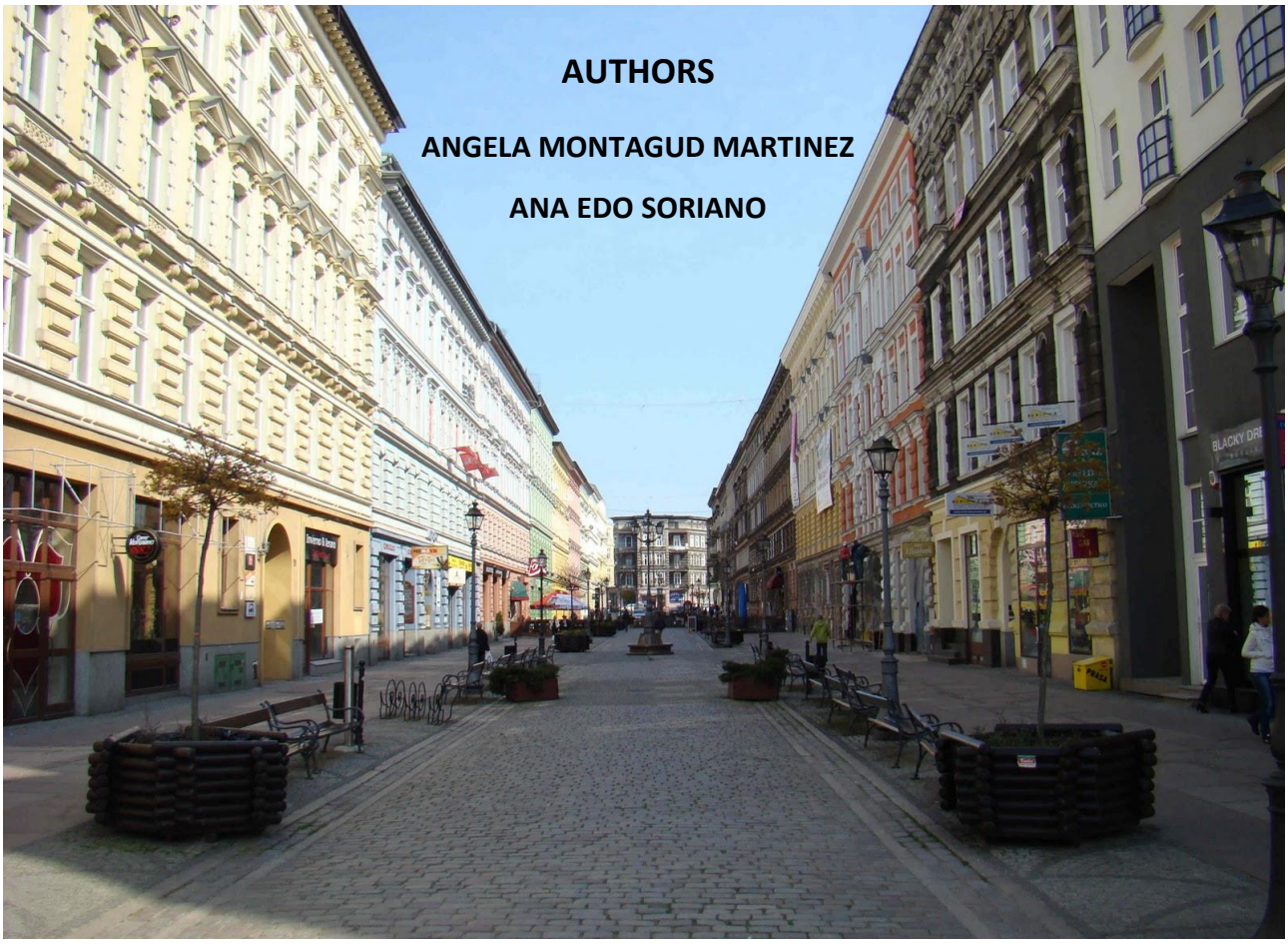
Zachodniopomorski Uniwersytet Technologiczny w Szczecinie

ESCUELA TÉCNICA SUPERIOR INGENIERÍA DE EDIFICACIÓN

UNIVERSITAT POLITÈCNICA DE VALÈNCIA

SZCZECIN PEDESTRIAN ZONES SURVEY

PATHOLOGIES AND CAUSES RESEARCH INTERVENTION PROJECT



AUTHORS

ANGELA MONTAGUD MARTINEZ

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"Quizá nadie se haya detenido a pensar en el filantrópico servicio que prestan las aceras. Esas criaturas grises y duras que viven eternamente tendidas tienen una gigantesca capacidad para el sacrificio. Tanto es así que nunca hemos escuchado de sus quejas a pesar de que vivimos, tal vez con demasiada frecuencia, pisoteándolas y derramando cuanta porquería existe sobre su plana existencia.

Sin explicación aparente nos protegen desde niños. Trazan los límites entre el peatón común y el conductor neurótico de los nenes de Ford. Estos últimos son los más inconmovibles y despiadados, pues en su amargura de embotellamiento, y en el colmo de la desconsideración, pasan o aparcan sus pesados nenes sobre las grises e indefensas criaturas. Tampoco hemos entendido su tristeza, su soledad. Ellas viven en completo aislamiento, abrazadas a una manzana que nada tiene que ver con su naturaleza, porque la indiferencia del asfalto niega toda posible comunicación con las compañeras de enfrente, de los lados. Por eso viven así, tristes y solas. Terriblemente solas."

Víctor Vegas

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CHAPTER 1 . INTRODUCTION

1.1. OBJECTIVES AND JUSTIFICATION ABOUT THE SURVEY

The project focuses on the study of the sidewalks of the city in northern Poland, Szczecin. In general sidewalks are public spaces where pedestrians can walk freely, that connect the shops and urban life. The importance of their good condition, is linked to using that is given. That is why we the survey about we will suggest representative streets of the city, thats mean different areas, uses and conservation status. Will be selected like sampling, to show an overall view of type of sidewalk we found and their characteristics.

The main goal is to know what are the causes which act directly on the pavement to alter their condition. This requires get in position and study previously the situation of the city, its climate, building systems used, materials used, maintenance performed, etc.. Once we know all these data we can delve into the study of pathologies and can say the causes that cause them.

It is interesting for us to see how climatic factors affect the condition of sidewalks. Comparing them with the pavement we know, the pavement of the city of Valencia, can be readily appreciated what and to what extent these factors affect each of the cities. So we will have a general comparative.

The next objective is to propose solutions for improvement. To do this, we ask a few questions: Are sidewalks efficient?, Do we build, taking into account the sustainability of pavement? We will try to answer them throughout the study, taking this into account, we will suggest sustainable and efficient improvement solutions for Szczecin.

Finally, innovation in this field is something that does not normally get attention, but we want to present some technological advances. For it we will present two pavement types that can help conservation and good use of this, proposing their combination for greater energy efficiency.

1.2. GENERAL SURVEY AND APPROACH: THE CASE METHOD

Regarding the methodology of the work, we first must choose the streets over which the study will be performed. The choice should be made so that we can study different conservation status, construction systems, areas, public concurrence streets, residential streets, etc...

Once choosing the study areas will take place visual inspection to determine the state, observe the lesions, and learn about the materials. After the inspection, we shall study the city, the history of the pavement, the weather, the existing materials in Poland, the construction system used on the sidewalks, etc.. This is a research work in order to know the different causes of the observed lesions.

Once we know, the causes that act on the pavement to cause its state, will suggest the pavement actions to return it to its original state. The performances will suggest based on our constructive knowledge.

Then, we will suggest new constructive solutions to improve the durability of sidewalks and their efficiency. To do this, we will study the use of new materials, a possible change of the constructive system, improve drainages and propose new designs. To do this, we will serve the knowledge gained in the previous steps.

Finally, the idea is to propose technological innovations to improve the efficiency and durability of sidewalks. For it, an investigation will take place about novelties regarding pavements and will choose the best solutions following the line of the sustainability and efficiency.

CHAPTER 2. HISTORICAL AND URBAN CONTEXT

2.1. HISTORY OF SZCZECIN PAVEMENT

Szczecin is the country's seventh-largest city, the major maritime port city in Pomerania and the capital of West Pomerania in Poland. Is located at the northwest of the country, near of the Baltic Sea, on the Oder river, south of the Szczecin Lagoon and the Bay of Pomerania.

Szczecin is the country's seventh-largest city, the major maritime port city in Pomerania and the capital of West Pomerania in Poland. Is located at the northwest of the country, near of the Baltic Sea, on the Oder river, south of the Szczecin Lagoon and the Bay of Pomerania.

Location of Szczecin in the map of Poland [1]

During the 17th century Szczecin was to Sweden during 100 years and the king of Sweden became the Duke of Pomeranian and held a seat in the German imperial diet (the Reichstag), after the Great Northern War, Prussia gets seize power of the city.

In the 19th century, the city became part of Germany and was used as the port of Berlin. During World War II the city was bombed by Allied troops, leaving city center, Old Town and industrial areas totally destroyed.

Images from Rynek Sienny square after Second War World War. [2]

Finally, after World War II, the city the city returns to its origins Polish.

The city's plan resembles that of Paris, and the reason is that both share the same designer, Georges-Eugène Haussmann. For this reason Szczecin has many parks, roundabouts and squares with star-shaped with many avenues that start at different directions.

The actual Szczecin's architectural style is influenced by the popular trends in the last half of the 19th century and the first years of the 20th century, Academic art and Art Noveau. During the city's reconstruction after the World War II, the communist authorities wanted the architecture reflect an old Polish era.

