# HAVANA CITY SEAWALL

## THE MALECÓN IN HAVANA, CUBA

## FEBRUARY – APRIL 2003

Universidad de la Habana

TU Delft
Technische Universiteit Delft

# PREFACE

This report is the work plan for a project within the scope of CT4061 (fourth year project education) at the Delft University of Technology, faculty Civil Engineering in the Netherlands. We are a group of five students and we will investigate a coastal protection problem in Havana, Cuba. Our specialty is hydraulic engineering and we are in the master phase of our study. The coastal protection project will be performed in cooperation with the Havana University and the Hydraulic Investigation Centre in Havana, Cuba. We will visit Cuba from January the 31st until April the 13th 2003.

We want to thank Ir. Verhagen, Prof. Dr. Luis Córdova López, Dr.ir. J. van de Graaff, Prof.dr.ir. M.J.F. Stive and Mrs. Y.E. de Haan-Simons for all there help and advise so far.

Project group CF06
Delft, January 2003

# SUMMARY

Havana City is situated on the north coast of the Republic of Cuba, the largest island in the Caribbean Sea. Because of Spanish and African influences Havana is one of the most picturesque cities of the western hemisphere. In the 18th and 19th century a part of the city that lies adjacent to the sea, the Malecón, has developed until today into a beautiful boulevard with a great historic and cultural value and acts at the same time as coastal protection. After a lack of maintenance for more than 40 years, the Malecón area is getting a revitalization project.

From here on we will only look at the seawall part of the Malecón, that is taking care of the coastal protection. The main problem is that the Malecón is frequently overtopped by waves and occasionally flooded due to bad weather in the Gulf of Mexico. To solve this problem we will develop a solution in cooperation with the Havana University and the Hydraulic Investigation Centre, that prevents future inundation and wave overtopping, while maintaining the environmental, historic and cultural value of the Malecón area. The solution can be onshore al well as offshore and has to fit in the local situation and Cuban possibilities as much as possible.

To develop a solution for the flooding problem we have to go through a whole design process. First we will gather information in the Netherlands especially from international resources about the marine climate, wave statistics and oceanography, because that kind of information is not available in Cuba. The information collection will proceed in Havana at the University and the Hydraulic Investigation Centre. The most important information we have to look for is about morphology, marine climate, information about the Malecón, wave information, construction methods and available materials.

After collecting all data and information the Program of Demands can be formulated. First we will review the investigated solutions already made by the Hydraulic Investigation Centre. The review will be done on three levels: the design process, assumptions and calculations. After the review, new solutions will be developed or existing ones will be improved. With the Program of Demands the best alternative can be picked. This definite design will be worked out in detail: dimensions and materials, a cost estimation and a timetable of the different construction phases. This whole design process will be documented in a report.

The participating parties who helped and will help us with our project are the Havana University (Instituto Superior Politéchnico José A. Echevarría), the Hydraulic Investigation Centre (Centro de Investigaciones Hidráulicas) and the Delft University of Technology.

# TABEL OF CONTENTS

# CHAPTER 1 INTRODUCTION

**General information about Cuba and Havana**
With a total area of 110.860 km$^2$ (2,7 times The Netherlands) is the Republic of Cuba the largest island in the Caribbean Sea. This Spanish speaking communist state has a population of more than 11 million and is the least commercialised island and one of the last bastions of communism in the world.
The main industrial and agricultural products are sugar, tobacco and coffee. There are plenty natural resources such as metals, salt, timber, silica, petroleum and arable land. The capital of Cuba is the ancient seafront city Havana.

