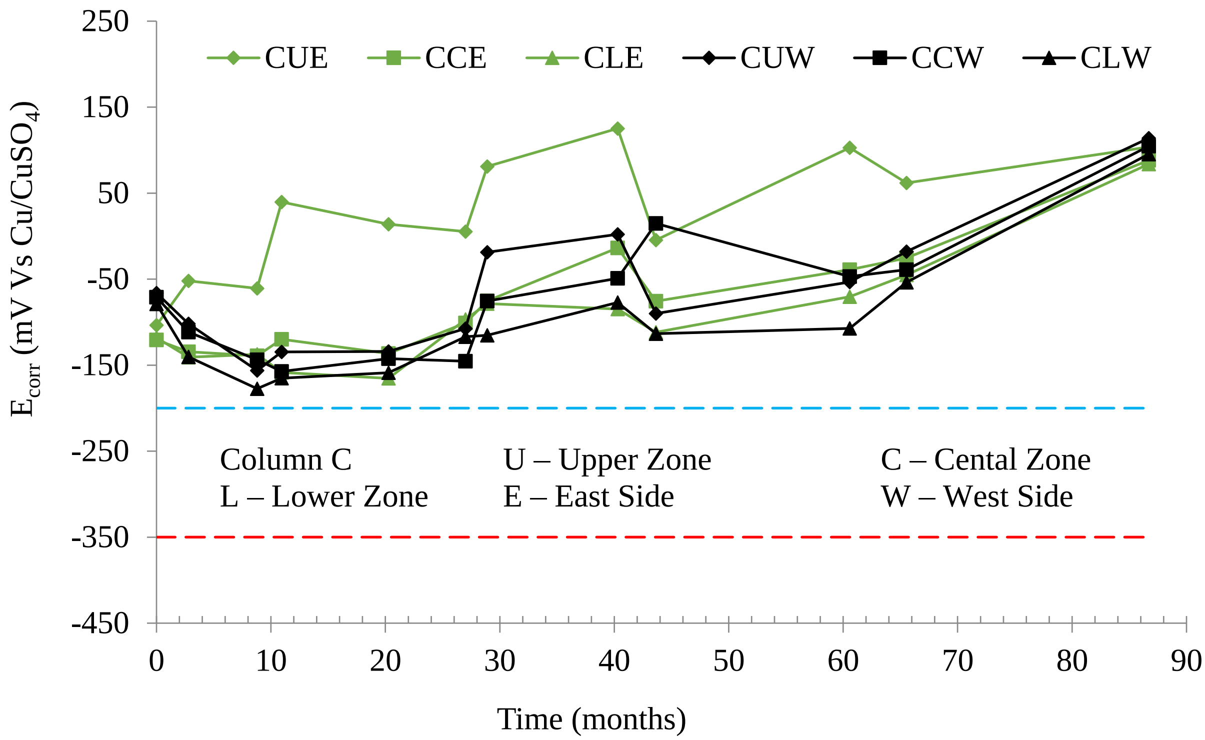


Figure 4. E_{cum} vs. time

Regarding the height and orientation of the columns, Figure 5 presents the individual results for columns C (North) and D (South). As shown in Column C, except for the measurement on the east side of the upper part, most of the data remain at more negative levels and do not reach the thresholds, so there would be no corrosion. In column D, the data distribution is similar across all measurement points.



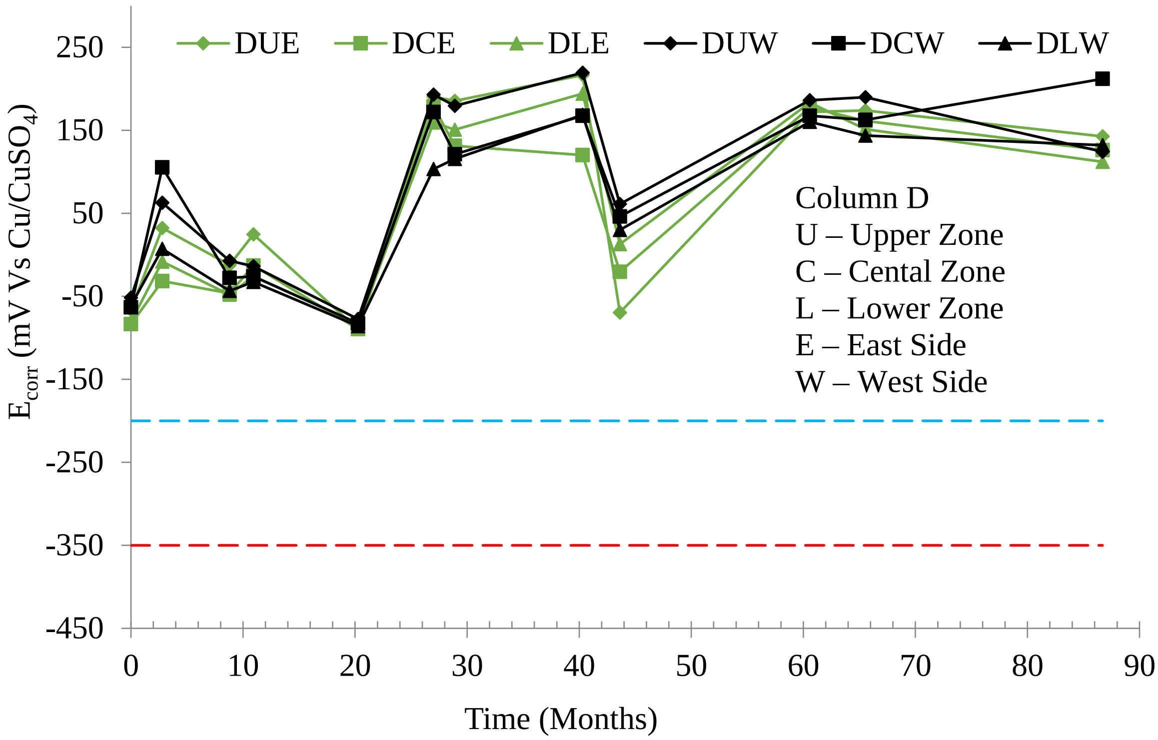


Figure 5. E_{corr} vs. time of columns C and D.