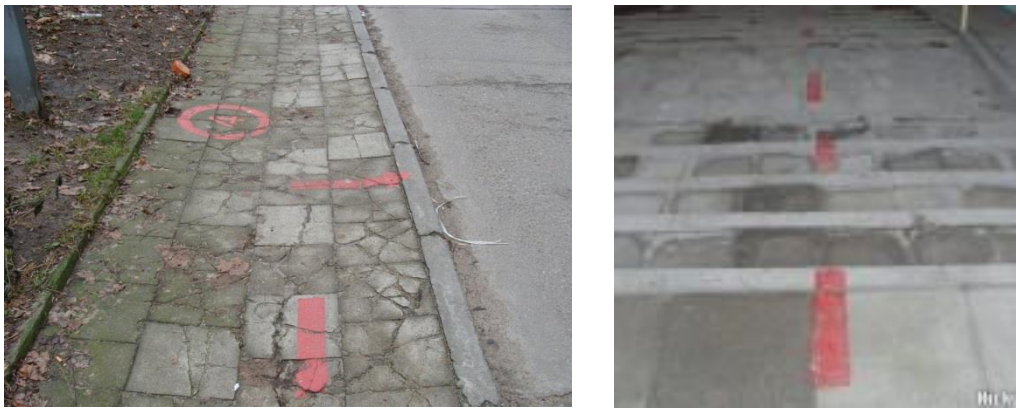
Focusing on the topic of study, the sidewalks of Szczecin are majority composed by big rectangular blocks of granite or gneiss, each one with different size and color and irregular shapes. The material comes mainly of Sweden. Nobody knows the true history about the arrival of that stones to the harbor city, one of the most widespread versions is the blocks came to Szczecin as ballast for ships. The stones were collocated under the deck of the sailboats of the 18th century, so they are more than 200 years old. So they have many histories to tell, like love words, round knockers or traces of bombings and artillery firing occurred in World War II.

In some areas of Szczecin, it has been carried out the replacement of the old pavement by their poor condition. The replacement has been made with existing pavement, which mimics the layout of the old big blocks of granite, with smaller pieces and appropriate for climate cycles present in the city.

Signals in Szczecin's sidewalks of artillery firing succeeding in Second World War. [3]

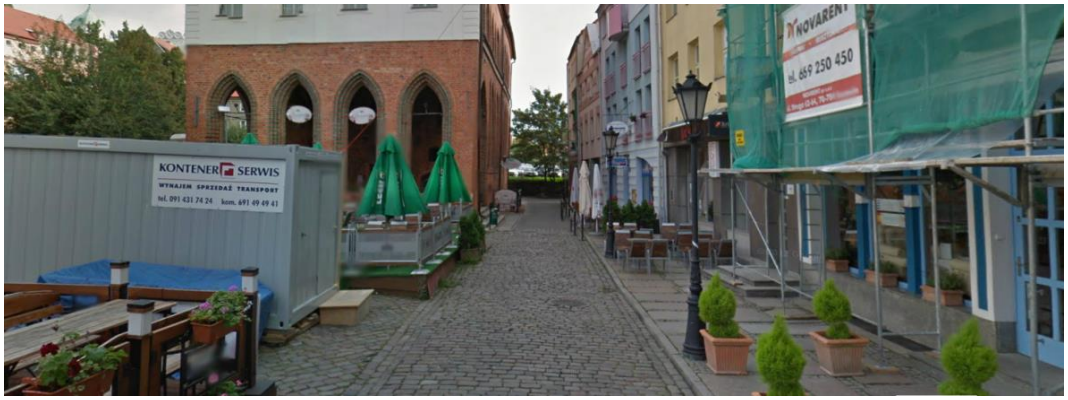
Replaced pavement in Szczecin' sidewalks. [3]

On the Szczecin's pavement it's possible to see also a red dashed line on them, it's called "red walk", a route of 7 kilometers, which connects all the important sightseeing to see in the city, in total forty-two. All attractions are marked by a number on the pavement and at each of them there is a sign explaining some details about the sight. The red line starts and ends at the Główny Railway Station. There are some maps that include the red line and an illustrated view of the city as well as additional information on the sites included in the red line tourist route some information about the history of the attractions.



Red line in Szczecin's sidewalks. [3]

One of the oldest pavements of the city is the cobblestone of Rynek Sienny square. Today it's a pedestrian square in the Old City, but some time ago was open like a park vehicles until it was closed to preserve the cobblestone because its antiquity.



Rynek Sienny square. [4]

2.2. URBAN AREAS IN SZCZECIN

Szczecin was built in 1880 according to the Georges-Eugène Haussmann, the same designer who handled the Paris' Plan. For this reason the city has many parks, green zones, roundabouts and squares with star-shaped with many avenues that start at different directions, and some green corridors with trees in the middle of the avenues that are often used to place the trams tracks and his stops.

Szczecin is divided administratively at four districts: Śródmieście, Północ, Zachód and Prawobrzeż; and each one, in turn is divided into various neighborhoods.

Map of Szczecin with neighborhood marked. [5]

In the city we can find we can find different areas of zoning:

RESIDENTIAL ZONES

1. Terraced houses blocks

It is a zone type, in the residential typology, consisting of groups of identical houses, shared their external walls. These areas are usually on the Outskirts of the town.

Terraced houses block in Szczecin [5] [6]

2. Exempt buildings block

It's another residential typology. It consists in buildings located separately by all the boundaries of the plot from other constructions.

Exempt buildings block in Szczecin [5] [6]

3. Single houses

It is independent houses that do not touch the houses of neighbors. They have free space inside the plot. This type of area is usually on the Outskirts of the town.

Single houses in Szczecin [5] [6]

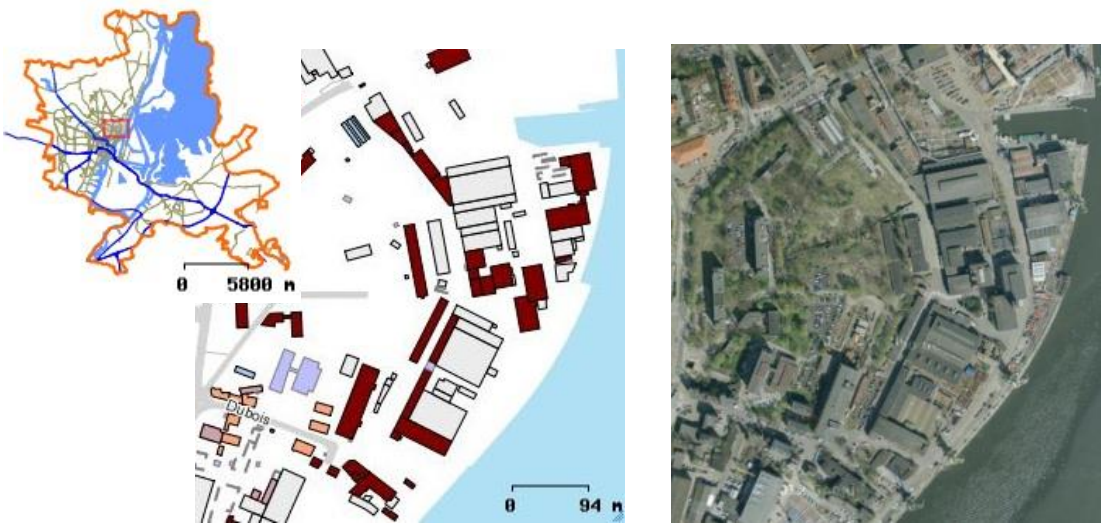
4. City expansion

New buildings on the city's outskirts, in order to expand the city. Usually designed under a planned urban development.

City expansion in Szczecin [5] [6]

5. Industrial-terciary zones

It's a management area, which are grouped in a number of industrial activities. This type of industrial area is mainly Odra's river banks.



Industrial-terciary zones in Szczecin [5] [6]