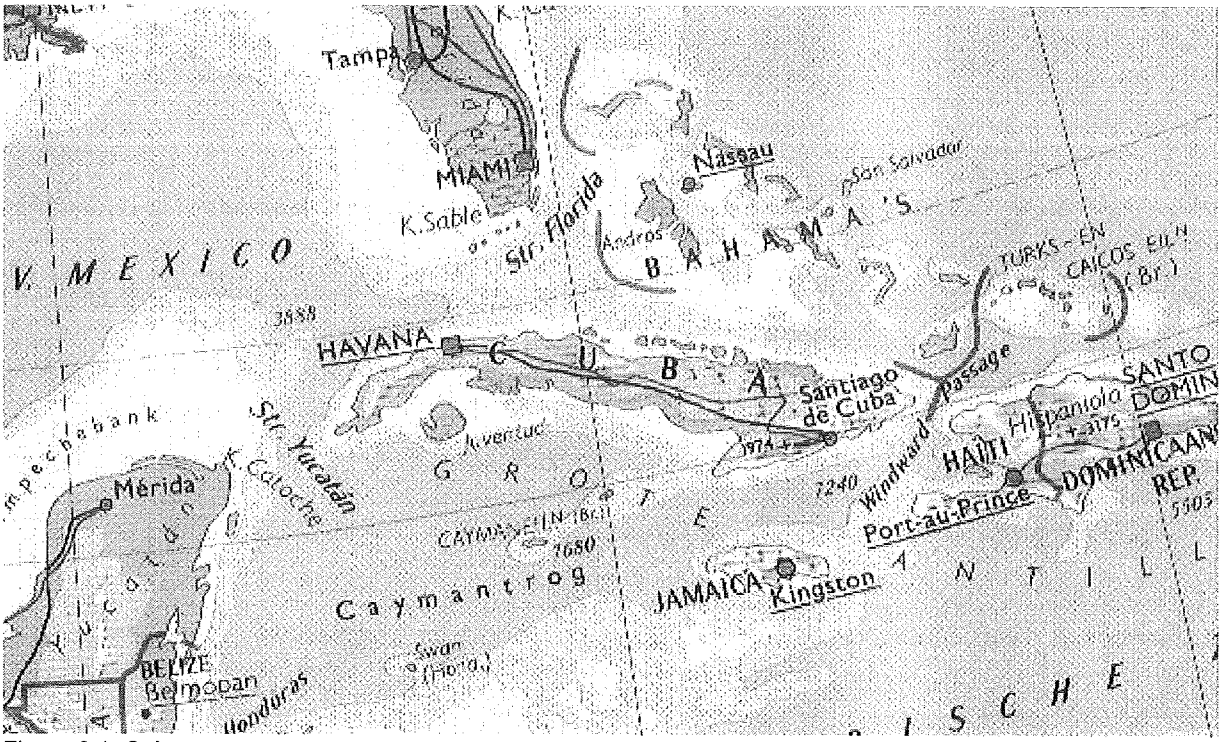


Figure 2.1: Cuba

As the capital city and chief seaport of Cuba and the largest city in the Caribbean Islands, Havana is one of the oldest and most picturesque cities of the western hemisphere. Its buildings are largely of white coral limestone. The original part of the city, located near the inner entrance of the harbour, has narrow, crooked streets, old houses with overhanging balconies, and various historic landmarks. Beyond the older section, Havana is essentially modern, with numerous magnificent residences, imposing public buildings and beautiful parks and plazas, and broad, tree-lined boulevards. To protect the city of entering waves from the sea, the Cubans built a seawall at the northwest shoreline of the city, which is part of the Malecón.

**History and future plan of the Malecón**
In the 18th Century, the land that is now occupied by the Malecón served as a buffer zone between Havana and the sea, and eventually evolved into a pleasant walkway. In the first part of the 19th Century, structures were being built along San Lazaro, a street directly perpendicular to the Malecón area. The buildings along this street were originally constructed with their backs facing the waterfront, as the punishing waves of the sea often washed over the shore and battered buildings. Later these buildings got entrances and facades along the Malecón. In the early 1950s, the road became congested with automobiles and buildings suffer from a lack of maintenance and care, especially since the Cuban revolution in 1959.

Figure 2.3: The Malecón in Havana, Cuba

The revitalization plan for the Malecón, entitles the Special Plan, aims to improve the buildings, the infrastructure and the social environment of its inhabitants. The living conditions of the existing population have to be improved, but also tourists have to be attracted. Therefore services will be created for the inhabitants as well as visitors. The plan encompasses 14 blocks and is one of the many plans that are currently underway in Old Havana. The main concern of the plan is the poor condition of the historic buildings, infrastructure, the waterlines, power lines and the seawall. The buildings are either restored, when of great historic and cultural value, or demolished when in poor condition and of little historic value. The infrastructure, power- and waterlines will be improved and repaired. Lastly there is still the problem of sea penetration. During bad weather in the Gulf of Mexico, large waves overtop the seawall and break onto the street reaching the basements of the buildings. The protection of the Malecón area has to be improved, to prevent the waves from breaking over the seawall.