The exhaustive analysis of the corrosion potential is showing, in accordance with the criteria of NMX-530-ONNCCE-2018 and NMX-495-ONNCCE-2015 (reapproved in 2021) that after 7 years in front of a tropical marine environment of the Yucatan Peninsula, there is a stable maintenance for all cases in the passivity zone, to be verified with other techniques, due to possible thermodynamic changes in electrochemical behavior that may not agree with kinetic changes.

3.2 Corrosion rate (i_{corr})

The general corrosion rates ranged from 0.003 μA/cm² to 0.5 μA/cm² and were classified as negligible according to NMX-C-501-ONNCCE-2015, as shown in Figure 6. Columns F and D reached their maximum values (0.5 μA/cm²) without compromising the integrity of the reinforcement, due to the overall trend of the study. On the other hand, column B reached the lowest value, whereas column C, in isolation, shows constant passive behavior.

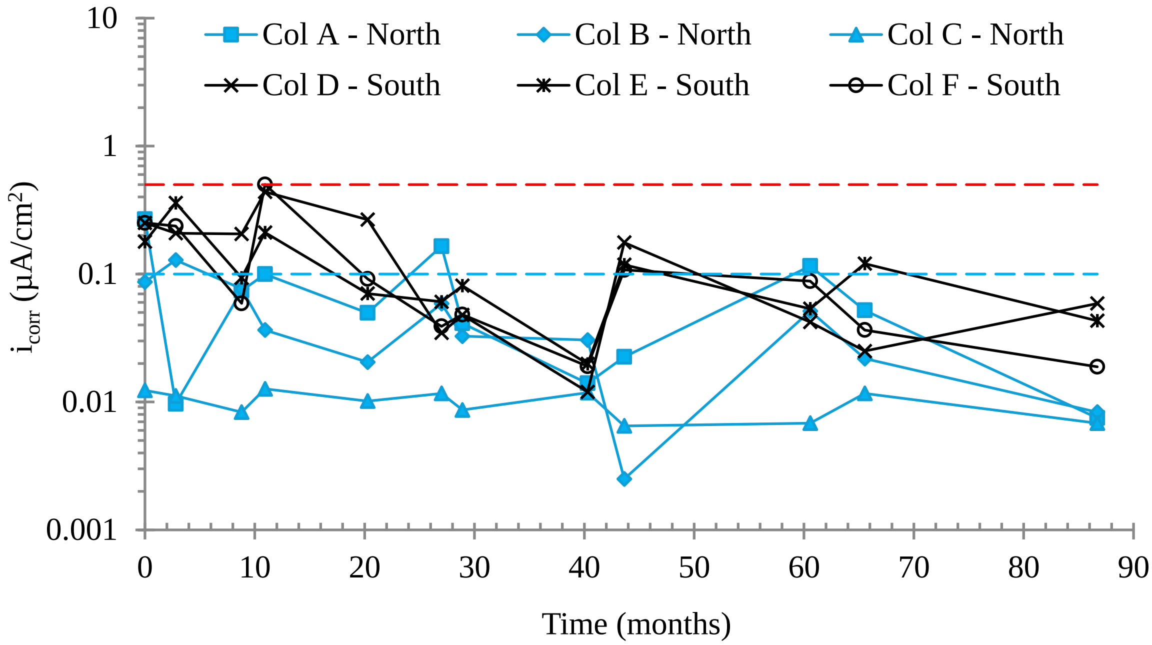


Figure 6. i_{corr} vs. Time.

The above figure shows variation in the data, so to improve the analysis, the accumulated corrosion rate is used (Figure 7) (Andrade et al., 2012; Castro-Borges et al., 2013, 2017). In this figure, you can see a clear difference between the columns located to the north and south, with those exposed to the weather to the south having higher corrosion rates. D is the most unfavorable, since in its first 20 months, a more positive slope change was observed, which then stabilized, indicating that corrosive processes are not yet present. Otherwise, the columns to the north exhibit stable behavior throughout the study period.