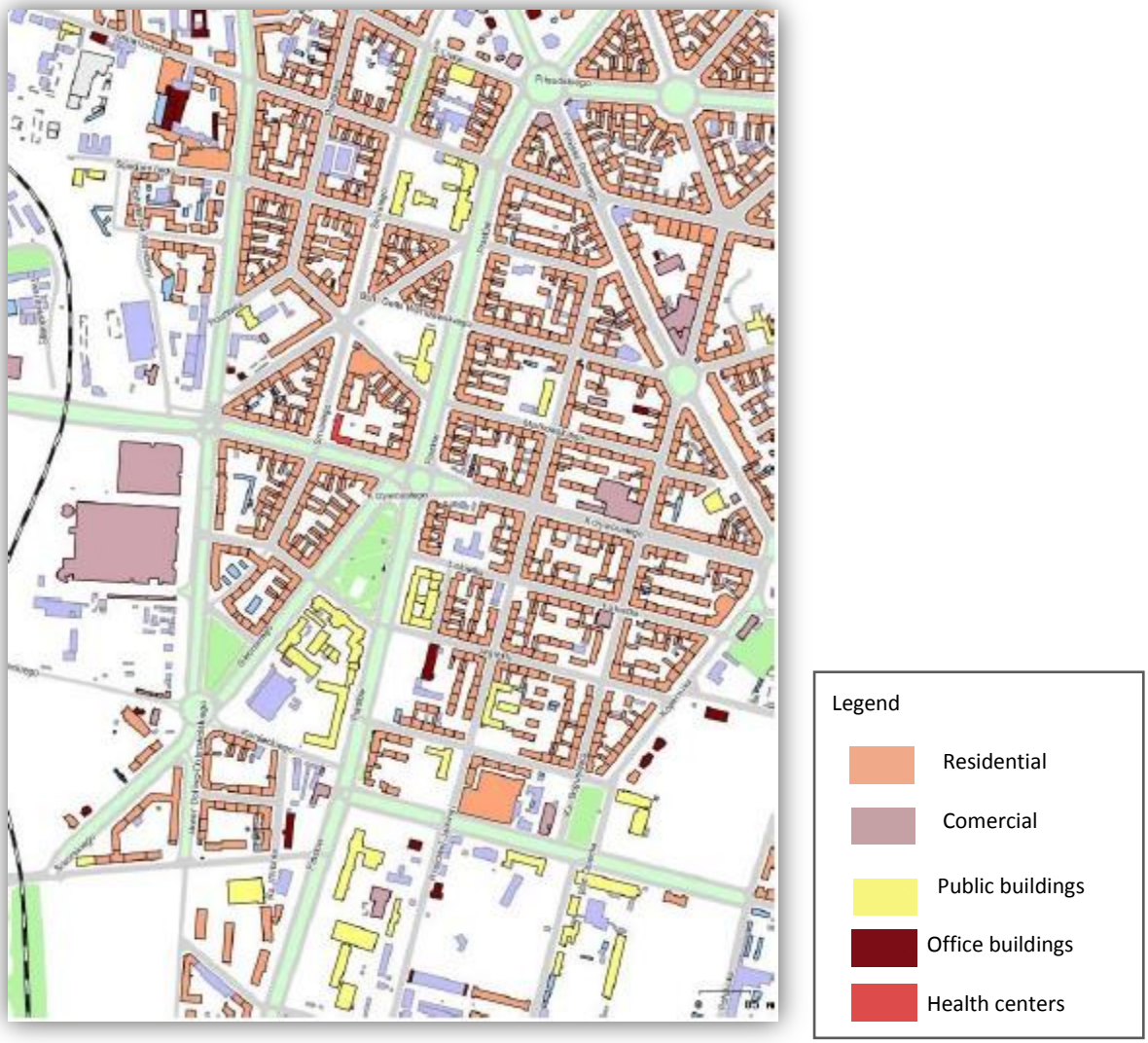
2.3. ZONES AND AREAS CHOSEN

Firstly for the accomplishment of the study the most representative zones of the Szczecin paving are chosen. For the choice were kept in mind the zones of public concurrence and residential, studied previously, the general condition in which they find the streets and the historical zones of the city.

After the initial study there were chosen four representative streets of the city and that show in a general way the condition of the pedestrian zones and the sidewalks. The selected streets are: Aleja Piastow, Ulica J. Sowinskiego, Ulica Bugosława X and Rynek Sienny.

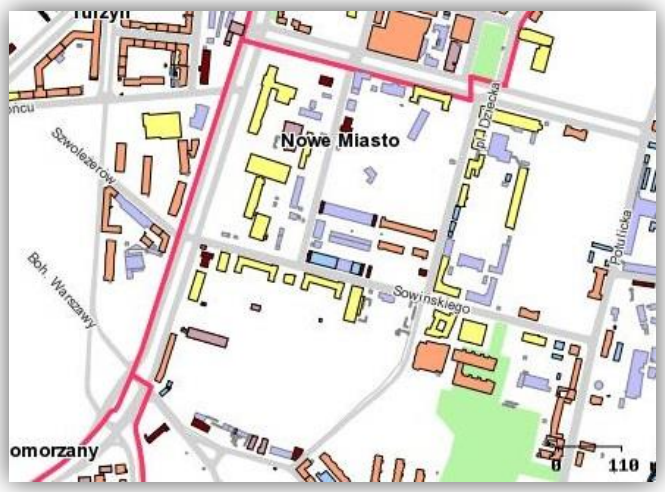
Map of Szczecin [5]

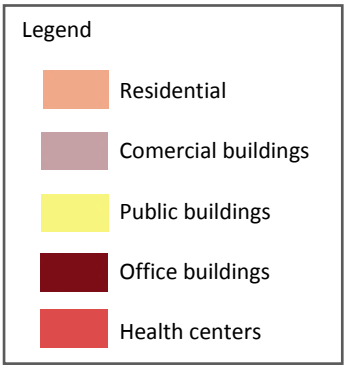
The street **Aleja Piastow** is one of the streets most travelled of the city where tram number 3, 4, 5, 11 and 12 circulate. There we find five faculties of Zachodniopomorski Uniwersytet Technologiczny. The predominant use in this street is residential and the constructive typology that more appears is a closed apple with blocks of multifamiliar's flats.



Aleja Piastow [5]

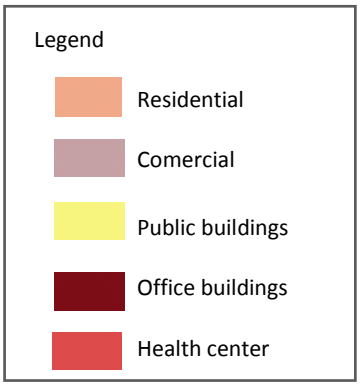
The street **Ulica J. Sowinskiego** is a street that at the same time that this study was elaborated was being done the rehabilitation of the sidewalk. The company that was doing this work is Lithonplus GmbH & Co. Adding this street to our study we can see how was the construction of the sidewalk and appraise possible pathologies with the construction.





Ulica J. Sowinskiego [5]

Ulica Bugosława X is the first pedestrian street in Szczecin, closed in 2000, the plan was to create a pedestrian city center around the square Zamenhof, so that 13 years later nobody expected it to remain the only pedestrian street. After closing this street, the center of Szczecin came alive and became one of the busiest streets. In this pedestrian street we can find different food bars and drinks. We can observe and study the pavement that was used for the only pedestrian zone and its materials. In this area we find a urban variable of residential type of closed apple. This typology is the most predominant int he central area of the city, as we can observe in the plan of urban arrangement enclosure.



Ulica Bugoslawa X [5]

The Square **Rynek Sienny** is situated in Stare Miasto (Old city), in this place there are one of the oldest pavements of the city. Formerly was open and the vehicles could park, but is currently closed and the pavement is preserved. In this pedestrian zone there are also different bars of food and drink, and normally is busied by tourists because it is found in the old part of the city and around there are some city landmarks.

Rynek Sienny [5]

2.4. ARCHITECTURAL CONTEXT

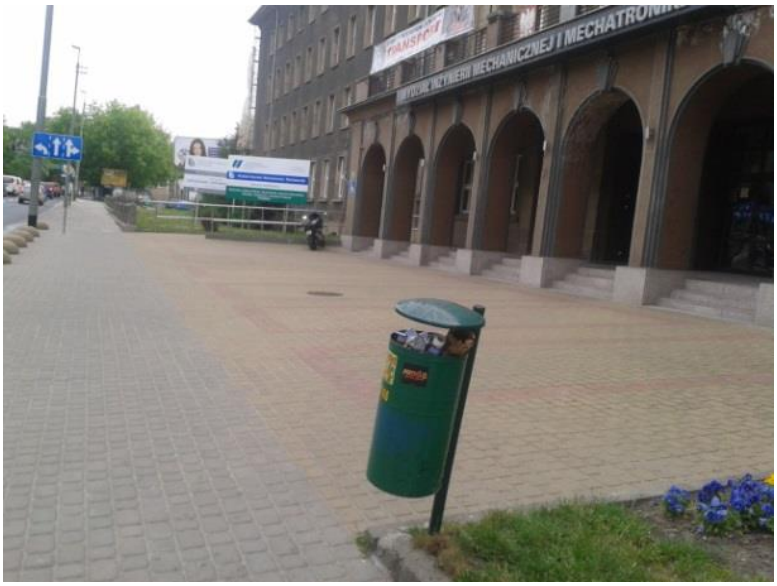
Each of the zones chosen for the study is located in an area with different characteristics of Szczecin. Below we provide a brief description of the architectural context in which is located each one of them.

Piastow Avenue

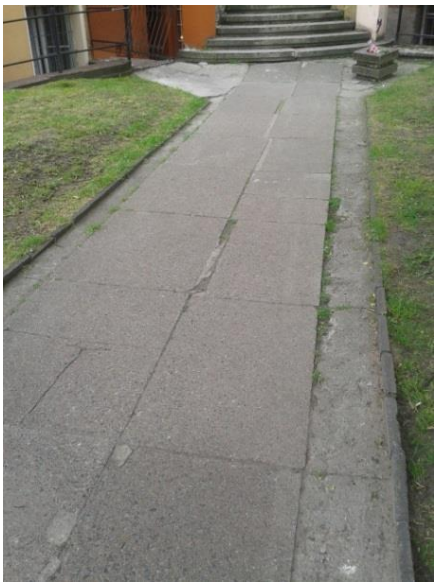
This avenue is in the expansion of the city. In this area, most of the buildings are residential buildings in Renaissance style with ground floor commercial premises. These usually have 4 floors high, with a total height of 18-20 meters, so that the height is regular along the whole street. Access to housing, are often retranqueadas from the entrances to stores or inner courtyards that are accessed through passages. These accesses are solved with the same pavement used on the sidewalks.

In addition to these residential areas, there are also several areas university residences as isolated blocks with greenery around. The height of these blocks is usually 4-11 plants.

There are also, along the street, numerous university schools, which access has been renewed due to high pedestrian traffic during school days.



Pavement renewed in access to the faculty of Mechanical Engineering [3]



Pavement access to housing [3]

Boguslawa Street

Pedestrian Street, located in the urban area of the city, with entertainment outlets (bars and terraces) and residential buildings in the Renaissance style. The facades of the buildings are aligned, so that there are no retranqueos in access to housing.

The pavement of this street was renovated in 2000, when the street was designated as pedestrian. For its execution were reused some of the pieces existed before the intervention. Has no sidewalks, all street pavement is level to facilitate access to existing commercial premises in the area.

Boguslawa Street [3]

Rynek sienny Square

Pedestrianized square that previously belonged to the old city, but after the World War II, was practically destroyed, barely preserving a facade of some building. In its reconstruction was attempted to capture the aesthetic of the buildings before the war.

Most of the buildings are residential entertainment (bars and terraces) or commercial (stores) in their ground floors.