Figure 2.4: Overtopping waves on the Malecón

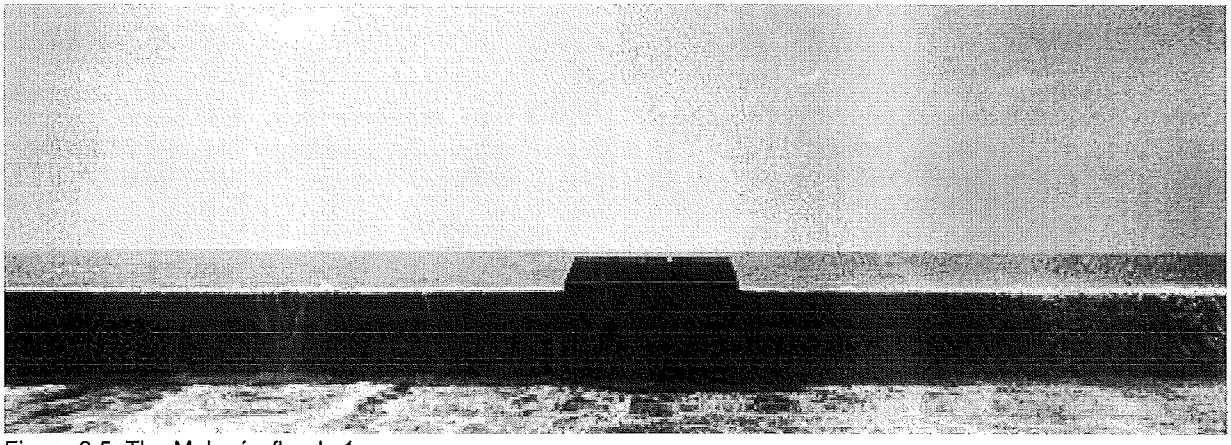


Figure 2.5: The Malecón floods 1

Figure 2.6: The Malecón floods 2

# CHAPTER 2 PROBLEM DESCRIPTION

## 2.1 Problem Analyses

After several years of a lack of maintenance and care, the Malecón in Havana City fell into disrepair. The total Malecón area has to be improved including buildings, infrastructure, water- and power lines and the coastal protection. We will only consider the last one, the coastal protection.

The Havana City Seawall that is taking care of a part of the coastal protection in Havana is no longer satisfactory. Very often waves overtop the current wall of protection due to bad weather in the Gulf of Mexico and occasionally the Malecón will flood.
The Havana University started a survey in cooperation with the Hydraulic Investigation Centre to investigate the cause of the floods and made a start with designing a solution for the floods. Due to a lack of international information, such as marine climate information from the north and western area of the islands, global wave statistics and oceanography, the survey cannot be finished and optimised.

## 2.2 Problem Definition

The Malecón, a part of the Havana coastal protection, is frequently overtopped by waves and occasionally flooded due to bad weather in the Gulf of Mexico.

## 2.3 Objective

Develop a solution, offshore or onshore, that prevents future inundation and wave overtopping of the Malecón in Havana, while maintaining the environmental, historic and cultural value of the Malecón area.

## 2.4 Starting Points and Preconditions

- The construction has to preserve the cultural and historic value of the Malecón
- The construction has to preserve the environmental situation near the Malecón. The environmental aspect has to be taken into account.
- The construction has to fit in the rest of the revitalisation plan of the Malecón as much as possible, possible problems have to be examined.
- The existing solutions of the Hydraulic Investigation Centre have to be tested with the new information.
- The solution can be onshore or offshore
- The construction has to fit in the Cuban legislation. If there is a lack of information, the construction has to fit in the Dutch legislation.
- The life of the construction has to last at least 50 years, with the current climate.
- The collection of new information has to get a lot of attention.
- The construction has to cost as little as possible
- The local situation and possibilities for the supply of raw material, production and employment has to be taken into account.

# CHAPTER 3 PROJECT PLAN

The designing process begins with information. From this information certain boundary conditions and the domain of solutions can be derived. Within this domain there are models and calculations, which can be used to develop alternative solutions. Checking these solutions with the program of demands will derive the most suitable one.

