

XTREME

Saba & Sint Maarten

The future of resilient
architecture in the Caribbean

Master Architecture | TU Delft | 2023





colophon

Extreme Architecture TU Delft
Xtreme Architectue organisation 2022/23
28 November - 8 December
Trip to Sint Maarten & Saba
Publiced by PrintenBind
Publiced March 2023
30 prints

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version PDF, Printable version
paper format 210x148mm

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Xtreme Architecture

INTRODUCTION

Xtreme Architecture is an organised research team by 65 architecture master students from TU Delft. The project takes place in Sint Maarten and Saba, areas that suffer from regular climatic disasters such as hurricanes and earthquakes. In 2017, more than 80% of the buildings on Sint Maarten were damaged by hurricane Irma. To respond, the wish is to provide innovative building and design solutions for extreme climate conditions in areas where help is needed. The ambition is to strengthen communities and develop different ways to help with earthquake and hurricane resilience.

A close collaboration with a local developer gives the research relevance to approach local parties as well. Research is going on and designs for affordable housing on Sint Maarten and a day-care center on Saba are made, which are not only hurricane and earthquake resilient but also boundary pushing in terms of circularity and sustainability. These projects are aimed to be actually built. In November, 25 students went on a

week-long research trip to Sint Maarten and Saba. The group visited the plots and conducted small-scale practical testing in the way of site analysis. These included: plot dimensions; predominant wind direction and soil types. The data was taken back to the Netherlands to make the designs as specific as possible and also to have a circular and sustainable design created to this specific climate.

This field trip also allowed students to make contact with the locals and local parties related to the construction sector. They exchanged knowledge and ideas with local people and local government agencies. By engaging with these parties, students gained valuable information about their lifestyle and their lives in areas facing extreme climate conditions. Instead of coming up with innovative building solutions from the TU Delft, Xtreme Architecture wants to discover the opportunities of building together with the locals. One day was dedicated to volunteering, during this

day students managed to renovate the Volunteer Center that still faced hurricane damage. Discussions with local contractors got students thinking of not only implementing sustainability in the final designs, but also explaining its importance and relevance for the locals.

As a final result we finish the individual designs for small-scale affordable housing on Sint Maarten and the design for a daycare center on Saba. These designs are presented both architecturally and technically. As a result this booklet is made to show interesting new designs that are both inspiring and informative for hurricane and earthquake resilience building solutions in areas that face these extreme climate conditions. To prevent future disasters, our building solutions are of Xtreme importance!

On behalf of the whole Xtreme Architecture team,

Daan Wierikx, Hein van der Helm and Leyla van der Waarde



Construction site on Sint Maarten, rebuilding of a small apartment by a local builder. Rebar sticking out to allow and enable the future construction of the first floor.



A word from the organisation

At the beginning of September, a group of 65 master architecture students were enthusiastic and excited to work on the project of Extreme Architecture. Creating and designing solutions that can make an impact during this project is something valuable that we as students really took into account. In order to actually get the chance of making an impact we created a student led initiative called Xtreme Architecture. We are extremely proud of what we as an organisation have achieved. During the first weeks of the studio we started off with a big group of students who helped setting up the

research trip. This amazing start gave us a lot of energy to work on the trip to make it unforgettable. During a time frame of three months we worked relentlessly to schedule and plan the whole trip and set up a crowdfunding page to secure financial support from sponsors.

In the end, the whole project was an interesting and educational experience for us as we were able to understand how local communities and engineers can work together to design and create solutions for extreme conditions. As organisation we would like to thank all

the students, teachers, the coordinator, people from Sint Maarten / Saba, sponsors and the Technical University of Delft. Our project and research trip to Sint Maarten and Saba was successful and we are very happy to have been part of it. We hope you enjoy reading this booklet and that this project will inspire others to think about architecture and how it can be used to create solutions to the growing threats of climate change and climatical disasters.

Daan, Els, Marion, Lise, Leyla and Hein

“An eye-opening, enriching, and motivating reality check.”

Students researching the plot of the daycare center on Saba.





“
Our students are keen
on making positive
changes to our world.
”

Students starting the
conversation with Armond,
a local builder from Sint
Maarten.



A word from **the coordinator**

EXTREME Architecture is one of twelve courses students can choose in their architecture master's track at the TU Delft. The assignment for the students in the EXTREME course is always in an extreme setting: We've been working on refugee camps, hurricane resilience, Ebola clinics, and earthquake resilience to name a few topics. These topics are very challenging and have great educational value.

The topics in EXTREME often relate to our changing climate and can learn us how we might adapt to a changing

climate in our own built environment. Our students are keen on making positive changes to our world, more than previous generations it seems. We always try to work with local partners, who can give the students valuable input and feedback.

The extreme setting of the assignment triggers the students to truly understand the problems and solutions of the project. Where projects in the Netherlands typically need double glazing, you can imagine that an Ebola clinic in Congo might need insect screens instead.

Although the assignments in the EXTREME courses are challenging, they help to get the students extremely involved. The students learn to do research and push their work to a higher level, with their teachers taking on the role of mentors. With their fresh mindset, they often find interesting and sometimes new solutions for the assignment.

I hope you will enjoy the designs in this book as much as I do.

Job Schroën

CHAPTER I

BUILDING RESILIENT

In 2017 hurricane Irma impacted multiple Caribbean islands, including Sint Maarten and Saba. The powerful winds and water floods of Hurricane Irma damaged more than 90% of the buildings on Sint Maarten (Red Cross, 2022). The tendency of quickly rebuilding the buildings in the same way as before did not always result in the desired solutions. The consequences were that these building methods could not resist a future natural disaster, such as a hurricane or earthquake. In order to have a sustainable and long-lasting outcome the solution lies in constructing resilient buildings.