It preserves the original pavement of the square, while the sidewalks of the square were rebuilt to allow good access to all the existing businesses.


Images of Rynek Sienny [3]

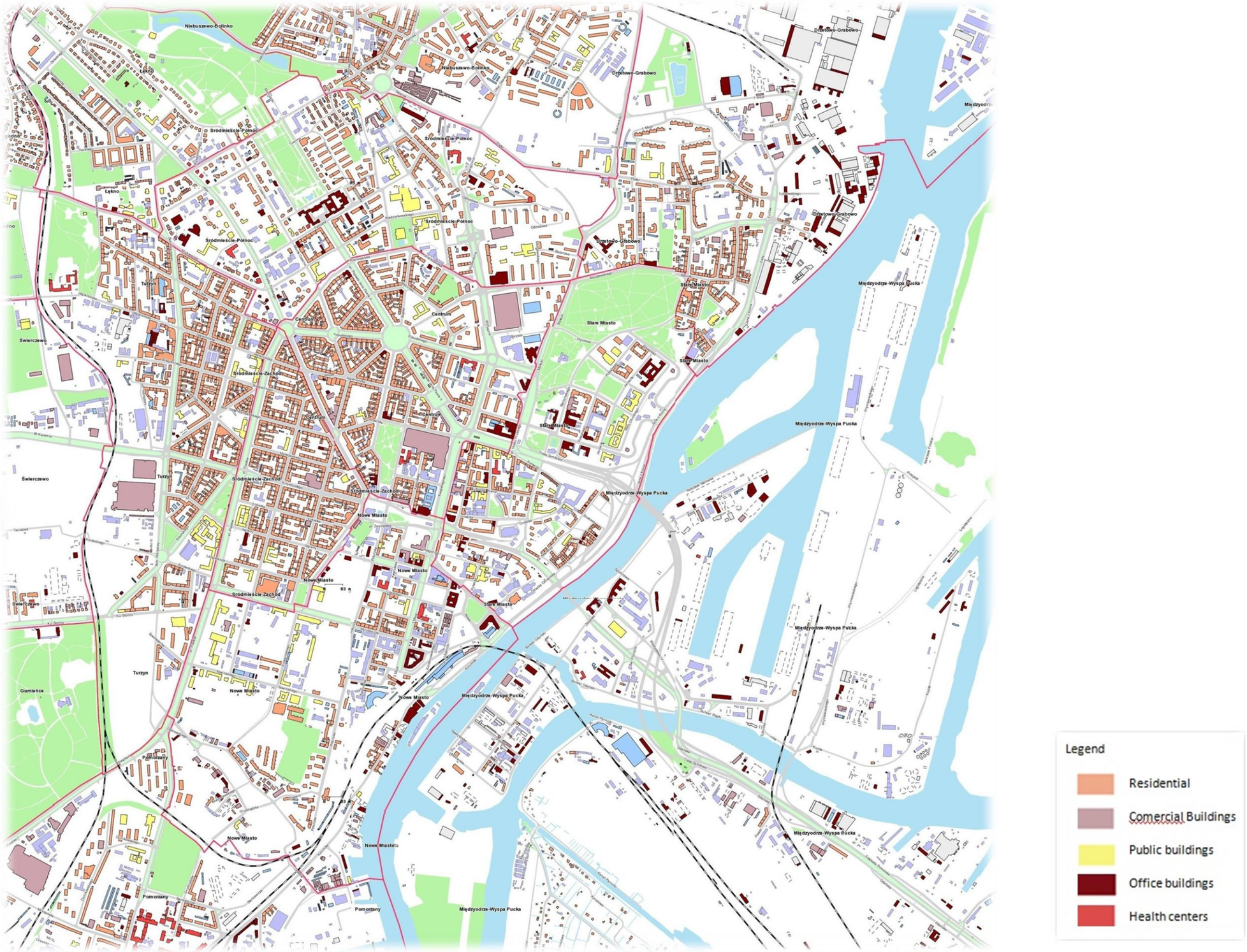
Sowinskiego Street

This street is located in the extension of the city. Most of the existing buildings on this street are public buildings (schools, universities), but its traffic is not very high because they are isolated buildings with greenery around and access to most of these buildings are located on other streets .

The pavements in this street has been recently renovated, expanding the width of them to improve pedestrian circulation because the ancient was in bad shape and its width was insufficient.

Renovated sidewalk Sowinskiego Street [3]

2.5. TYPES, USES AND SINGULARITIES



SOURCE OF THE IMAGES OF CHAPTER

[1] http://www.google.com/imghp?hl=es

[2] www.sedina.pl

[3] Author

[4] http://www.google.es/intl/es/earth/

[5] http://gis.um.szczecin.pl/UMSzczecinGIS/chapter_85056.asp

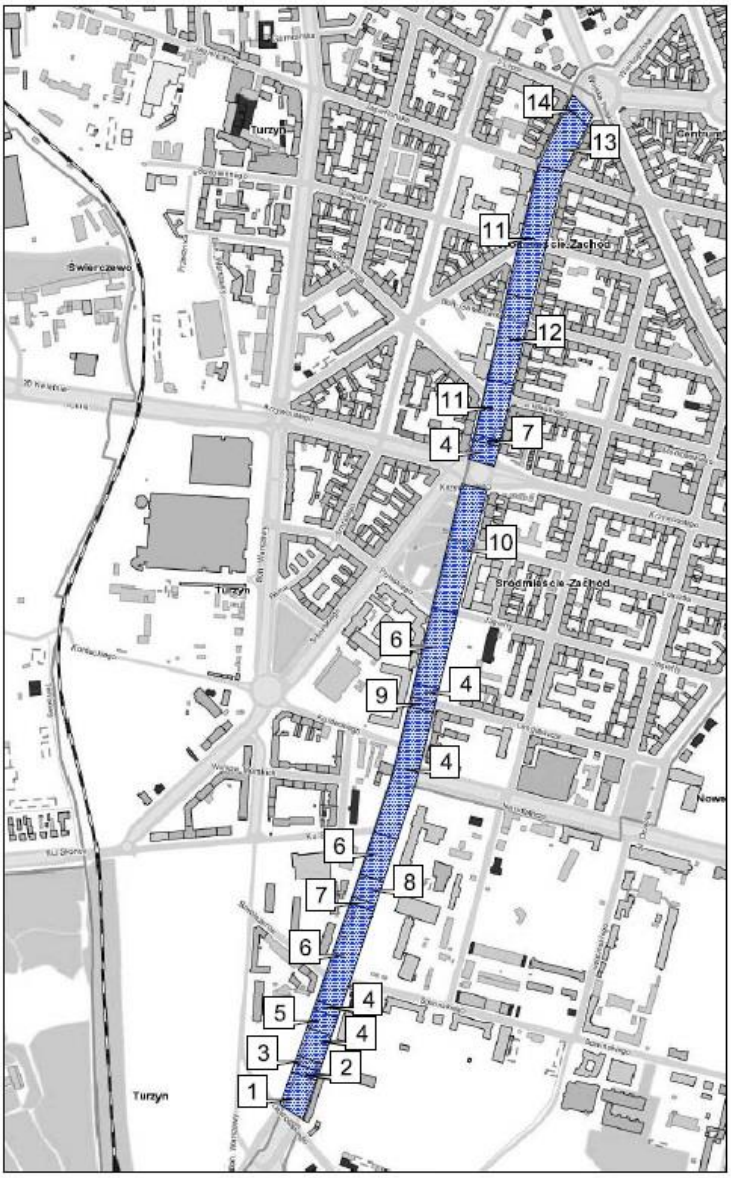
[6] https://maps.google.es/

CHAPTER 3. STRUCTURAL AND ARCHITECTURAL CONTEXT

3.1. MAPPING SZCZECIN

The zones of study chosen and explained previously have different type of pavement, different studding and different conservation. In this paragraph we present the mapping of the chosen zones, showing the typology of the pavement, the studding and his condition of conservation.

ALEJA PIASTOW



Aleja Piastow [1]

MAPPING ALEJA PIASTOW

Aleja Piastow 1

Aleja Piastow 2

Aleja Piastow 3

Aleja Piastow 4

Aleja Piastow 5

Aleja Piastow 6

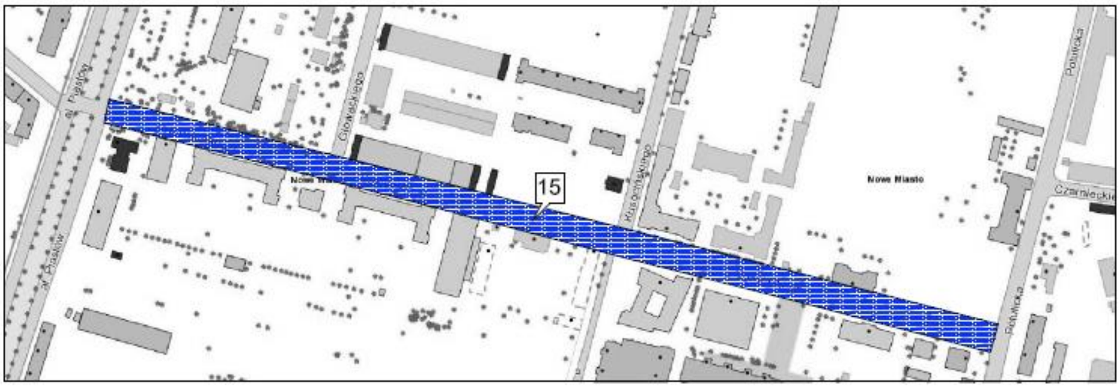
Aleja Piastow 7

Aleja Piastow 8

MAPPING ALEJA PIASTOW	
Aleja Piastow 9	**Aleja Piastow 10**
	
Aleja Piastow 11	**Aleja Piastow 12**
	
Aleja Piastow 13	**Aleja Piastow 14**
	

Pavement images [1]