## *3.1 Time Schedule*

| Activity \ Week | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Find and collect information | | | | | | | | | | | | | |
| 2. Work plan | | | | | | | | | | | | | |
| 3. Departure to Cuba | | | | | | | | | | | | | |
| 4. Find and collect information | | | | | | | | | | | | | |
| 5. Review investigated solutions | | | | | | | | | | | | | |
| 6. Develop new solutions | | | | | | | | | | | | | |
| 7. Determination definite design | | | | | | | | | | | | | |
| 8. Work out definite design | | | | | | | | | | | | | |
| 9. Evaluation | | | | | | | | | | | | | |
| 10. Writing report | | | | | | | | | | | | | |
| 11. Free time | | | | | | | | | | | | | |
| 12. Back to the Netherlands | | | | | | | | | | | | | |
| 13. Finishing report | | | | | | | | | | | | | |

Table 3.1: Time schedule

**Explanation**

1. Find and gather information

The Hydraulic Investigation Centre and Havana University has a lack on international information about oceanography, wave statistics and the marine climate. We have to try to find this information and bring that to Cuba. What information we exactly need is described in the following paragraph.

2. Work plan

In the work plan the problem description and the approach of the problem is written. From here the process of the project can be described. This gives a better view about the problem and the possibility to work efficient in Cuba.

3. Departure to Cuba

At Friday January the 31st we will leave to Cuba.

4. Find and collect information

All the background of the project and the investigations that are already done by the Hydraulic Investigation Centre has to be examined, because that information is not available here in the Netherlands. In practice the gathering of information will proceed during the whole project, but the most intensive time will be in the first two weeks. Necessary fieldwork investigations also have to be done during these weeks. The exact information that is needed is described in the following paragraph

5. Review investigated solutions

The solutions, which are investigated by the Havana University and the Hydraulic Investigation Centre, will be reviewed with the new gathered information.

6. Develop new solutions
With the new information from the Netherlands and the existing information from Cuba, new alternatives can be developed and the already investigated solutions improved.

7. Determination definite design
All alternatives can be compared with each other with the program of demands and the best solution can be picked.

8. Work out definite design
The final design has to be worked out: the dimensions, material, construction, etc.

9. Evaluation
This contains the recommendations and conclusions about the project itself, but also the cooperation in the group and with the Investigation Centre and the Havana University, our skills and recommendations for the Delft University about the project education in general.

10. Writing report
During the project, the report has to be written. The writing has to catch up with the process. To make sure, this will happen, every week we have to send a chapter to our supervisor in Delft.

12. Back to the Netherlands
At Sunday April the 13th we will fly back to the Netherlands.

13. Finishing report
The first week after we are back in the Netherlands, we will finish our report and hand in the report.

### *3.2 Gathering Information*

To collect the information about the project is probably one of the most important phases of the project process. With the right information, the Program of Demands can be written without a lot of assumptions. The information collection is divided in two parts:
- Gathering information in Cuba
- Gathering information in the Netherlands

**Gathering information in Cuba**
The flow of the basic information is at this moment insignificant, because the information transfer is very difficult from Cuba to the Netherlands. That information we will have to gather in Havana during the first weeks of the project. In order to work as efficiently as possible knowledge of the necessary kind of information is essential.

In Cuba we have to find the following information:
- Bathymetry
  With the structure of the seabed, predictions can be made about the wave behaviour, currents and the morphological process.

- Morphology
  Knowledge about the current morphologic process is necessary to predict the new sedimentation transporting mechanism after interrupting the process by a construction (partly) offshore. The areas where erosion and sedimentation can occur can be predicted.

To describe the morphological system, the variables that are needed are: original coastal topography, water level, wind, waves and tide.

- Marine Climate
  The climate determines the way in which the naturally available water behaves. It influences the kind and the amount of vegetation (by the salinity and temperature), the direction and velocity of wind, the currents (temperature differences), wave height and use of a material for the construction (salinity).

- Information about the Malecón.
  This can be divided as follows:
  - Dimensions and shape of the Malecón
  - Used material and construction method of the current Malecón
  - The plan of the Malecón area with the historic and cultural values of the different buildings and objects
  - Flexibility of parts of the Malecón, for example buildings, objects, the seawall itself.
  - Foundation information
  - Maintenance condition

- Common construction methods and available materials currently used in Cuba.
  The information about these methods and materials will help us to develop a realistic design.

- Limited expenses or financial possibilities.

- General wave information
  The statistic and probabilistic data about wave heights, wavelengths, directions, etc.

- Oceanography
  Variations in density and geostrophic currents play a dominant role in the processes in the upper zone of the ocean. The primary forces that produce a disturbance of the sea surface are wind (wind waves and seiches), tsunamis and tides.

- Environmental balance
  Information about the environmental balance and its vulnerability is needed to preserve the environmental value of the Malecón area after the construction is finished.

**Gathering information in the Netherlands**
The Cuban system prevents the Hydraulic Investigation Centre to collect all the international information they needed. We can help them to gather this information.