Building resilient means to facilitate a build environment that can ‘bounce back’ after a natural disaster. Building in a resilient way will reduce the damage of future natural disasters, moreover it will result in a more sustainable building method. By decreasing the loss of materials and damaged materials, reconstructing can also become more circular.

The desired goal is to improve resilience to extreme climate environments and to ensure that climate change adaptation is mainstreamed within the building methods.

In order to gain this goal of resilience it is essential to have professional knowledge and experience to design and build hurricane-resistant buildings. In seismic and hurricane prone areas this knowledge is not always there when needed. Moreover, it is clear that the reconstruction after a natural disaster is often rushed and badly designed and built. It is of importance to rethink the way we build and with the people in those areas. Creating building methods that are not dependent on external knowledge and share this knowledge directly by allowing understandable building methods. Encouraging these building methods with the local builders and inhabitants can reduce future catastrophic damage.

Photo after hurricane Irma on Sint Maarten. Houses and nature were damaged, which resulted into a lot of waste.



After hurricane Irma hit in 2017, multiple houses were damaged and were uninhabitable for the inhabitants. People left there houses, resulting in a stack of unused building materials.

CHAPTER II

RESEARCH FIRST WEEKS OF PROJECT

The built environment plays a tremendous role in the emission of CO2 and we will soon face global shortages in building materials. The fact that Saba and Sint Maarten fully rely on the import of products calls for efficient, innovative and responsible use of materials. This goes beyond choosing sustainable building materials. A circular built environment focuses on a sustainable loop and differs from a linear system (Amsen, 2022). This loop is created by recycling, reusing and rethinking the way we use materials and products. The goal of a circular system is to avoid waste and reuse where possible. In that way waste can even be reused as a source for a new product (Amsen, 2022). How do we design homes that owners can repair themselves after natural hazards hit? Can we control what parts of the building are allowed to be

damaged without posing a threat to the environment? Can we incorporate waste and debris on the islands in the construction of new homes? By closing material loops and by looking at the relationship between the users and the material flows, we aim to inspire locals and everyone who has ties with the built environment to start thinking in a more circular way. The first weeks of the project students researched multiple areas in the field of circular innovative solutions. Moreover, the research was focused on the case study of the Caribbean islands. This resulted into a mix of different investigations varying from windvelocity to constructing with local soil. This chapter shows a selection of research topics.

CIRCULARITY RESEARCH

Sint Maarten has a high municipal solid waste generation in the Caribbean: 9.7 kg per capita per day, adding up to 300,000 tons. In the Netherlands this is 1.3 kg per capita per day. The island has major waste problems due to the poor state of the landfill, low waste separation, insufficient recycling and inadequate waste management practices and policies. Our research aims to improve and search for new innovative solutions to address this problem.

The team investigated how the current waste of plastics can be stored or used in a wall to reuse it in the build environment. The invention is an ecobrick that uses plastic waste and plastic bottles combined by a biodegradable mortar consisting of local materials. In the end this product addresses the waste problem, but will only be a contemporary solution until Sint Maarten puts focus on recycling their waste.

By: Luka Brandsma and Josephine van Buuren



CIRCULARITY RESEARCH

The research team spent four weeks researching the use of more sustainable materials in Sint Maarten. This was a very difficult project because of the fact that almost everything is imported in the Caribbean. During our research we concluded that the use of bamboo and engineered timber can be good solutions for new structural materials. As for infill of the wall the research team discovered that hempcrete is a sustainable and suitable material. This material has very good climate regulating qualities and is easily repairable. A smart combination between sustainable materials can improve the way of thinking and adds to a more circular build environment.

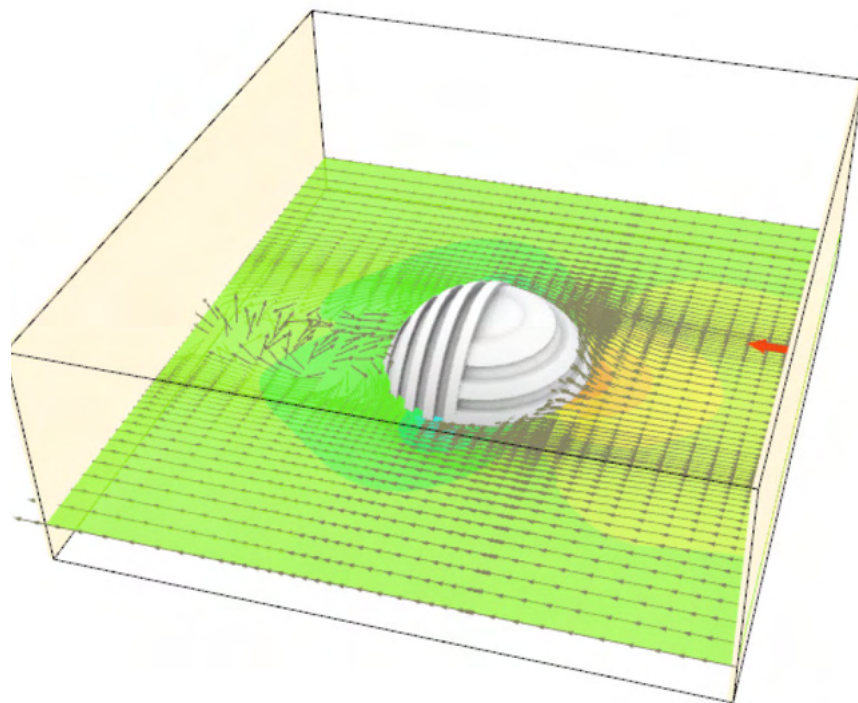
By: Hanlin Stuer, Ana Mendica and Justin Roelofs