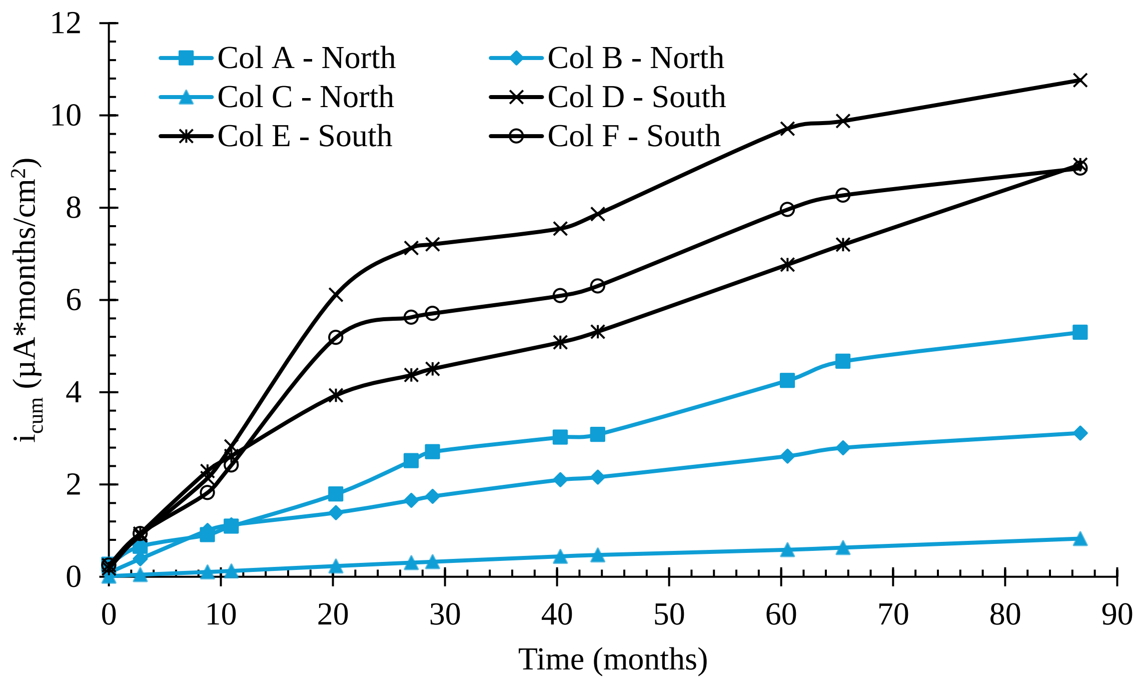


Figure 7. i_{cum} vs. time.

To understand the above, the behaviors observed in columns C and D (Figure 8) are analyzed. In this case, column C shows continuity in measurements, with values in the range of 0.01 µA/cm². In column D, it can be seen that, at the beginning, the corrosion rates were close to the thresholds due to passivation in natural environments, and later stabilized below the threshold.

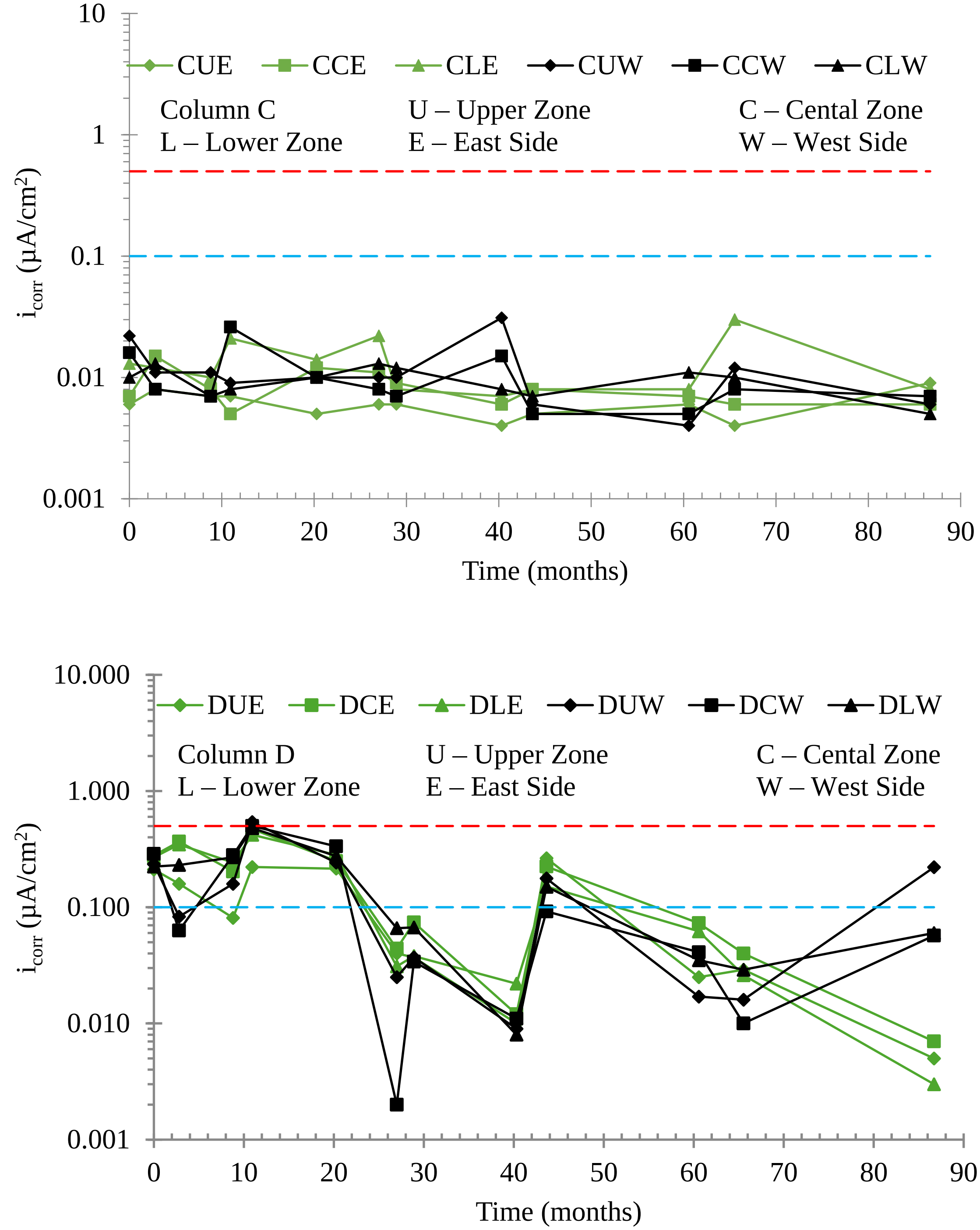


Figure 8. i_{corr} vs. time of columns C and D.