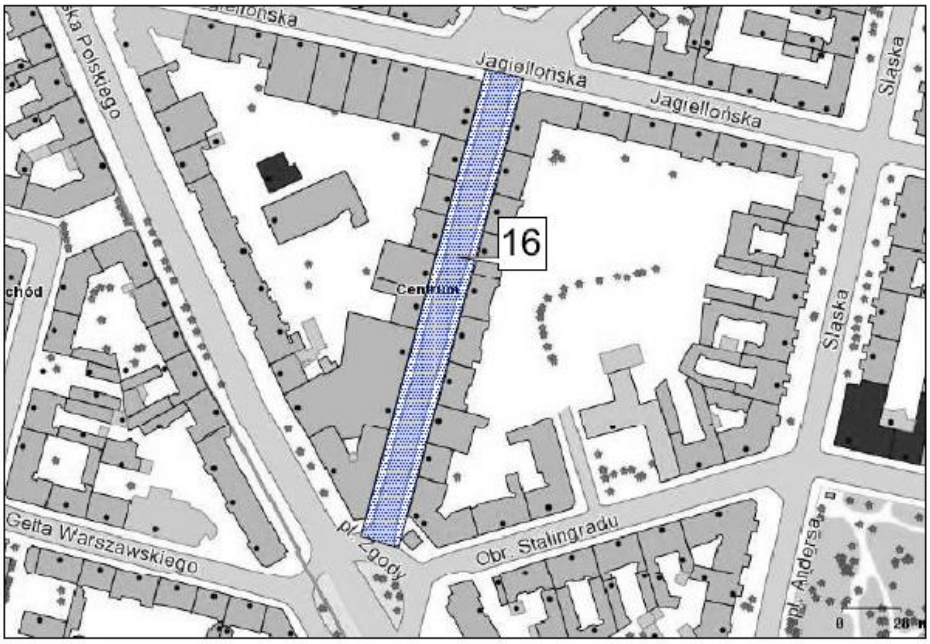
ULICA J.SOWINSKIEGO



MAPPING ULICA J.SOWINSKIEGO
Ulica J. Sowinskiego 15


Pavement images [1]

ULICA BUGOŁAWA X



MAPPING ULICA BUGOSLAWA 16

Ulica Bugoslawa 16

Pavement images [1]

ULICA RYNEK SIENNY

MAPPING ULICA RYNEK SIENNY

Ulica Rynek Sienny 17

Ulica Rynek Sienny 18

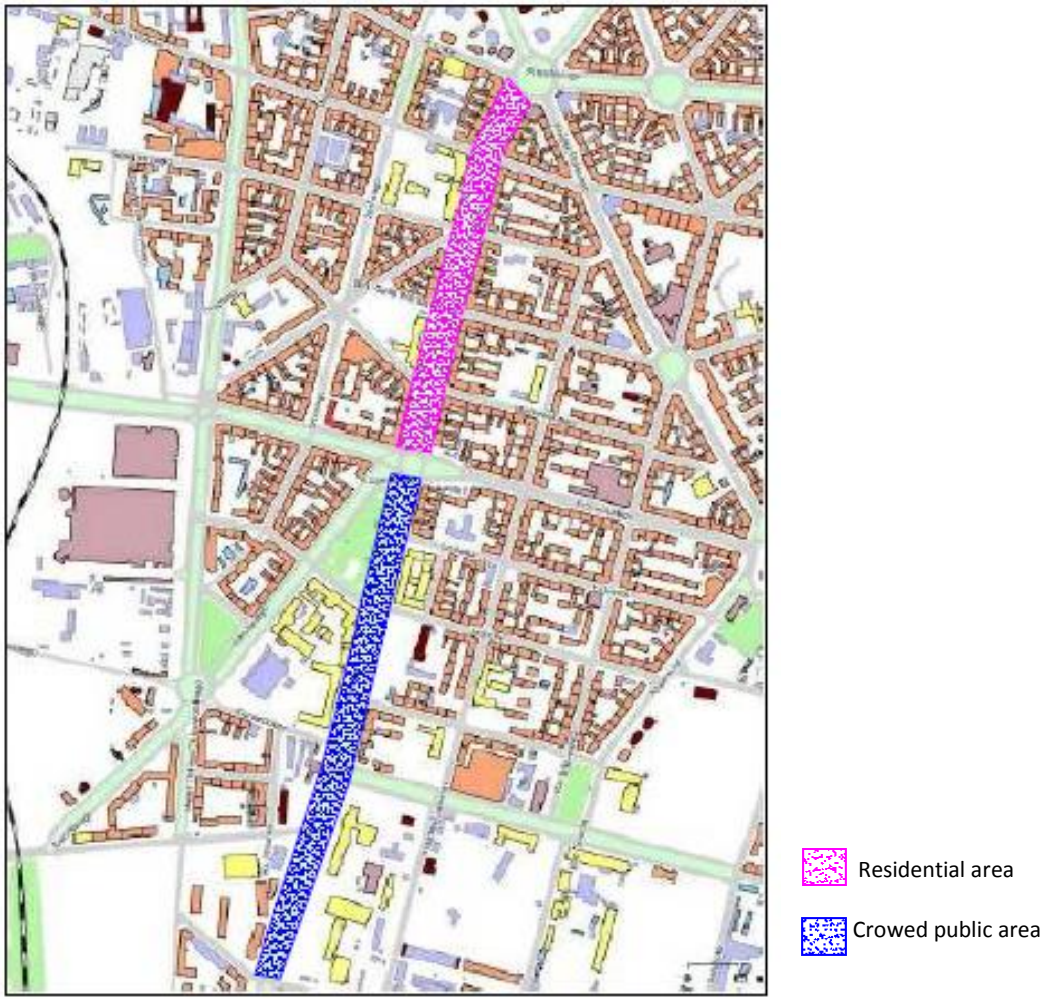
Pavement images [1]

3.2. DENSITY DISTRIBUTION: CROWDED PUBLIC AREAS AND RESIDENTIAL

The areas chosen have different types of density depending density around existing servicies. This factor has a direct influence on the state of the existing pavement. Depending on the use to which there is a major street or pavement poorer preservation, in addition to the materials used are also different depending on the density expected in that area.

Density distribution in each zones are as follows.

ALEJA PIASTOW

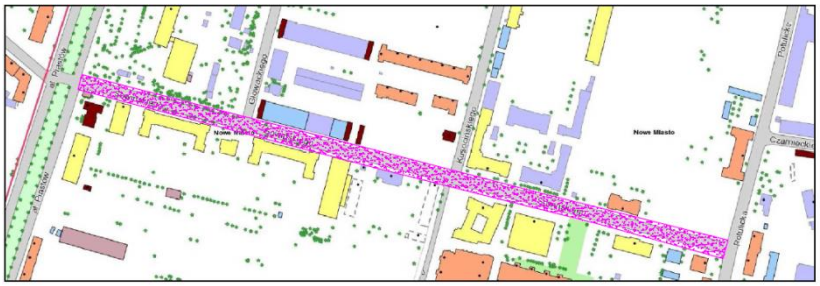


Aleja Piastow [1]

Aleja Piastow has a density change in the route of the road. The density difference is because in Piastow area are concentrated several universities and colleges, as well as student residences. This area is considered public places, due to the high pedestrian and bicycle traffic during the day. It is therefore most affected street.

The northern part of the street Piastow, once passed the area's universitiesis home buildings. Aleja Piastow is located in the center of the city. This area is considered as a residential area density found. The pedestrian traffic is more fluid.

ULICA J.SOWINSKIEGO



ntial area

Ulica J.Sowinskiego [1]

The street J. Sowinskiego is a street located in an area where there are various educational buildings, but still pedestrian traffic density is quite mild. It is a street that has been recently renovated and has good condition. As a quiet street, is considered a residential area.

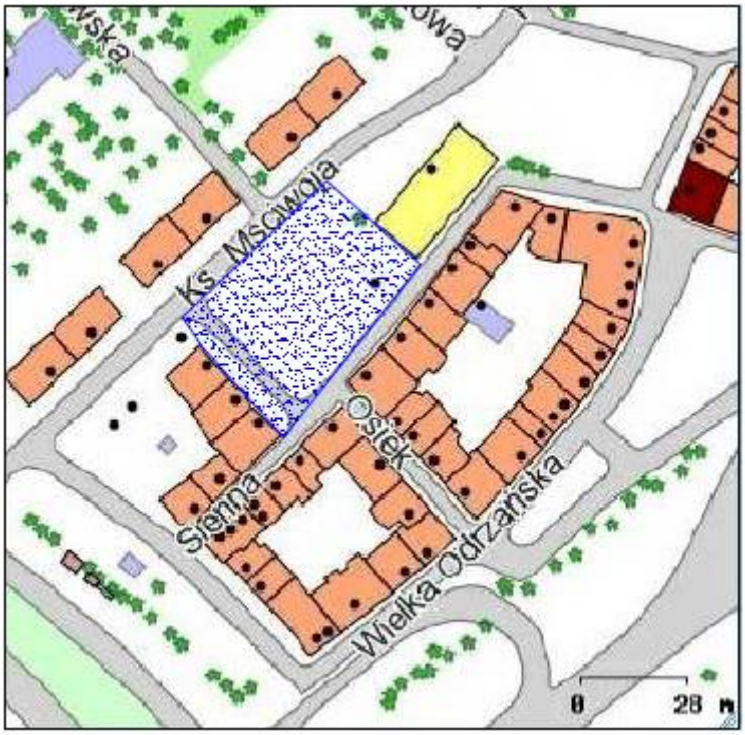
ULICA BUGOŁAWA X

Crowed public area

Ulica Bugoslawa [1]

Bugoslawa X is the only pedestrian street of the city, located in the city center and its many bars and restaurants. This street is busy during the day, at night is one of the busiest areas for young people who go to pubs that are in the city center. It is a crowded public area with good condition.