WIND RESEARCH

We, Sasha and Jasper, have been researching hurricane-resistant building shapes by focusing on the wind. A literature research resulted in multiple hypothetically best and worst shapes to withstand a hurricane. Moreover the team investigated the most typical building forms of Sint Maarten. Following up was creating a 3D model of these best suited shapes. The team created its own wind tunnel and computer model to test these building shapes against hurricane winds. The figure shows the computer model and the wind pressure that is measured on these shapes. The more red, the more pressure there is. To conclude, it becomes visible how the shape is related to the impact and damage a hurricane can cause.

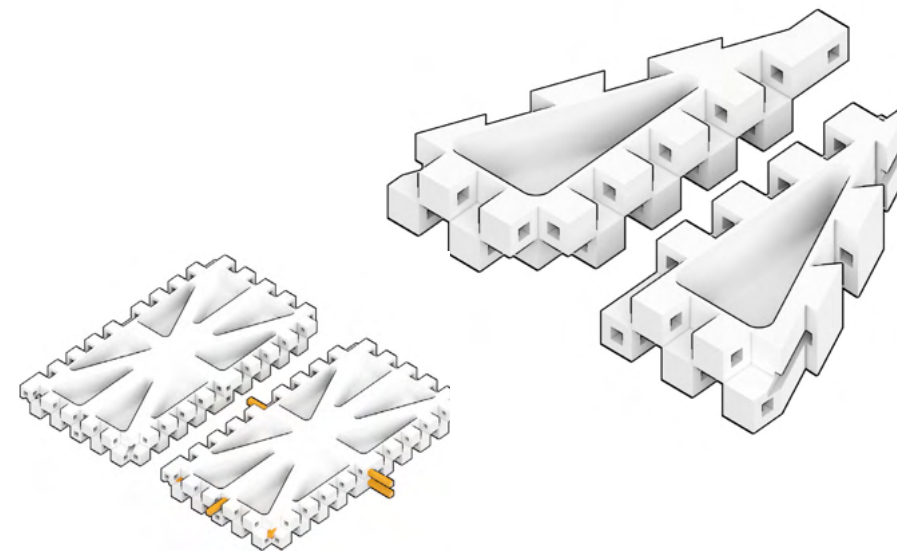
By: Jasper Holtus and
Sasha den Elt



MATERIAL RESEARCH

Instead of using traditional building materials we researched a structure constructed primarily from recycled plastic, such as PET and HDPE. These plastics can be melted and injected into moulds to create prefabricated elements. Inspired by the Japanese joinery, the elements can be easily connected to form slabs, walls, and eventually entire constructions. The specific geometry of these elements means that no additional materials are required for connection, making it possible to create everything from plastic waste found on the island without importing any specific materials. Being able to reuse plastics in a new way can reduce the amount of waste and increase the ideas and thoughts behind a circular economy.

By: Jan Morzynski



Research resulted into a structure constructed primarily from recycled plastic, such as PET and HDPE. These plastics can be melted and injected into moulds to create prefabricated elements.



CHAPTER III

TRIP TO SINT MAARTEN & SABA



View from Windwardside, a village on Saba. The island has a rich variety in vegetation. Due to the steep hills it is difficult to built on the island, so it is key to research the height differences on the plot.



Saba, The Unspoiled Queen in the Caribbean, seen from the ferry to the island. Mount Scenery is the name of the vulcano.



For the Architecture master students from TU Delft it was important to fully understand the site and the needs of the locals regarding the real design assignments, which are provided by the local government of Saba and a project developer from Sint Maarten. Going there in person allowed us to start the conversation with the community, hearing their stories and seeing the consequences and the severity of the natural disasters which have happened there.

In addition to this, the goal of the research team is to provide designs that are boundary pushing in terms of circularity and sustainability. Instead of coming up with innovative building solutions from the TU Delft we want to

discover the opportunities of building and designing together with the local parties. That way we can actually convince people to rethink the current way of (re)construction to build more resilient.

On site exploration of the building plot, created the opportunity to gather multiple sources of information. This site specific information will improve the precision and relevance of the individual designs immensely. After all, this trip proved that architecture students not only learned and gathered knowledge to build and design hurricane- and earthquake proof, but can actually apply it for greater causes to prevent the impact of future natural disasters.



Open discussion session during the visit to the social housing project.



View of Sint Maarten from
the ferry going to Saba.

The project takes place on Sint Maarten and Saba, islands part of the Dutch Kingdom. The islands, which are located in the Caribbean, suffer from regular climate disasters such as hurricanes and earthquakes.

Extreme Architecture has two projects, one on Sint Maarten, a housing project and one on Saba, a daycare center. The goal of the project is to not only provide solutions applicable for Sint Maarten and Saba but to provide creative and sustainable solutions also fitting for other areas that experience these natural disasters.

Sint Maarten is split in two parts, the French area (Saint Martin) and the Dutch part. The island has a total of 75.000 thousand inhabitants, of which about 43.000 live in the Dutch part.