3.3 Resistivity

Resistivity values ranged from 10 to 150 kΩ·cm (Figure 9). Column B stood out at 150 kΩ·cm, indicating a high-density concrete matrix. Despite not having a constant measurement cycle, the influence of the rainy season can be observed, with resistivity, in some cases, decreasing by up to 20% of its average value and recovering to original levels during the dry period.

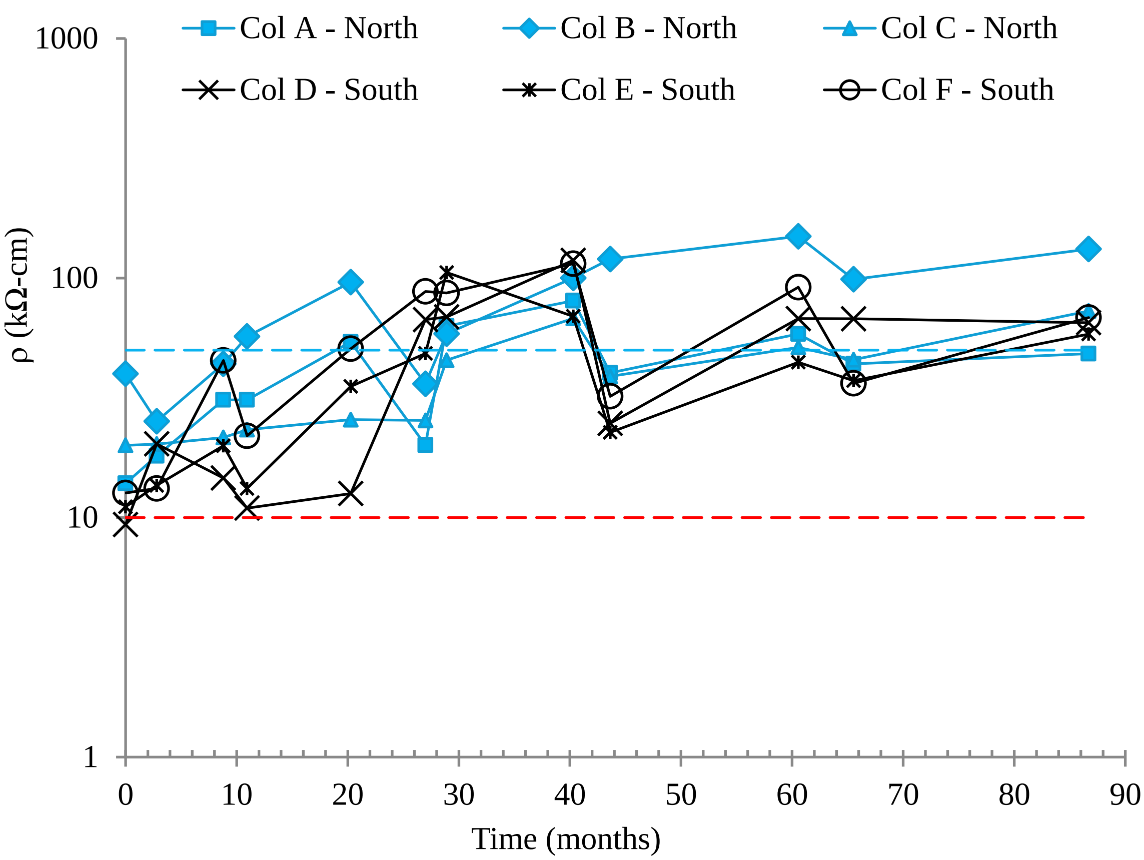


Figure 9. ρ vs. time.

Figure 10 presents the cumulative data for the columns' resistivities (Briceño-Mena et al., 2025). Unlike the corrosion rate, there is no clear difference between the North and South zones. However, it can be noted that column B, located to the north, exhibits higher resistivity. Although, as with corrosion potential, the accumulated resistivity is shown as a qualitative parameter during the initiation stage, its quantitative influence is expected to become apparent as the structure approaches depassivation.