ULICA RYNEK SIENNY



Ulica Rynek Sienny [1]

Sienny Rynek Square is located in the historical district and is one of the stops on in the tourist routes in the city. In this square are located numerous bars and restaurants, so it is a busy street during the day. It is considered crowded public area.

3.3. TYPE OF PAVEMENT

Since already we have seen in previous points that in Szczecin exists many type of pavement depending on each one street. Principally in Aleja Piastow we find a lot of variety of pavements and every section with a different studding.

In this point it presents the material of each one of the pieces that form the pavement of the studied sidewalks. Having in it counts the antiquity of the construction of each one of the sidewalks and his rehabilitations we can find the same type of piece elaborated with different material according to the year of execution.

We can say that the streets tell us their evolution, since in the same street we find equal pieces with different condition of conservation or even, sections of street rehabilitated and others without rehabilitating and in poor condition. Nowadays the rehabilitations that are realized are studied to evoke to the most ancient pavement of the city, the stones of gneis of great size that they came by ship from Sweden try to be kept and in other cases the studding is designed by another type of material that it evokes to the typical stones of Szczecin's pavement.

Now, referring to the planes of the point 3.1, there appear the pieces with which the pavement has been constructed.

PHOTO	DESCRIPTION	LOCATION
	It is done of concrete B20 or B50 with additives to do it more plastic. The bevelled edges it does that it is more resistant to the blows and they help the water to flows for the joints. His form is designed for big loads.	According to the map of 3.1. Alieja Piastow 1
	Cobblestone of granite, resistant to the inclemencies of the time, to the abrasive agents, to the passage of time and to the impacts. The size is variable, between 16-21,5 cm of length and 15-17 cm of width.	According to the map of 3.1. Alieja Piastow 2

PHOTO	DESCRIPTION	LOCATION
	Cobblestone of colored granite and basalt, resistant to the inclemencies of the time, to the abrasive agents, to the passage of time and to the impacts. The size is variable, between 25-28 cm of length and 13,5-15 cm of width.	According to the map of 3.1. Alieja Piastow 3 Ulica Bugoslawa 16 Ulica Rynek Sienny 18
	It is done of concrete B20 or B50 with additives to do it more plastic. Great capacity of load. The size is 35,5x35,5 cm.	According to the map of 3.1. Alieja Piastow 4 Alieja Piastow 6 Alieja Piastow 7 Alieja Piastow 8 Alieja Piastow 12 Alieja Piastow 13
	It is done of concrete B20 or B50 with additives to do it more plastic. Great capacity of load. The side it measures 20 cm.	According to the map of 3.1. Alieja Piastow 5
	Slabs of granite and gneis, it is the pavement that characterizes Szczecin's sidewalks. Of great size and variable, between 109-125 cm of length and 65-119 cm of width.	According to the map of 3.1. Alieja Piastow 6 Alieja Piastow 8 Alieja Piastow 11 Alieja Piastow 12 Alieja Piastow 13 Ulica Bugoslawa 16 Ulica Rynek Sienny 17
	Cobblestone of concrete B20 or B50 with additives to do it more plastic. Great capacity of load. The size is 21x10 cm.	According to the map of 3.1. Alieja Piastow 9

Pavement images [1]

PHOTO	DESCRIPTION	LOCATION
	Slabs of granite, resistant to the inclemencies of the time, to the abrasive agents, to the passage of time and to the impacts. The size is 40x40 cm.	According to the map of 3.1. Alieja Piastow 10
	Stones of granite, resistant to the inclemencies of the time, to the abrasive agents, to the passage of time and to the impacts. The size is variable, between 10-9 cm of length and 8-7 cm of width.	According to the map of 3.1. Alieja Piastow 10 Ulica Bugoslawa 16 Ulica Rynek Sienny 17
	Slabs of concrete B20 or B50 with additives to do it more plastic. The finished superficial one are little stones. The size is 40x40 cm.	According to the map of 3.1. Alieja Piastow 14
	It is done of concrete B20 or B50 with additives to do it more plastic. Great capacity of load. The finished superficial one is granite. The size is 9,5x9,5 cm.	According to the map of 3.1. Ulica J. Sowinskiego 15
	It is done of colored concrete B20 or B50 with additives to do it more plastic. Great capacity of load. The size is 15,5x15,5 cm.	According to the map of 3.1. Ulica J. Sowinskiego 15

Pavement images [1]

3.4. EXECUTION AND MATERIALITY OF PAVEMENT

Building a stone pavement execution requires a careful and sufficiently experienced staff. A lot of pathologies that occur in pavements are caused by a faulty commissioning work, therefore often the typical emergencies of the last moment to finish on schedule.

The steps are:

1. Setting out and marking

The setting out work is performed according to project plans. Axes is limited by stakes and marked the different elements that affect the development of the works.

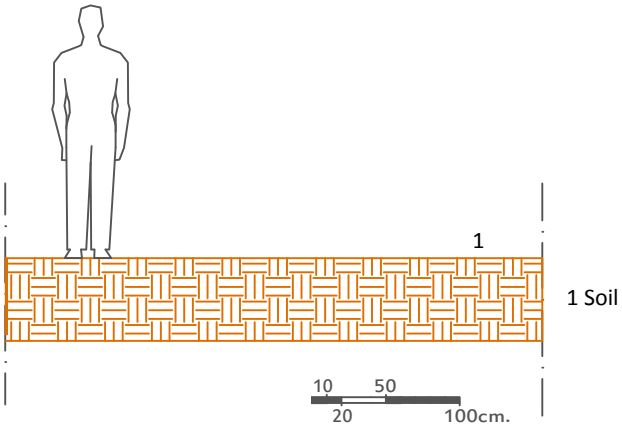
Topographic reference points are also fixed for the correct development of the works and the subsequent leveling system layers.

2. Soil compaction

To carry out appropriate soil compaction, the square should always be dry and well drained.

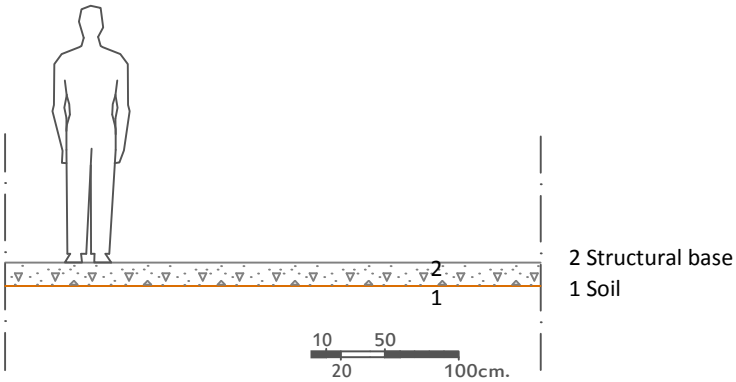
First removed all the roots and organic matter necessary to obtain the height of the project and provide for the pitches.

Below will take place the compaction of the esplanade and refined of the box, to guarantee 100% of the maximum density of the Modified Proctor test tamped. The commissioning work will be forming single wipes previously, variable length of 30 m2 and width no greater than 3 m, according to the characteristics of each work.



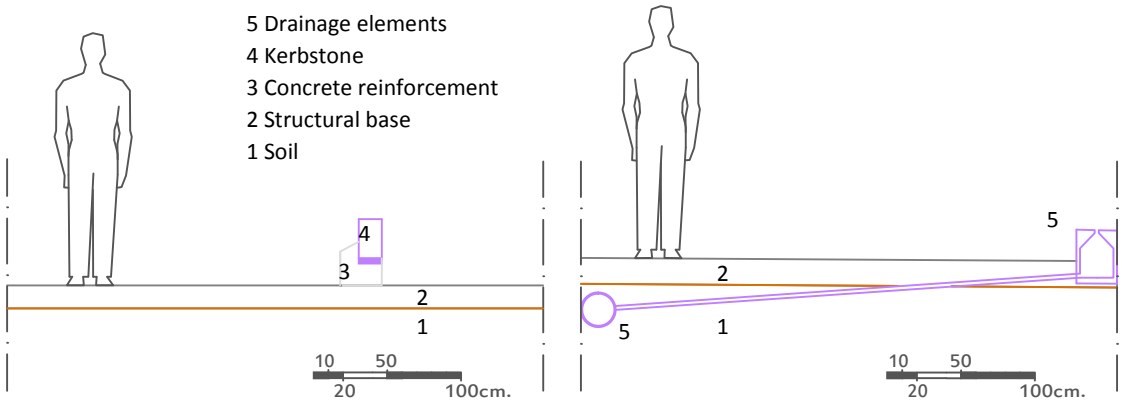
3. The structural base

As a structural base, is done a concrete slab, preferentially from center. The esplanade should be watered before the widespread, especially when it is hot, or it is constituted by draining materials. At the end of each working day and, if the construction process is longer suspend the workability time of the mixture should be placed transverse working joints.



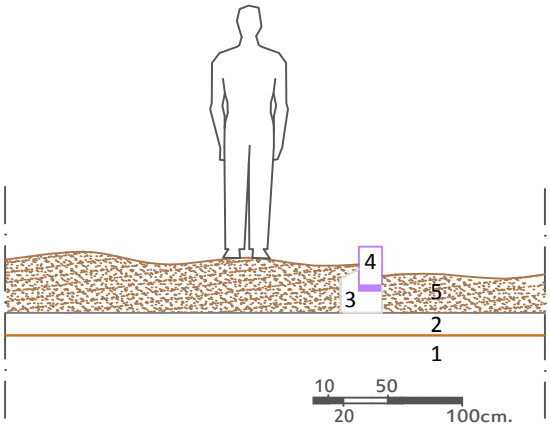
4. Placing kerbstones and drainage systems

For the good execution of the pavement, it is necessary prior to placing the cobblestones are placed curbs perimetral, to keep the alignment and support needed to the realization of the paving, containing the external force that causes the pavement and avoiding sand may disperse. Drainage elements are placed after structural base too.