We have to find the following data:
- Marine climate from international resources, especially from the north and western area of Cuba
- Wave statistics
- Ocean atlas

### *3.3 Review Developed Solutions by the Hydraulic Investigation Centre*

The review of the given solutions will be done on three levels. On the whole we will look at the designing process, which led to these solutions. More specifically we will look at the assumptions and calculations used in the process to appoint the best solution.

The designing process begins with information. From this information certain boundary conditions and the domain of solutions can be derived. Within this domain there are models

and calculations, which can be used to develop alternative solutions. Checking these solutions with the program of demands will derive the most suitable one.

**Design process**
The process taken by the Hydraulic Investigation Centre to develop the solutions will be carefully checked on the basis of the newest ideas and thoughts about designing. We will check whether the approach to resolve the problem is the correct approach for this specific problem and the steps of the process and the choices made to select the best solution will be examined.

**Assumptions**
The solutions developed by the Hydraulic Investigation Centre were based on the information available at that time. With the new information, which we try to gather, boundary conditions can be entirely different and former assumptions can proof to be wrong. With the new information, new boundary conditions can be developed and calculations can be performed to check the solutions.

**Calculations**
Calculations and models often have a limited area of application. New information can change boundary conditions and therefore the applicability of certain models. It is also possible that new numeric models exist that give a better representation of the situation in Cuba. Lastly the knowledge and application of probabilistic design can differ between countries and we have to examine the applicability in this particular case.

With the new information new boundary conditions can be developed which can make the developed solutions no longer valid. If a solution is no longer valid it will be rejected and a new one will have to be developed.

### *3.4 Develop Solutions*

We will go trough the designing process again, using the new information, to see if we can come to new solutions, which under the given circumstances may be better than the ones that have been previously developed. For the development of these new solutions we will use all the information and methods available to us. It is also possible to find new solutions within the existing solutions. This means adjusting former solutions at points where they did not met the boundary conditions. If they are properly adjusted a new solution arises. Access to new information and better methods can lead to better solutions and thus a better protection of the Havana coastline.

### *3.5 Definite Design*

When all the previously developed solutions have been reviewed and perhaps new ones have been derived the solution, which best answers the program of demands has to be extracted. When this solution is found it will be worked out and the following points will be worked out in detail:

- Description of the kind of operation
- Shape and exact location
- Dimensions and materials
- An estimation of the amount and the length of labour
- Cost estimation
- Time-table which gives the distribution of the different construction phases in time

# CHAPTER 4 TABLE OF CONTENTS FINAL REPORT

PREFACE

SUMMARY

TABLE OF CONTENTS

INTRODUCTION

1. PROBLEM DESCRIPTION
    - 1.1 Problem analyses
    - 1.2 Problem definition
    - 1.3 Objective
    - 1.4 Starting points and preconditions

2. PROGRAM OF DEMANDS
    - 2.1 Technical demands
    - 2.2 Financial demands
    - 2.3 Environmental, cultural and historic demands
    - 2.4 Management demands

3. RESEARCH
    - 3.1 Bathymetry
    - 3.2 Morphology
    - 3.3 Marine climate
    - 3.4 Information about the Malecón
    - 3.5 Methods and materials
    - 3.6 Financial possibilities
    - 3.7 General wave information
    - 3.8 Oceanography

4. DESIGN
    - 4.1 Review developed solutions Hydraulic Investigation Centre
    - 4.2 Develop new solutions
    - 4.3 Determine definite solution

5. DEFINITE DESIGN
    - 5.1 General description
    - 5.2 Dimensions and materials
    - 5.3 Cost estimation
    - 5.4 Time table

6. CONCLUSIONS AND RECOMMENDATIONS

7. LIST OF LITERATURE

APPENDICES
- Time schedule
- Participating parties
- List of sponsors

# CHAPTER 5 PARTICIPATING PARTIES

The following participating parties helped and will help us with our project.

**Instituto Superior Politéchnico José A. Echevarría (ISPJAE)**

- Prof. Dr. Luis Córdova López Dean of the Faculty of Civil Engineering
- Miss Haydée Alvarez Goris

Professor Luis is our supervisor at the Havana University in Cuba. We came into contact with him trough Professor Verhagen at the Delft University. He has been studying the Malecón and its inundation problems for years. Together with the (CIH) he has developed solutions to handle the problems.
Mrs Haydée Alvarez Goris takes care of the international relationships at the university and she has arranged our visa and helps us finding decent and affordable housing during our stay in Cuba.