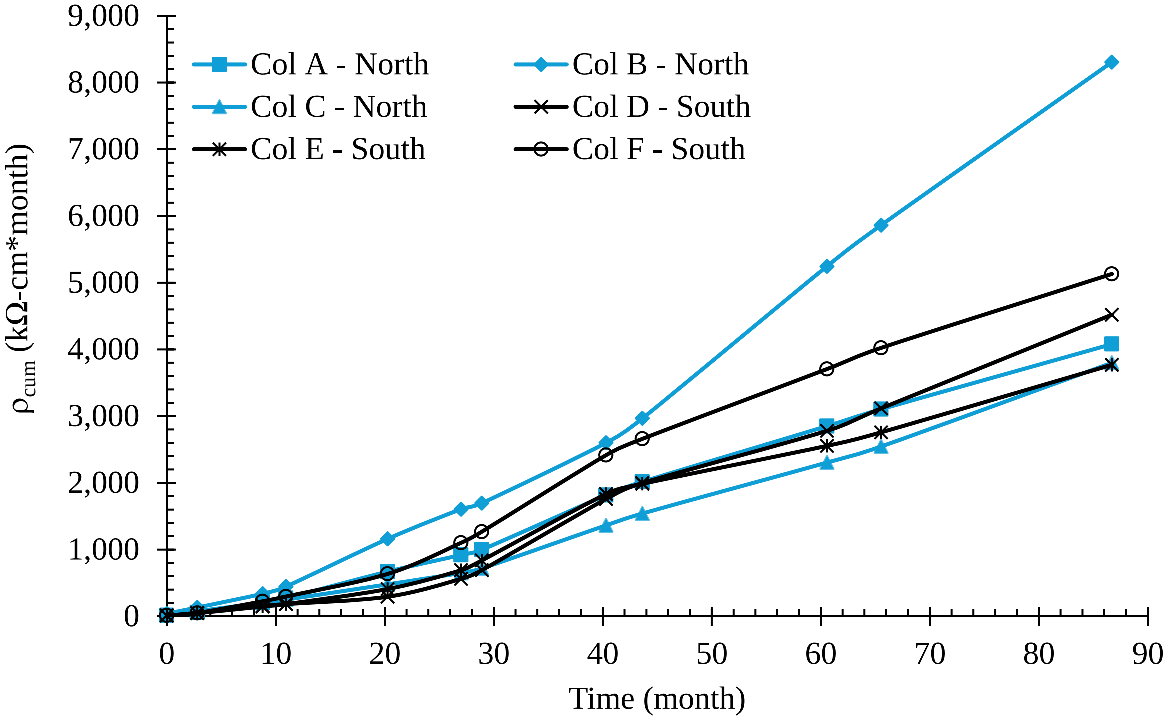
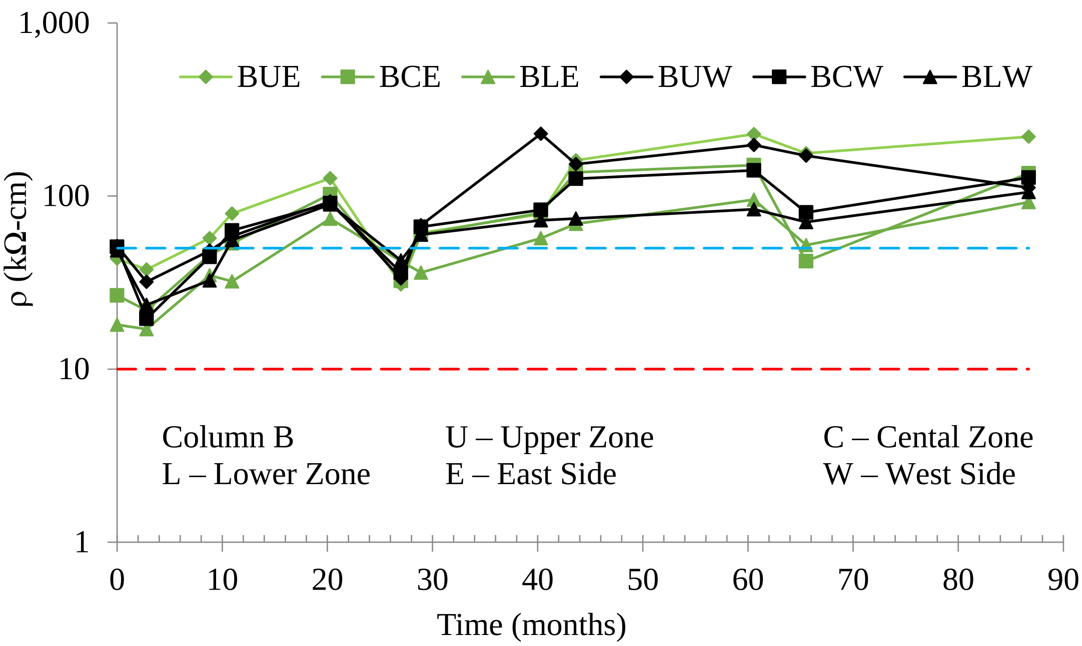


Figure 10. ρ_{cum} vs. time.

Figure 11 shows the electrical resistivity of column B, where resistivities at an early age exceeded the upper threshold, which would explain what was observed in the accumulated resistivities. For column D, it took up to 30 months to reach a considerable level of resistivity, and it remained at that level until the end of the reported period.



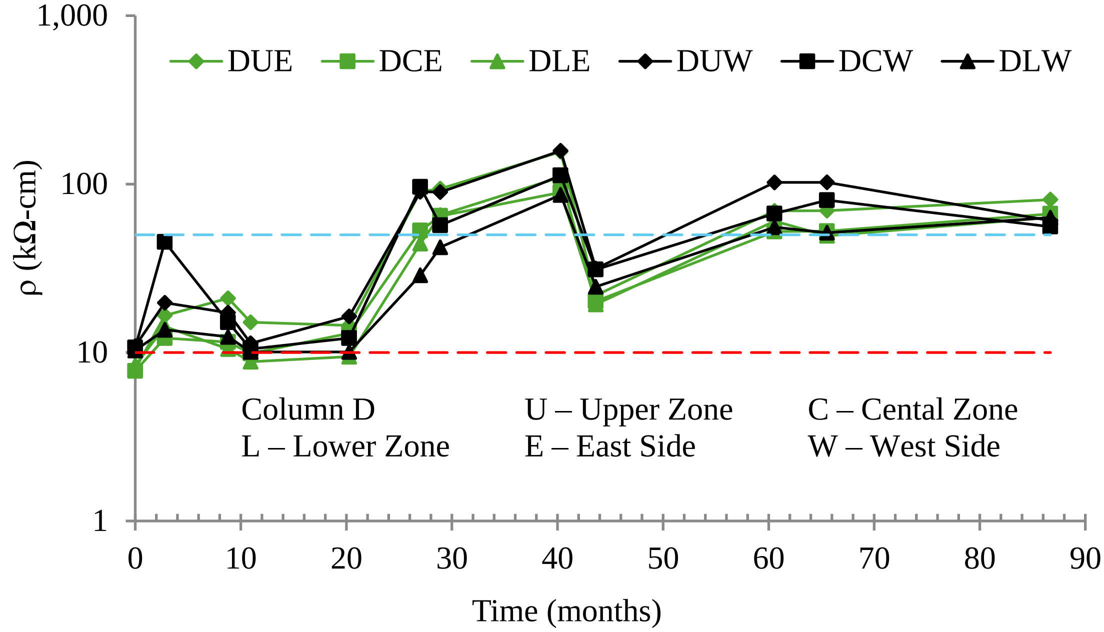


Figure 11. ρ vs. time of columns B and D.