Sint Maarten was colonized by the Dutch in 1648 and became an autonomous part of the Dutch Kingdom in 2010. There is only one main road on the island. This road is 30 km long and goes around the island. The housing project is situated in Belaire, five km from the capital of the dutch part, Phillipsburg.

Saba is a smaller island, only 13km2 and has 1900 inhabitants (CBS, 2021). This island has been part of The Netherlands since 1816 and has been a special municipality since 2010. On the island the highest mountain of the Dutch Kingdom is situated, Mount Scenery, which is 887 meters high. During our visit we visited this spectacular scene. The daycare centre was located in the Bottom, the capital of Saba.

WHERE

Prior to the research trip, students were able to follow lectures of professionals in multiple areas of expertise. Together with the research done in the first four weeks, students gathered information on building materials, climate, construction methods and vernacular architecture. During the trip, students got the opportunity to talk with many different people, however all these people lived on the island. Various activities were planned, a visit to the university, to the concrete plant, the landfill, students got a presentation by a dutch architect, talked to local

builders and most importantly, had conversations with locals. Student stalked about building methods with builders and got an understanding of why certain materials were used and questioned why some methods or materials are not commonly used. The group compiled local knowledge to use in their designs, together with getting a sense of the climate. They got to see the project sites, see the height difference, how the wind blows, the type of soil, flora and fauna, local climate, dimensions, height differences and the view.

Students observing
the plot on Saba and
engaging in discussions.



DAY 1 | 29.11.2022

First day

On the 29th of November the group arrived at the Juliana international Airport on Sint Maarten. At the airport they were greeted by Michael, the project developer. He invited all the students to have an introduction drink at the beach to settle down and relax before the busy planning of the next week! After the drinks, the students travelled to the Vicky's Keys Hostel where they would stay for the week.

The research trip was started and all students prepared themselves for the busy upcoming week.



DAY 2 | 30.11.2022

Belvedere village

In the morning the group visited the Belvedere village, a neighbourhood on Sint Maarten. Smaller groups were formed to explore the area and to look at the social housing developments. The whole area exists out of different forms of housing. Social housing is mixed with private housing and bigger apartment blocks. Students also got the chance to talk to residents and builders working in the area.

The students got the assignment to look and analyse different aspects regarding sustainability and the hurricane resistance of the buildings.

Making sketches is an important and effective way to analyse an urban area, since students will reminder this and can discuss these sketches to the students in Delft.

The whole group discussed the findings and sketches afterwards to share all the individual analyses.



DAY 3 | 01.12.2022

Discussions and site visit

This day, a part of the group split off to go to Saba. The group of students took the ferry in the morning and although a few students and teacher got seasick they arrived on Saba.

A lunchmeeting was planned together with the project developer, investor and people from the local government. During the lunch all students had the chance to discuss with the stakeholders about the project.



New insights regarding the project of the daycare center were shared with all parties. Moreover, the open discussions worked as inspiring for the students as for the men from the government of Saba. By handing over the model of the island of Saba we ended this fruitful lunchsession.

After the lunch the project site was visited in The Bottom. At the site students got the opportunity to



fully investigate the plot. Students took pictures, made sketches and researched the flora and fauna.

Lastly, the local daycare was visited. The direction of the daycare was kind enough to give a tour and answer all the questions from the students. It was helpful to understand the new program of the daycare better and get a sense of all sizes and the scale of the future functions.



DAY 4 | 02.12.2022

Concrete plant

While the Saba group had a hike to the top of Mount Scenery, the Sint Maarten group visited one of the concrete plants of the island.

Sint Maarten is dependent on the import of construction materials. For the construction industry on the island concrete is used in a large percent of all projects. The concrete



plant the students visited is one of the bigger plants. The manager explained the ins and outs of concrete and the industry on the island, followed by a tour around the plant.

New insights were written down and although one student asked a more critical question regarding the sustainability of using concrete and



the industry, the focus for now will still be on using concrete according to the manager of the plant.



DAY 5 | 03.12.2022

Traveling day

The fifth day was the last day on Saba. In the morning everyone packed their bags and the group was ready to go back to Sint Maarten.

The day before, on the 2th of December it was the national day, called Saba Day on Saba. All the inhabitants celebrated the day and the whole group of students was invited to join the party in the afternoon and evening.

Meeting new people and enjoying the local food, prepared by the locals.

Leaving Saba meant one last time driving on the steep and small roads, so the group headed back to Sint Maarten.

On Sint Maarten all students and teachers were reunited. In the afternoon the group planned a visit

to the French site of the island, Saint Martin. It was remarkable to notice the difference between both sides. The French side still made clear that multiple buildings were left behind and were extremely damaged after hurricane Irma. The rebuilding on this side of the island was more difficult due to financial and political aspects.



DAY 6 | 04.12.2022

Volunteering day

This day stood in light of volunteering. Together with Cee, the owner of the Eco Hostel, the students helped to restore the eco volunteering center which was badly damaged after the hurricane. The aim of the hostel is to become self-sufficient and sustainable. A volunteering center together with a friendly and warm hostel feeling.

The day started early to do as much as possible, some students started painting the hostel itself, while others were tasked with removing overgrown greenery. During the day, the hydroponics farm was cleared, fencing was placed and large areas were cleaned up.

While working neighbours came to talk to the students and telling the students how happy they are that Vicky's Keys became the lively place it had always been. One of the neighbours even brought some well deserved homemade lemonade.

After a long day of working, students had some time off to relax at one of the beaches together with the people working at the hostel.