**Centro de Investigaciones Hidráulicas (CIH)**

This is the Cuban institute for hydraulic investigations. This institution has been investigating the Malecón and developed the solutions, which we are going to investigate. This is probably also a source from which we can derive al lot of information.

**Dutch embassy in Havana**

The Dutch embassy helps us by answering our questions about every day life in Cuba.

**Delft University of Technology**

- Dr.ir. J. van de Graaff: staff member at the section of coastal engineering
- Prof Dr.ir. M.J. Stive: professor of the section of coastal engineering
- Mrs. Y.E. de Haan

Dr.ir. van de Graaff and Prof Dr.ir. Stive are our supervisors and attendants from the section of coastal engineering at the Delft University of Technology.
Mrs de Haan is the attendant from the section of practical work.

# CHAPTER 6 LIST OF LITERATURE

This is a list of books and models that we intend to use for our work in Cuba. Some of these were used to write this work plan.

## Books

Bed bank and shore protection, *G.J.Schiereck*

Dredging for development, *Charles W. Hummer*

Manual on the use of rock in hydraulic engineering, *CUR manual*

Wave mechanics for scientists and engineers, *Dean and Dalrymple*

### Lecture notes

Probabilistic design, *prof. Vrouwenvelder*

Introduction to coastal engineering, *Prof.Ir.K.d'Angremond*

Coastal Engineering Volume II, *Ir. E.T.J.M. van der Velden*

## Online databanks

Coastal engineering manual, *successor of the shore protection manual (US Army)*

Cress, *coastal processes databank*

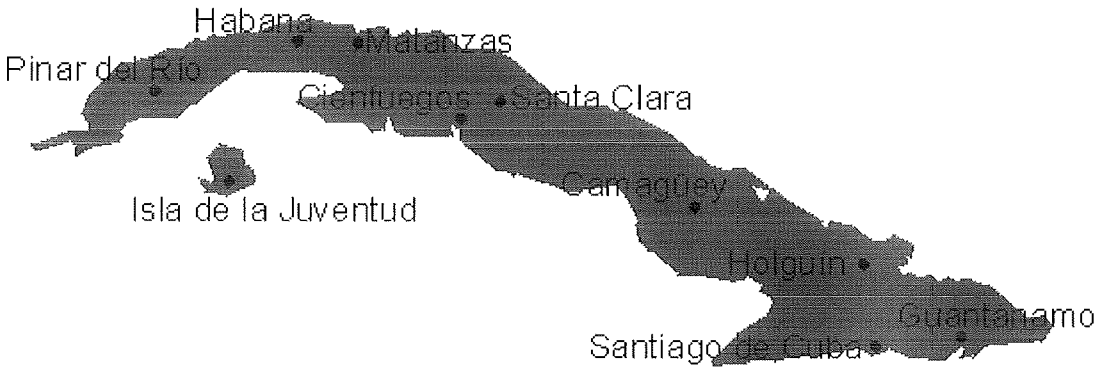
Kennisbank waterbouw, *hydraulic data bank*

Virtueel kenniscentrum civiele techniek, *civil engineering database*

# APPENDICES

# GENERAL INFORMATION CUBA

**Geography**
The Republic of Cuba is an archipelago formed by the island of Cuba, with an extension of 106,007 km2, the Isle of Youth, with 2 200 km2 of surface, and around 4 200 keys and small islands. It's total surface covers 110 922 km2, lying at the entrance of the Gulf of Mexico, in the Caribbean Sea. It limits to the north with the peninsula of Florida (United States of America), at a distance of 180 km; to the south with Jamaica, at 140 km; to the east with Haiti, at 77 km, and to the west with the Yucatan peninsula (Mexico), which lies 210 km away.




Flat lands which cover 70% of its territory make Cuba an essentially plain territory, with three big mountain chains: Sierra de los Organos, in the western region; Sierra del Escambray, in the center of the island, and Sierra Maestra in the eastern part, the latter including the main height in the country, Pico Real del Turquino, with 1 974 meters (5 933 feet) above sea level.

**Climate**
Cuba's climate is considered subtropical moderate, with predominance of tropical maritime conditions. The average annual temperature is 25,2 degrees Celsius (77 degrees F) in summer and 22 degrees C (71,6 degrees F) in winter, with two very well defined seasons: the dry season, from November through April, and the rainy season, from May through October.