3.4 Relative humidity and temperature

Figure 12 shows that the internal humidity ranged between 60 % and 90 %, with an average relative humidity of 74 % and peaks in the second half of the year, coinciding with the rainy season, as can be seen in the 3 main peaks obtained in the months of June and July, which is essential to assess the probability of corrosion in particularly vulnerable areas (Pacheco-Torgal et al., 2019). The average relative humidity of the columns in the northern zone is 72%, while those on the southern side, exposed to the environment, average 76%.

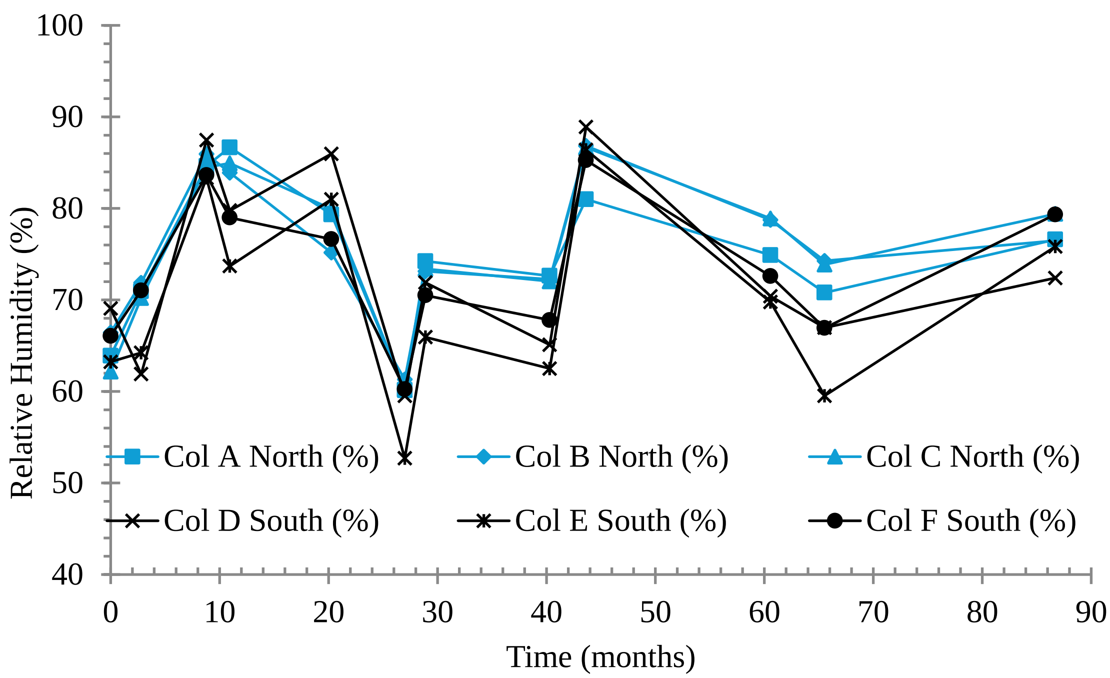


Figure 12. RH vs. time.

Figure 13 presents the cumulative results for relative humidity; it can be seen that the northern columns have higher humidity. However, all columns show the same trend.

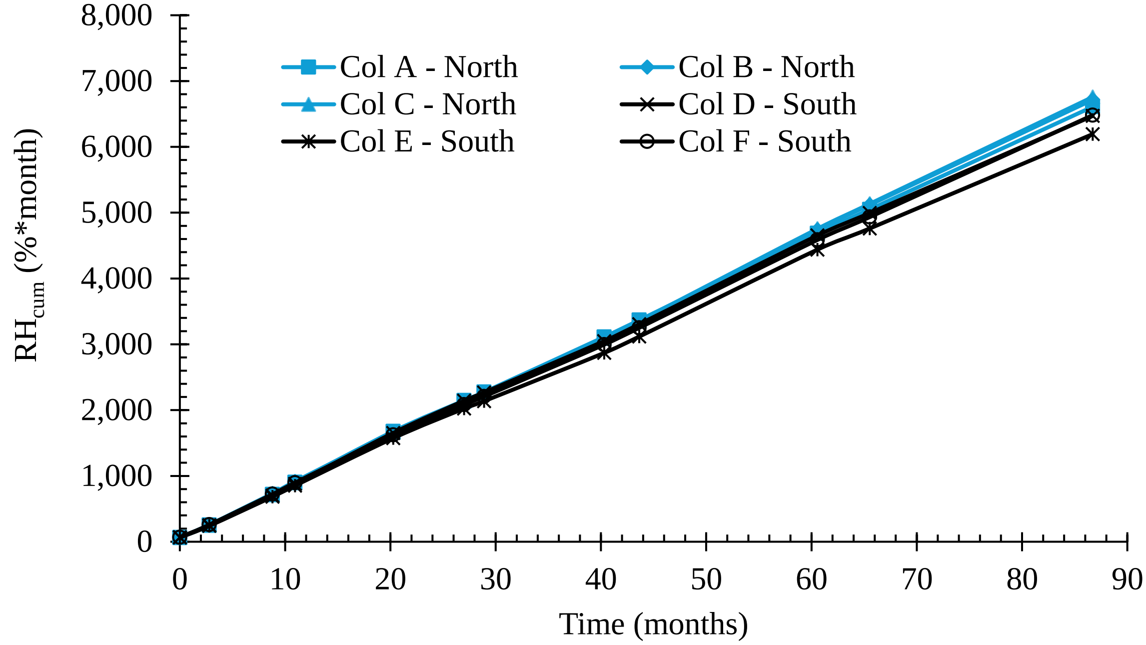


Figure 13. RH_{cum} vs. time.