DAY 7 | 05.12.2022

Dam Caribbean and belvedere homes

The students had the opportunity to visit the architectural firm DAM Caribbean. The firm was kind enough to give a presentation about designing and building on Sint Maarten and the challenges the island brings.

The architects showed technical drawings and details to demonstrate how to build hurricane and earthquake proof which was of great help to the

students. The Dutch architect had experienced the differences between designing in the Netherlands and design for projects in the Caribbean. He also explained these differences to the students.

Afterwards, a smaller group of students went back to the Belvedere village, where they got another presentation

and had a great discussing with the project managers. During this discussion the students really got to know the building culture on Sint Maarten, as well as learning from the mistakes dutch builders made on the island. E-mails were exchanged to keep in touch about new ways of designing, which could be implemented on Sint Maarten.



DAY 8 | 06.12.2022

Last day

An end has come to this amazing trip. The last day the students were left to discover the island one last time. Some students went kayaking, some went for a drink at the local bar and others enjoyed the time at the Eco Hostel. Towards the end of the afternoon we said our goodbye's to everyone and left for the airport.







Students at the current daycare on Saba. Gathering knowledge and asking question, regarding the program of the new daycare and kindergarten.

On the Islands of Saba and Sint Maarten small, tight communities are created, where people take care of each other. During the trip, the students had the opportunity to talk to locals. The people on the Islands were all very welcoming to tell their stories and experiences. However the sadness of the situation was very clear from the start.

In this section a couple of these stories are shared. These stories show how important it is to share these stories of the locals, and to realize how important our case study is. Cee, the owner and manager of the Vickys Keys volunteering

centre on Sint Maarten, Armond, a local builder on Sint Maarten and Rosa, the owner of the daycare on Saba all share their personal stories about their life and work.

With their perspective, students were able to adapt their designs accordingly. It is true that students can read about the hurricanes, do research, listen to the numerous excellent lecturers, and provide our own conclusions and solutions to design hurricane proof. When, in reality, most of us never experienced a natural disaster. However, by having conversations with the community on the islands students really dove into the lives of these people.

MEET THE LOCALS



ROSA

After school care direction

Rosa, the head of the daycare center on Saba, is an integral part of the Saba community. Her family has been running the daycare center on the island for generations, providing the children of Saba with a safe and nurturing environment.

The building itself serves a dual purpose, being utilized for daycare during the week and for gatherings, community events, and as a hurricane shelter in times of need. Rosa is dedicated to making sure the building is as accessible and beneficial as possible to the people of Saba, and has made great strides to ensure its continued use in the community.

Not only does the daycare center provide an invaluable service to the children of Saba, but it also serves as a place for people to come together and create meaningful bonds. The building has become a second home to many, offering a safe haven during times of crisis and a place to make memories and build friendships.

Rosa has been a driving force in keeping the daycare open and available to the community, and her efforts are a testament to her commitment to the people of Saba.



CEE MARLIN

Eco Hostel / Volunteer Center

Cee Marlin, founder of Stichting Marlin Yard, has been exploring ways to reduce the “ecological footprint” since 1998. Inspired by his enslaved ancestors at the 17th century plantation Succour located at the settlement now known as Sucker Garden on Sint Maarten, Cee’s mission is to apply the sufficient eco lifestyle. For more than 300 years Cee’s family remained living at this settlement in a little village known as The Keys. There Cee created the foundation subsidiary named Vicky’s Keys Volunteer Center and applied the 4 x R motto which stands for “Reuse, Reduce, Recycle and Repurpose”.

This location purpose is to help create food security by rolling out agricultural activities that supports a sustainable

lifestyle. And to help build ecological hurricane-and earthquake challenged homes. Together with the foundation’s subsidiaries Vicky’s Keys Volunteer Center the mission is to promote and help execute sustainability and self-reliance throughout the Kingdom of the Netherlands, with special focus on Sint Maarten. Something that is urgently needed after witnessing and experiencing the destructive 2017 hurricanes, climate change impact and the COVID-19 pandemic.

Cee’s core activities involve Sustainable Development Goals and he is looking for partners to help eradicate poverty, make education accessible for everyone and to help deal with the climate crisis.



ARMOND
Local builder

Armond is the proud owner of his own construction firm on Sint Maarten. The way he is working is typical for an one-man job and he reconstructs and builds private housing apartments. Talking to Armond made us realize how the building industry in the Caribbean is completely different from the Netherlands.

At first, people on Sint Maarten are not thinking in terms of sustainability and circularity. The building industry is way more traditional and uses a lot of concrete. Armond adds: "People feel safe in concrete houses and prefer to live in a completely concrete house, instead of wood."

Sustainability is not the main point, it is inferior to feeling safe in areas where people deal with earthquakes and hurricanes on a yearly basis.

A second aspect that makes it difficult to build on those islands is the dependence on importing building materials. All cement is imported from Jamaica and Turkey and wood is imported from The Netherlands and America.

Armond made clear that people on Sint Maarten started rebuilding their homes after hurricane Irma in a rush to quickly have shelter again. This in combination with higher living costs makes it almost impossible to survive a next hurricane. In order to prevent future damage, people should act and the construction sector should act in a more resilient way. Armond concludes that the government should insure people when they have the will to build sustainable and to prevent a future existing out of a concrete build environment.



Being on Sint Maarten the team spoke to the dean of the university of Sint Maarten. Students studying on Sint Maarten mainly study in the evening and work on daytime to finance their study.

MEET THE STUDENTS



Vanessa Heider
Sint Maarten Housing

While designing the Belair housing project, we had to deal with earthquakes, hurricanes, a hot and humid climate, and circular construction methods.