Average rain fall totals 1 059 mm during the rainy season and 316 mm in the dry season, for an annual average of 1 375 mm.
The Cuban coasts have a length of 5 746 km, the north coast being the largest with 3 209 km. The coastal zones have numerous excellent beaches as well as bays, ports and cities.

**Political situation**
Since Fidel Castro led a rebel army to victory in 1959 Cuba has been a communist state. His iron will have held the country together since. Cuba's communist revolution, with Soviet support, was exported throughout Latin America and Africa during the 1960s, 70s, and 80s. The country is now slowly recovering from a severe economic recession following the withdrawal of former Soviet subsidies, worth $4 billion to $6 billion annually, in 1990. Havana blames its difficulties on the US embargo in place since 1962.

**Brief history of Cuba**
Arawak (or Taino) Indians inhabiting Cuba when Columbus landed on the island in 1492 died from diseases brought by sailors and settlers. By 1511, Spaniards under Diego Velásquez had established settlements. Havana's superb harbour made it a common transit point to and from Spain.

In the early 1800s, Cuba's sugarcane industry boomed, requiring massive numbers of black slaves. A simmering independence movement turned into open warfare from 1867 to 1878. Slavery was abolished in 1886. In 1895, the poet José Marti led the struggle that finally ended Spanish rule, thanks largely to U.S. intervention in 1898 after the sinking of the battleship *Maine* in Havana harbour.
An 1899 treaty made Cuba an independent republic under U.S. protection. The U.S. occupation, which ended in 1902, suppressed yellow fever and brought large American investments. The 1901 Platt Amendment allowed the U.S. to intervene in Cuba's affairs, which it did four times from 1906 to 1920. Cuba terminated the amendment in 1934.
In 1933 a group of army officers, including army sergeant Fulgencio Batista, overthrew President Gerado Machado. Batista became president in 1940, running a corrupt police state.

In 1956, Fidel Castro Ruz launched a revolution from his camp in the Sierra Maestra Mountains. Castro's brother Raul, and Ernesto (Ché) Guevara, an Argentine physician, were his top lieutenants. Many anti-Batista landowners supported the rebels. The U.S. ended military aid to Cuba in 1958, and on New Year's Day 1959, Batista fled into exile and Castro took over the government.

The U.S. initially welcomed what looked like a democratic Cuba, but a rude awakening came within a few months when Castro established military tribunals for political opponents and jailed hundreds. Castro disavowed Cuba's 1952 military pact with the U.S., confiscated U.S. assets, and established Soviet-style collective farms. The U.S. broke relations with Cuba on Jan. 3, 1961, and Castro formalized his alliance with the Soviet Union. Thousands of Cubans fled the country.

In 1961 a U.S.-backed group of Cuban exiles invaded Cuba. Planned during the Eisenhower administration, the invasion was given the go-ahead by President John Kennedy, although he refused to give U.S. air support. The landing at the Bay of Pigs on April 17, 1961, was a fiasco. The invaders did not receive popular Cuban support and were easily repulsed by the Cuban military.
A Soviet attempt to install medium-range missiles in Cuba—capable of striking targets in the United States with nuclear warheads—provoked a crisis in 1962. Denouncing the Soviets for "deliberate deception," on Oct. 22 Kennedy said that the U.S. would blockade Cuba so the missiles could not be delivered. Six days later Soviet premier Nikita Khrushchev ordered the missile sites dismantled and returned to the USSR, in return for a U.S. pledge not to attack Cuba.

Cuba fomented Communist revolution around the world, especially in Angola, where thousands of Cuban troops were sent in the 1980s. The U.S. established limited diplomatic ties with Cuba on Sept. 1, 1977, making it easier for Cuban-Americans to visit the island. Contact with the more affluent Cuban Americans prompted a wave of discontent in Cuba, producing a flood of asylum seekers. In response, Castro opened the port of Mariel to a "freedom flotilla" of boats from the U.S., allowing 125,000 to flee to Miami. After the refugees arrived, it was discovered their ranks were swelled with prisoners, mental patients, homosexuals, and others unwanted by the Cuban government.

Russian aid, which had long supported Cuba's failing economy, ended when communism collapsed in Eastern Europe in 1990. Cuba's foreign trade also plummeted, producing a severe economic crisis. In 1993, Castro permitted limited private enterprise, allowed Cubans to possess convertible currencies, and encouraged foreign investment in its tourist industry. In March 1996, the U.S. tightened its embargo with the Helms-Burton Act.
Christmas became an official holiday in 1997, for the first time since the revolution, in response to Pope John Paul II's 1998 visit to Cuba, which raised hopes for greater religious freedom.