On the other hand, Figure 14 presents the temperatures recorded in the columns; these fluctuated between 26 °C and 34 °C, with an average temperature of 29 °C for the columns located in the North and 30 °C for those located in the South, with no notable changes or variations observed due to the drought or rainy season. These observations support the importance of continuous monitoring in coastal structures, where environmental gradients can vary substantially with exposure.

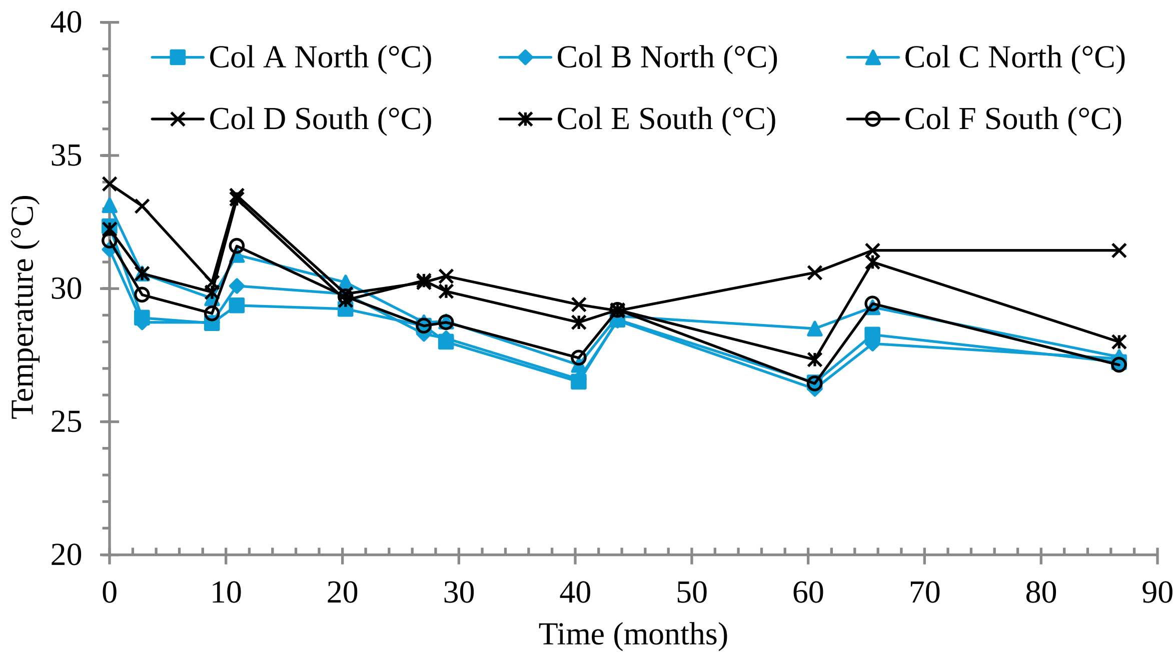


Figure 14. Temperature vs. time.

Figure 15 shows the cumulative temperature trends. As observed in the punctual ones, the temperatures of the columns to the north are lower.

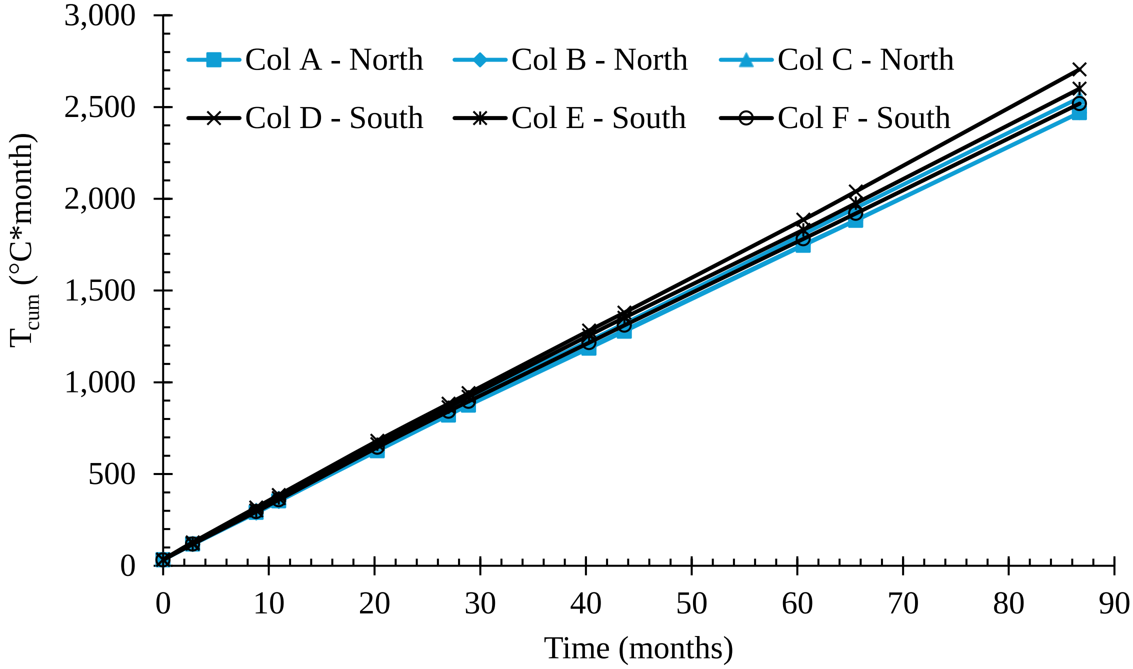


Figure 15. T_{cum} vs. time.