In trying to combine all the information we learned in the various tutorials and lectures; I covered two different aspects: The protection from hurricanes and earthquakes and the use of passive cooling methods.

The ability to open and close a building

as much as possible at the same time is something that is not only helpful in extreme environments like on Sint Maarten but could become increasingly important in our daily lives in Europe. Due to global warming, the climate will change, and we will need more and more passive cooling methods as well as protection from natural hazards. Therefore, it is important to understand the architecture that is already used in extreme environments and apply what we learn to our future projects.



Thomas Brandt
Saba Day Care Center

The extreme architecture studio was a challenging experience where I learned how to design a functional building in a tropical landscape and climate. Going to Saba was unreal, the island is beautifully green and has a unique, peaceful atmosphere. During the visit I discovered how high the need for shade is, even in December temperatures rise to 30 degrees Celsius. So the trip has been very valuable for my design process, because in my design I have focused on preserving a lot of greenery and facilitating enough shade. The studio has also taught me how to deal with extreme climate conditions in constructions, a valuable tool I will keep with me.



Jason Galea
Saba Day Care Center

Working on our recent visit to the Caribbean island of Saba was an incredibly insightful and rewarding experience. The studio which is part of TU Delft's MSc1 Extreme Studio was focused on creating innovative design solutions for communities and regions exposed to extreme ecological and environmental conditions. The trip aimed to explore the island's unique blend of culture, landscape, and built environment to deepen our understanding of the local requirements.

While on the island, we visited local sites of cultural and natural significance and interacted with the local people to learn about their ways of life. Through a combination of meetings, site visits, and hands-on activities, we gained a deeper understanding of the island's complex situation, its environmental and logistical challenges, and the importance of protecting its cultural heritage.

The fieldtrip served as a valuable learning experience for me, helping me to appreciate the cultural diversity of Saba and its influence on our designs for the childcare centre. It was an eye-opening experience that I will never forget.





Hanlin Stuer
Sint Maarten Housing

An eye-opening, enriching, and motivating reality check. That was my EXTREME architecture experience. The introduction to earthquake and hurricane resilient building paired with the excursion to Sint Maarten where I had the chance to explore the building practices on the island and talk to locals provided me with a lot of insight into designing for extreme environments.

The striking contrast between the ambition we have at the TU Delft to pursue innovative designs with a strong focus on sustainability and the locals' preference for concrete bunkers really became apparent in their skepticism

when discussing our ideas. This was an important lesson for me on the topic of designing for communities and how important it is to engage with the users to hear their side of the story because there are certain experiences which you can never relate to unless you have physically experienced it yourself. It also showed me that there is plenty of room for innovation in the building sector and motivates me to continue looking for better solutions and not only settle for the commonly accepted solution.



Hania Adamczyk
Saba Day Care Center

During the semester, I tried to understand the tropical climate and deal with different weather conditions. Developing the project was challenging every week, but one thing made it easier for me to understand the whole task – going to Saba for a study trip. Being on Saba allowed me to feel the atmosphere of the place. Temperature, wind, sun, humidity – all of these can only be experienced with a physical presence. All these factors shape the space and the architecture we create. Other than that, the greatest experience was talking to the local community. Understanding their needs and culture was key during the design process, in which I tried to create new, interesting spaces for Sabans.



CHAPTER IV

FINAL DESIGNS

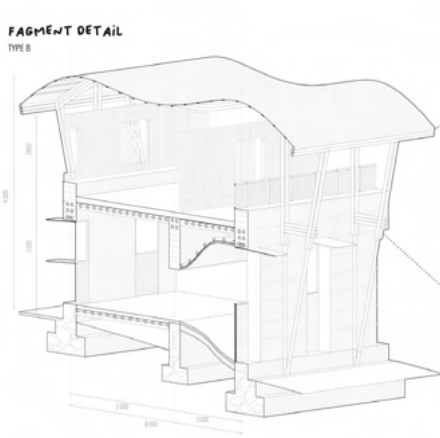


MARION ACHACH
Saba Day Care Center

Located on the Caribbean island of Saba, this project addresses the climatic and social constraints it faces. The 2018 UNICEF and Security Profile reports clearly indicate a significant need on Saba where women and children are in a vulnerable position. Today, half of the island’s population claims child abuse and violence against women as a common occurrence on the island. Therefore, the Saba Child and Women Shelter aims to respond to an urgent need to offer a social and climatic shelter to its users.

Building in a way that respects the extreme conditions of the land, the steep slope, the hurricanes, the hot climate all year round and the specificity of building on an island, was a major challenge in this project. The main structure made of bamboo, grown on site, and the rammed earth walls, using the excavated clay of the site, allow a maximum resistance to the climatic conditions as well as offering a sustainable place where children learn from their environment. This center is also built with a repetitive assembly process allowing for a more

sustainable learning and maintenance of the project. In addition, particular importance has been given to the continuity created between the exterior and interior, the limits no longer exist. The interior spaces are open to the exterior for cross ventilation and can be adaptable in case of extreme events. The project is designed to fit into the site according to its environment, the curved shape of the plan and the aerial shape of the recycled textile roof optimize the natural elements to make it a passive building. The continuity of the exterior and interior also meets the social criteria of the project, where children and women are welcomed in a place where they feel safe.