In June 2000, Castro won a publicity bonanza when the Clinton administration sent Elian Gonzalez, a young boy found clinging to an inner tube, back to Cuba. The U.S. Cuban community had demanded that the boy remain in Miami rather than be returned to his father in Cuba. By many accounts, the influential Cuban-Americans lost public sympathy by pitting political ideology against familial bonds.

In June 2002, Castro claimed to have secured signatures from 99% of the electorate calling for a constitutional amendment that would declare the country's socialist system "untouchable."

# PICTURES

Figure A1: The Malecón close by from landside

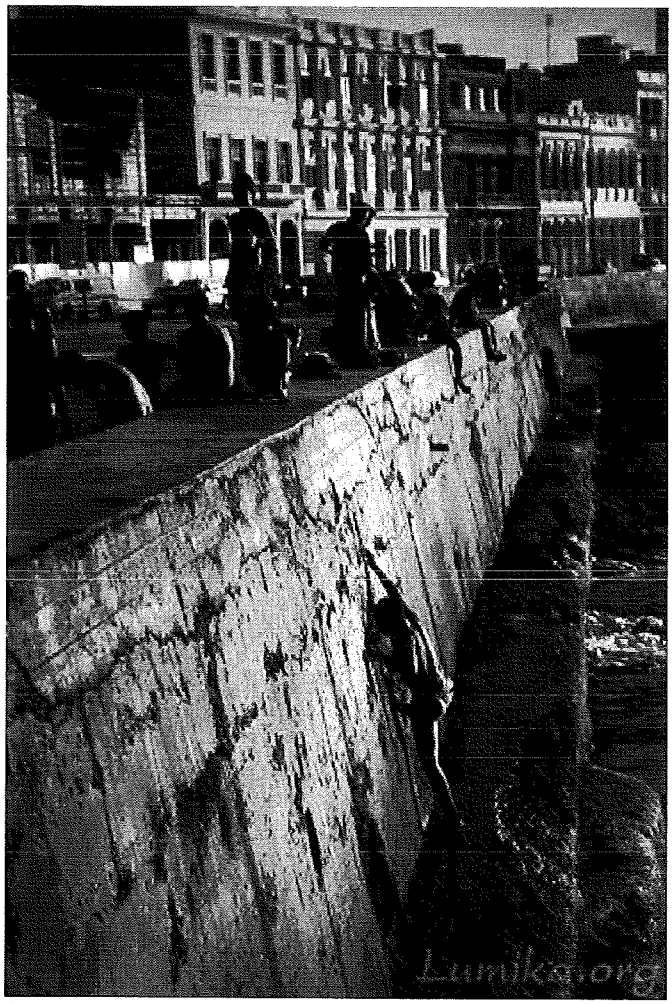


Figure A1: The Malecón close by from seaside

Figure A3: The buildings on the Malecón

Figure A4: View on the Malecón from sea

# GROUP MEMBERS

**Eelco Veentra**
Raamstraat 47
2613 RW Delft
☎ +31 (0) 15 - 2157986
✆ +31 (0) 6 - 24502605
✉ veenstra_eelco@hotmail.com
Study number: 9857147
Main subject: Coastal Engineering

**Koen Versmissen**
Julianalaan 33
2628 BB Delft
☎ +31 (0) 15 - 2135432
✆ +31 (0) 6 - 41310243
✉ versmissen@hotmail.com
Study number: 9883710
Main subject: Coastal Engineering

**Martijn Meijer**
Kloosterkade 167
2628 JA Delft
☎ +31 (0) 15 - 2615545
✆ +31 (0) 6 - 18884934
✉ martijn_meijer@hotmail.com
Study number: 9568292
Main subject: Coastal Engineering

**Michiel Muilwijk**
Oude Delft 89
2611 BD Delft
☎ +31 (0) 15 - 2123654
✆ +31 (0) 6 - 24856487
✉ muilwijk@hotmail.com
Study number: 9586017
Main subject: Coastal Engineering

**Ester Groenendaal**
Paardenmarkt 46
2611 PC Delft
☎ +31 (0) 15 - 2143636
✆ +31 (0) 6 - 47486836
✉ estergroenendaal@hotmail.com
Study number: 9280245
Main subject: Coastal Engineering