Throughout the seven years of monitoring, the data from the electrochemical and electrical point measurements in specific areas of the elements show variability linked to environmental conditions. For example, the changes observed when electrical resistivity decreases (Figure 9) and the corrosion rate increases (Figure 6) correspond to periods of higher relative humidity (Figure 12) and temperature (Figure 14). This represents the responses of concrete and steel to external climate changes, in terms of their physical and electrochemical behavior, respectively, as reflected in the internal microclimate of reinforced concrete (Cabrera-Madrid et al., 2014).
This analysis, throughout the study period, also allowed us to observe differences in the locations of the measurement points: in the columns located on the North side, with an analysis face to the South, under the slab, and in the columns located on the South side, with an analysis face to the South, outside the slab. Microclimates can be distinguished due to orientation. The columns on the south side exhibited higher accumulated corrosion rates due to direct environmental exposure, as they lacked the physical protection of the slab, as evidenced by the dispersion in relative humidity measurements.

3.5 Impact of the strategies followed on the parameters measured.

When the different generations of stilt houses were designed and built, they were looking for a way to be able to provide an orderly monitoring that would allow, over the years, to discriminate the influence of the variables that were designed, such as geographical orientation, position with respect to height, shielded or not against marine influence. shielded or not against shade and sunlight. This would be achieved not only by the placement of the fitters but also by measurements taken in different seasons over the years. Likewise, it could be analyzed how climate change would affect the variables studied.
As is known, the external environment of the structure is reflected inside the concrete at different depths (Castro-Borges & Veleva, 2015). There is a lag time between the external climate and its

reflection in the internal climate, which is difficult to measure. However, since the durability parameters are internal, understanding how climatic variations affect the reinforcing steel is essential to identify correlations between the environment and electrochemical behavior.
In addition to the above, a complementary analysis of the punctual follow-up (i.e., the cumulative follow-up) was necessary. Although there is no kinetic interpretation, there is a thermodynamic one. The results discussed, based on those accumulated in the previous figures, have shown that it is possible to discriminate the influence of climate on electrochemical parameters according to geographical orientation, measurement height within the columns, shielding or not from the sea breeze, and shade versus sunlight. With data obtained after seven years, it is now even possible to intervene in the structure to assess its behavior against chlorides and carbonation, and, with that, to model its service life from age seven, or set year zero at the beginning. This will be part of another work that will be published soon.

4. CONCLUSIONS

The present study, developed during seven years of continuous monitoring, has provided valuable information on the electrochemical and environmental behavior of a stilt-type substructure exposed to the aggressive conditions of the Gulf of Mexico. The results not only confirm the effectiveness of the design and materials used but also offer ideas for constructing resilient coastal infrastructure. The following are the conclusions on the main findings.

- Corrosion potential (E_{corr}) values ranged from –150 mV to +150 mV against the $Cu/CuSO_4$ reference electrode, indicating a low probability of corrosion (<10%) in all monitored columns, according to NMX-C-495-ONNCCE-2015 (reapproved 2021). This behavior reflects the effectiveness of the structural design in aggressive marine environments, characterized by high chloride concentrations and a relative humidity of around 80%.
- The installation of integrated monitoring devices (fitters) proved to be an effective and non-destructive solution to evaluate concrete parameters, such as humidity, temperature, and electrical and electrochemical activity (E_{corr}, i_{corr}, and ρ). Its installation did not alter the electrochemical properties or structural integrity of the concrete, thereby validating its use in future projects.
- The protected columns (located to the north, A, B, and C) showed outstanding stability in their i_{corr} values (between 0.01 and 0.1 μA/cm²), attributed to the physical protection provided by the upper slab.
- The exposed columns (located to the South, D, E, and F) presented temporary peaks of up to 0.5 μA/cm² attributed to the rainy season, generating increases in relative humidity (up to 90%). However, these values stabilized during the dry periods and in later stages of the study.
- The internal humidity of the concrete ranged from 60% to 90%, with peaks during the hurricane season, which had direct effects on electrochemical activity.
- The increases in i_{corr} and decreases in electrical resistivity (ρ) during rainy months are consistent with previous studies on the influence of humidity on corrosive processes in marine environments.
- The recorded temperatures fluctuated between 26 °C and 34 °C and did not show, for the moment, a significant influence on the electrochemical parameters, confirming that, in tropical climates, humidity is the main factor in the activation of corrosive processes, while thermal variations have a less noticeable effect.
- The industrial prefabrication of the structural elements led to a uniformity in the properties of the concrete, having a reduction in construction defects, such as porosity and cracks,

which are usually more common in in-situ constructions, which allowed a resistivity greater than 100 kΩ·cm.

- Although there is no kinetic interpretation, there is thermodynamics. The results discussed, based on those accumulated in the previous figures, have shown that it is possible to discriminate the influence of climate on electrochemical parameters according to geographical orientation, measurement height within the columns, shielding or not from the sea breeze, and shade versus sunlight.
- With the data obtained after seven years, it is now even possible to intervene in the structure to know its behavior against chlorides and carbonation, and, with them, model its service life from the age of seven, or take year zero as a start. This will be part of another work to be published soon

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