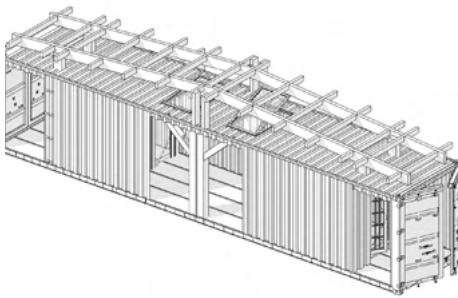


JANEK BOSMAN
Sint Maarten Housing

To battle the massive loss of biodiversity and mangrove forests, as well as coastal erosion on St. Maarten, my project aims to protect the Little Bay Lagoon as much as possible, by providing ample space for new mangrove plantations on an urban scale. To make space for nature to thrive, the 41 homes are clustered into “villages”.

The houses are to be built on an eternal grid of concrete columns, like acupuncture in the landscape, keeping the existing soil structure largely untouched. The lightweight modules placed on the columns are of two typologies: a) prefabricated timber modules, produced in the Netherlands; and b) slightly edited shipping-container modules that ship the timber modules to St. Maarten. By doing so, construction waste is kept to a minimum, and all the materials needed for building and shipping are used in the final houses.

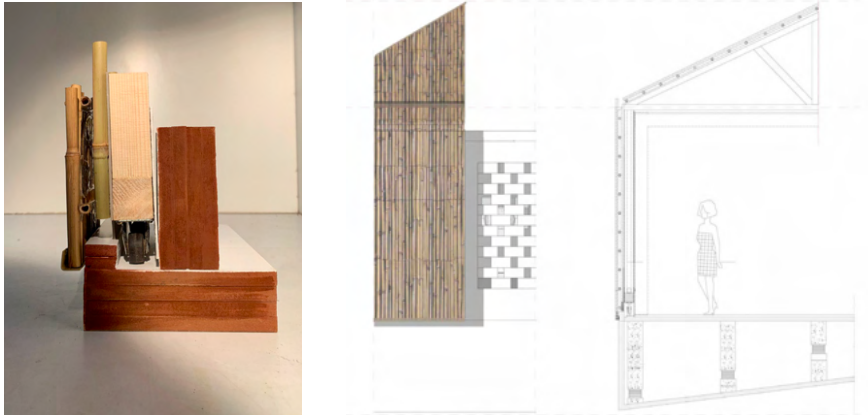
Every ISO-container has the capacity for 4 timber modules. Every module is its own climate-machine: optimally using passive cooling and ventilation. Every module is independent from the next. Placed together, the modules form a home + they can extended and downsized to the owner’s wishes. By embedding pendulum bearings in the foundation columns, and steel cross-cables in the façade structure, the houses are made disaster-proof. Therefore being: incremental + elemental.



LEYLA VAN DER WAARDE
Sint Maarten Housing

The first main focus during the design proces that came to my mind was the focus on the people there. My main question: How could we make the people feel safe and at home? During my research and the trip I figured out that people like to be in control of their own houses. This is how my design came into place. The wooden structure around the Ferrock inner “box” is the protecting shell when a hurricane strives.

The wooden bamboo structer can be slid closed by a simple mechanical motor. The closed house has the same shape and size as the old wooden vernacular architecture houses that have survived for many centuries. This gives people a sense of being in control and being able to prevent their own houses and that of their neighbours to get destroyed during a Hurricane.



The whole group of Extreme Architecture students. One evening was organised to celebrate the project results so far and to get to know the fellow students better.



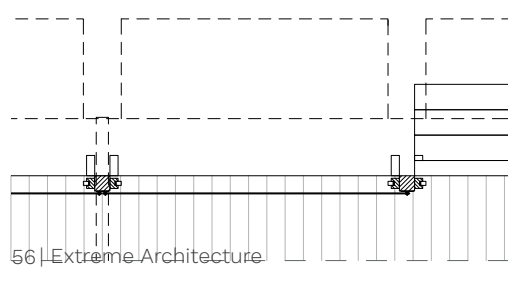
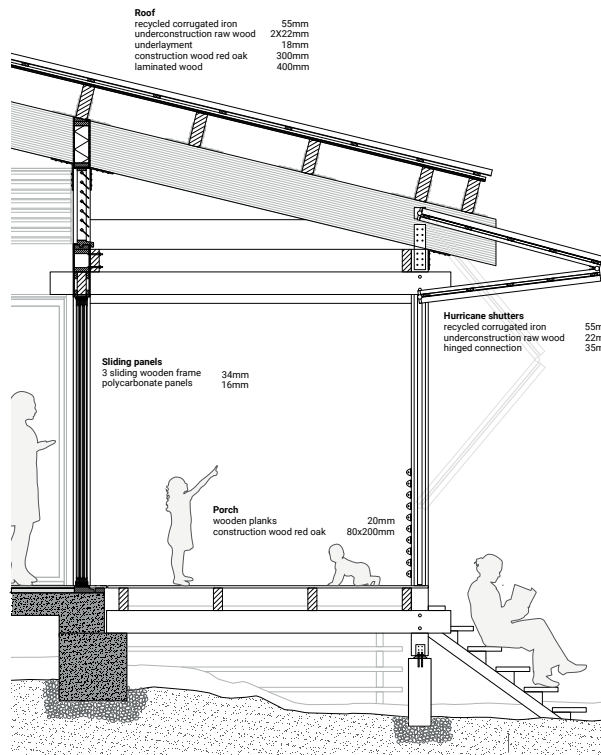


“ Building for the people, by the people. ” - Leyla van der Waarde

Students researching the plot of the daycare center on Saba.

DESIGNS BEFORE HURRICANE

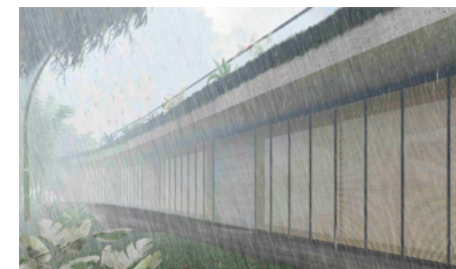
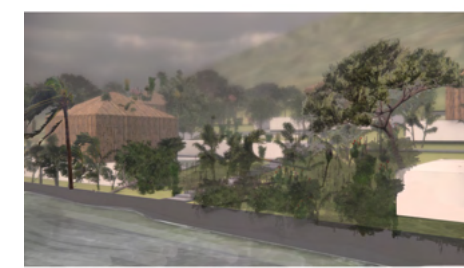
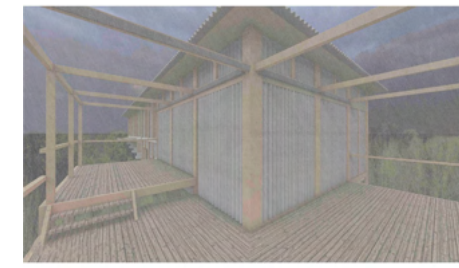




“The locals shouldn’t just be happy to be alive. They have the right to really live.”

- Ana Mendica

Technical fragment of a student’s project to illustrate the use of the hurricane shutters during a hurricane

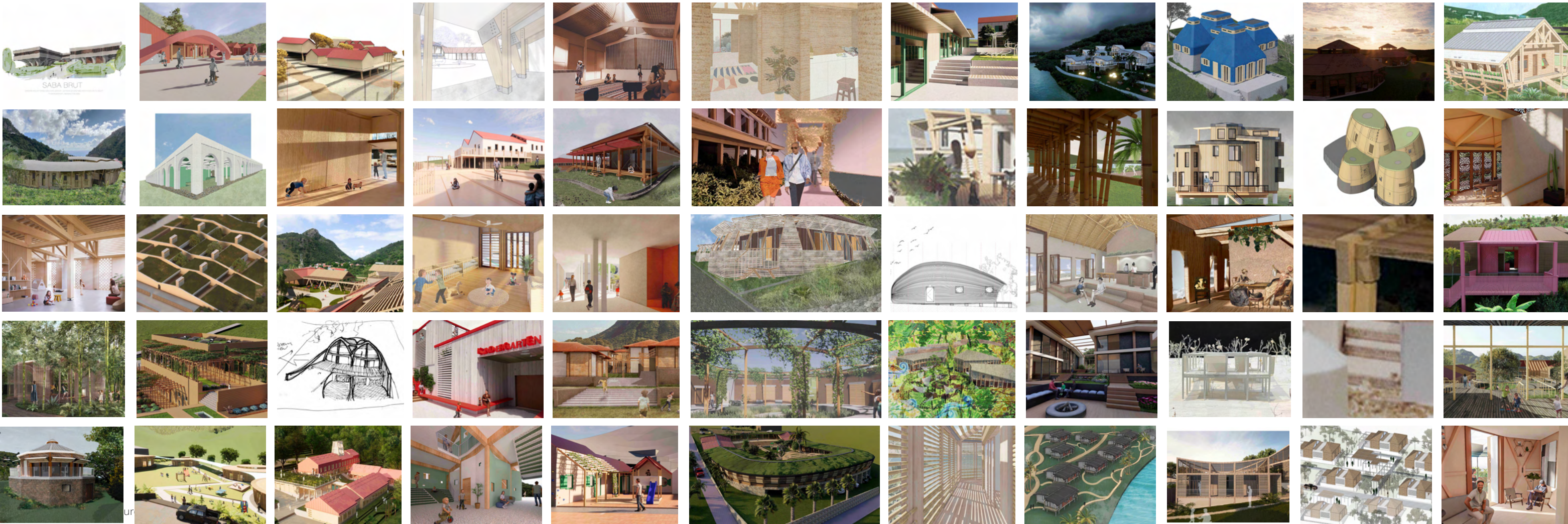


DESIGNS DURING HURRICANE

EPILOGUE

First of all, the Xtreme Architecture project was a success, and the designs for small-scale affordable housing on Sint Maarten and the design for a day-care center on Saba were presented to the local government, developer and other stakeholders. The designs were not only hurricane and earthquake resilient but tried to be also boundary pushing in terms of circularity and sustainability. Local parties, including contractors and government agencies, were engaged to ensure that the designs were tailored to their needs and program. The project was also an opportunity to educate on the importance of circularity and the implementation of sustainable building solutions. In addition, we are happy to announce that a smaller group of enthusiastic students will continue to work on the final design of the daycare center on Saba, which will be built in the upcoming years.

In the end, the Extreme Architecture project has demonstrated the importance of collaboration in the implementation of sustainable and resilient building solutions. Every student walked away with new knowledge, skills and connections that will aid them in future projects and the research trip is sure to be remembered fondly by all. We would like to thank Micheal Bacon, as project developer, for the opportunity to work together on real projects in the Dutch Caribbean. Besides, we would like to thank all the guest lecturers and professors that took part in the project and shared their knowledge. For the future, Xtreme Architecture hopes to inspire more people to rethink the way we currently build and that building resilience becomes more important in areas with extreme environments.





ON BEHALF OF XTREME ARCHITECTURE THANKS TO:

XTREME
Saba & Sint Maarten