5. Base and support adherence, sand bed

In this case, the support is performed by a sand bed. To build the layer which the pavers are directly supported is used clean coarse sand. Sand extends in a uniform layer is not compacted loose filling up to the height necessary to obtain, after being compacted, the desired slope.

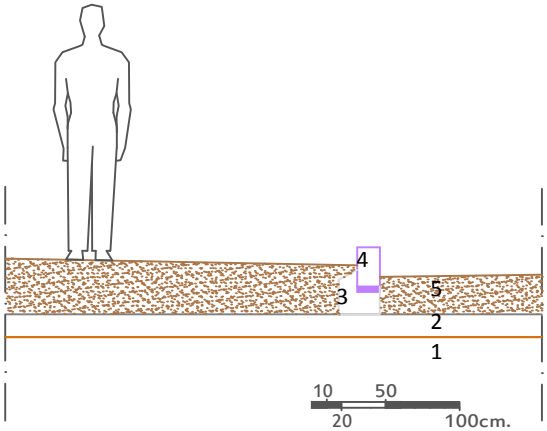


5 Sand bed
4 Kerbstone
3 Concrete reinforcement
2 Structural base
1 Soil

Sand bed [2]

6. Compactation of the sand bed

Once the sand is extended, it will undergo a compaction process with vibrating plates or stompers of vibrating rollers. Furthermore, in order to be compact, the sand must not contain too much moisture.

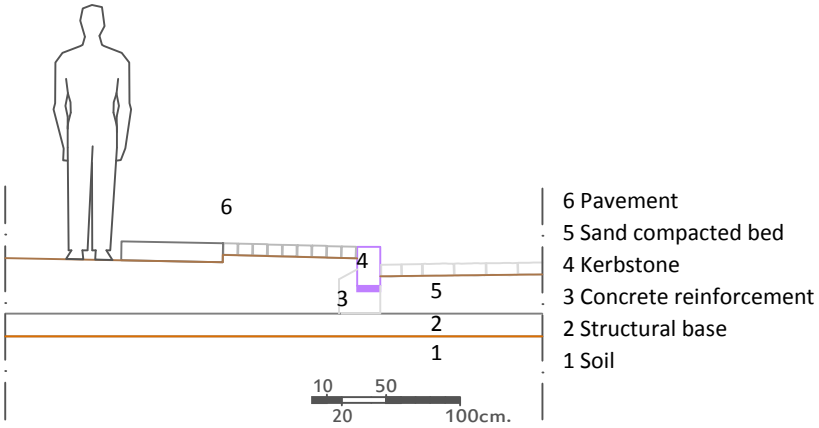


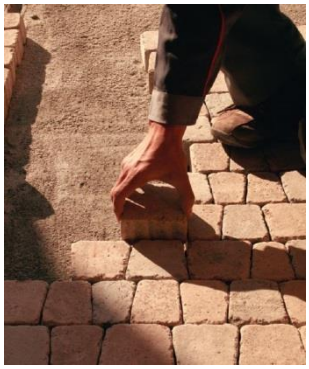
5 Sand compacted bed
4 Kerbstone
3 Concrete reinforcement
2 Structural base
1 Soil

Compactation [2]

7. Laying of the pavement

The laying of the pavement over the sand bed must be soft, following the guidelines of the drawing and with the help of spacers that allow to maintain the provided grout. Once placed each piece, it must be placed by a blow with a rubber mallet on a terraced board to its lateral face and with a certain frequency. Should be made controls of the surface leveling and correct it if necessary.

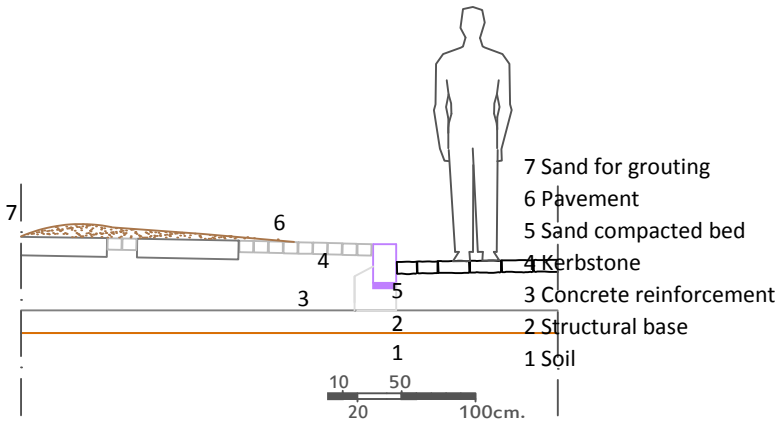




Laying on the pavement [2]

8. Sand sweep to grouting

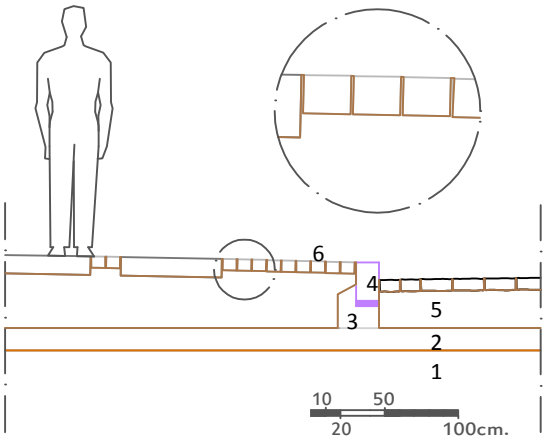
Grouting sand is done with fine and dry sand. This grouting is done by sweep of the granular material on the paved surface to penetrate sufficiently. The remaining sand is also removed by sweeping. In the case of prefabricated concrete tiles the joints are performed with sand and mortar.



Sand sweept [2]

9. Vibrated of pavement

After completing the grout with sand, the pavement should be vibrated by vibrating coated neoprene plates or vibrating roller compactors. It is sometimes necessary to place a blanket of felt above the pavement in order to absorb shocks. Once compacted pavement and removed the excess sand is convenient to water the pavement to facilitate bonding of the aggregate.



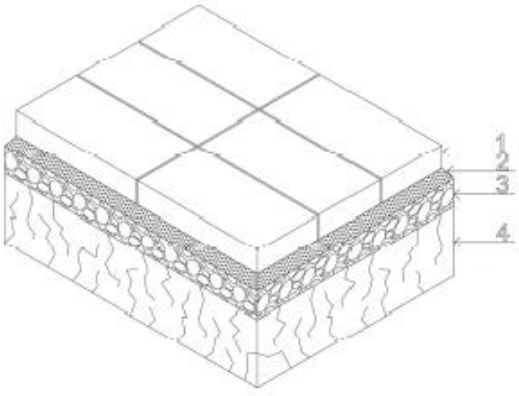
7 Sand for grouting
6 Pavement
5 Sand compacted bed
4 Kerbstone
3 Concrete reinforcement
2 Structural base
1 Soil

Vibrating coated [1]

MATERIALITY

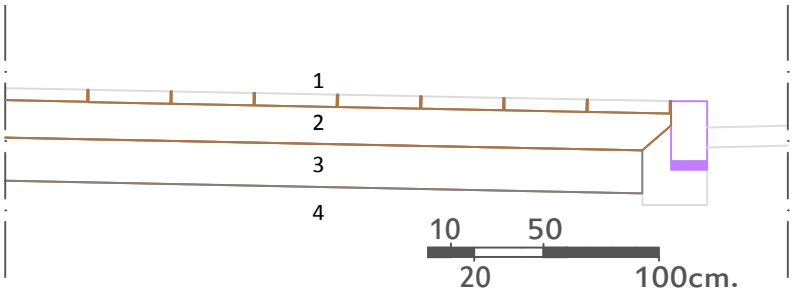
There are three types of pavement depending kind of tiles and joints:

1. Prefabrecated concrete tiles withs joints solved by morter and sand



1	Concrete tile	8 cm
2	Sand bed	3 cm
3	Structural base of concrete	50 cm
4	Compacted soil	-

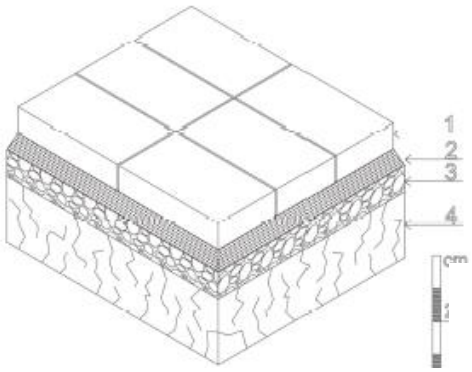
Section example:



Characteristics of the pavement:

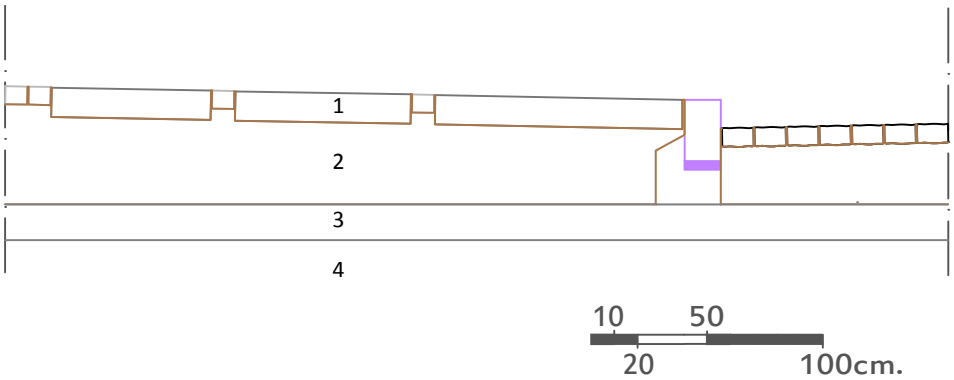
Type of intended use	Limited wheeled traffic, pedestrian traffic
Load Capacity	Limited
Attachment Method	Settlement on sand.
Flexibility	Semi-flexible
Stability	Limited
Usual colors	Grey
Surface texture	Hard, harsh, spongy
Conduct heat capacity	0.97-1.90 W/m²C
Durability	More than 25 years
Permeability/cleaning	Permeable. No cleaning difficulties due to particular characteristics.
Maintenance	Replacement of individual parts
Advantages	Sure for pedestrian crosswalk, chemical resistant
Specifications	Concrete slab paving

2. Flexible stone tling with joints solved by sand



1	Stone tile	8 cm
2	Sand bed	5 cm
3	Structural base of concrete	50 cm
4	Compacted soil	-

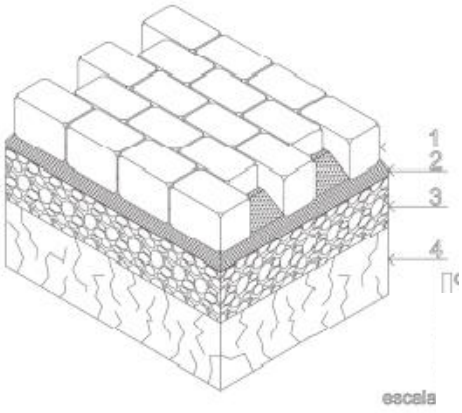
Section example



Characteristics of the pavement:

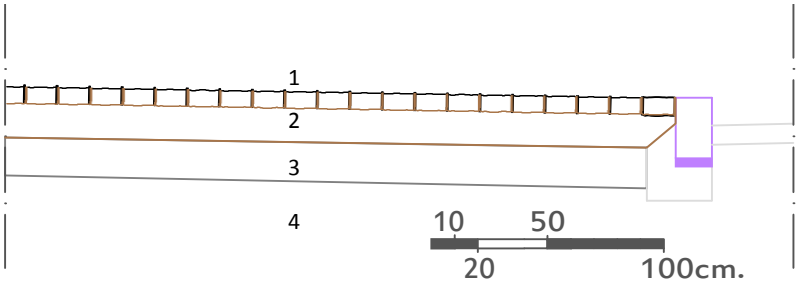
Type of intended use	Limited wheeled traffic, pedestrian traffic
Load Capacity	Limited
Attachment Method	Settlement on sand.
Flexibility	Semi-flexible
Stability	Limited
Usual colors	Grey, black, rose
Surface texture	Hard, smooth, wrinkled
Conduct heat capacity	2.2-3.5 W/m²C
Durability	70-100 years
Permeability/cleaning	Permeable. Is recommended specific products of cleaning
Maintenance	Replacement of individual parts
Advantages	Sure for pedestrian crosswalk, hygienic, chemical resistant
Specifications	Natural stone tile of granite, one side polished

3. Cobblestone with joints solved by sand



1	Stone tile	12 cm
2	Sand bed	5 cm
3	Structural base of concrete	45 cm
4	Compacted soil	-

Section example



Characteristics of the pavement

Type of intended use	Limited wheeled traffic, light wheeled traffic, pedestrian traffic
Load Capacity	Limited
Attachment Method	Settlement on sand.
Flexibility	Semi-flexible
Stability	Limited
Usual colors	Grey, black
Surface texture	Hard, smooth, wrinkled
Conduct heat capacity	2.8 W/m²C
Durability	70-100 years
Permeability/cleaning	Permeable. Is recommended specific products of cleaning
Maintenance	Replacement of individual parts
Advantages	Sure for pedestrian crosswalk, hygienic, chemical resistant
Specifications	Natural cobblestone

SOURCE OF THE IMAGES OF CHAPTER

[1] Author

[2] www.budujemydom.pl

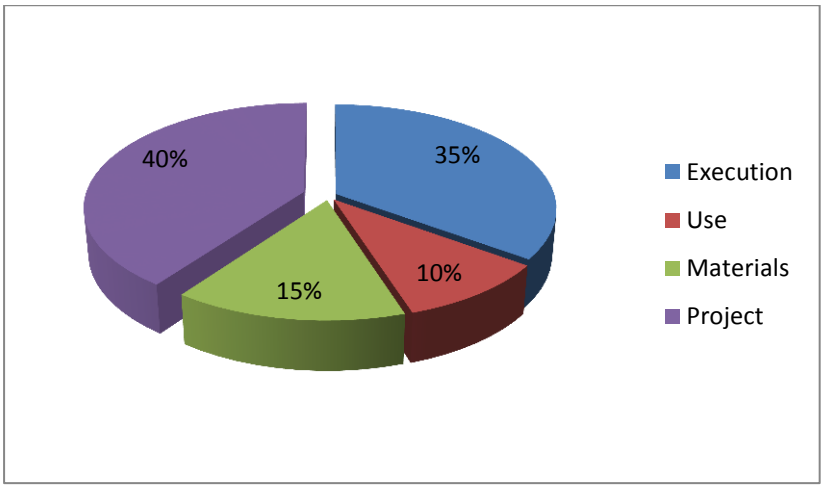
CHAPTER 4. PATHOLOGICAL CONTEXT

4.1. CONSTRUCTIVE AND MATERIAL DIAGNOSIS

"The detection of a pathological process in the professional world is in the habit of taking as an aim his solution, which implies the repair of the constructive unit damaged to return his constructive - architectural initial function."

Encyclopedia BROTO of construction pathologies

Diverse studies carried out by different entities of the sector of the building in Spain, considering the problems that arise in the construction, conclude with that the above mentioned damages it owe in major measure to failures during the phases of the project and execution.



Percentage graphic about done failures during different phases [1]

In the previous chapter has explained detailed which is the constructive process of the studied sidewalks. Bearing in mind that we have the necessary knowledge to execute correctly the sidewalks, we can explain which are the possible pathologies in the construction of these having in accounts in which condition in which they find the sidewalks.

Diagnosis about the structural system

Thinking that we depart from a structural base already executed initially:

PASO	PHATOLOGY	PHOTO
Step 1: Execution of the base and support of adherence by means of a bed of sand.	The bed of sand like base is necessary in order that the pieces remain in his place once placed. If there is not placed a bed of sufficient sand it is very easy that the pieces lose his correct position, even they go out of the studding and get lost. In case of mistakes in the thicknesses of the base of support, will appear differential seats and the cause will be the break of the land.	
Step 2: Compaction of the bed of sand.	It is necessary to fulfill a compacted good one making her leveled and with a thickness of between 3 - 5 cm. If we do not compact the bed of sand or not compacted correctly the consequences are: presence of drops in the pieces, since on not having been the base compacted once enters load or the pavement is trodden the bed of sand is compacted heterogeneously; unequal sunk of pieces, a piece they enter load more than other this is sunk more, giving place to the staggered pavement.	 
Step 3: Placement of the pavement.	In this phase there must be made rigorous controls of leveling of the pieces and correct any observed mistake. If the pavement of the sidewalk is not realized correctly it will be unbalanced.	

Pavement pictures [2]

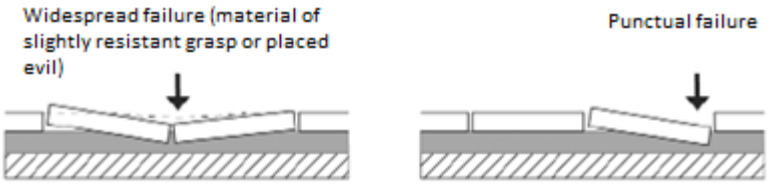
PASO	PHATOLOGY	PHOTO
Step 4: Sand sweep to grouting.	The sand is swept over the pieces to achieve that it penetrates in the joints if this step is not realized correctly by the sufficient sand for the joints easily the pieces go out of his position and / or the inclemencies of the time and other factors can act more aggressively on the pavement. If the joints has little thickness provokes that in the process of expansion of the materials exposed to high temperatures, they hit and create fissures and cracks.	
Step 5: Vibrated of pavement.	The vibration on the pavement is realized in order that the sand placed in the previous step penetrates between the joints and is compacted. If the sand is not vibrated it is not compacted and easily the pavement remains without the material of the joints and the inclemencies of the time with other factors can act aggressively on the pavement.	

Pavement pictures [2]

Has been observed that concretely one of the studied streets presents many pathologies caused by a bad execution of the pavement of the sidewalk. One of the reasons by which big pathologies are observed in this street is for the works of repair or placement of pipelines of services buried, since the technical personnel and workers at the moment of returning to place the pavement it is not execute correctly, because they do not make the steps correctly.

Other one of the reasons is the evil work of repair of torn pieces, replacing, in many cases, the torn part of a piece with other pieces in his place with small size that they do not fit correctly. This pathology owes to an evil exposition in the repair project.

The lack of study and design of joints and joints between materials and elements is different of the reasons for which we find pathologies. This gives place to deficient displacements of the materials or the constructive elements, favoring the production of fissures and cracks. The lack of joints is one of the reasons of the raising of the pieces.



Punctual compression on the base layer [3]

Diagnosis about the used material

As for the material used to realize the pavement, it is made principally of granite and in other cases of concrete.

The granite is an igneous rock with a composition that grants him a very high hardness and a great resistance to the graze. Totally recyclable and ecological, it can find in very different formats, tones and colors. His color is inalterable to the sunbeams, is resistant to the striped one and to all kinds of caustic agents. Due to his high place contained in quartz and feldspar it is the hardest natural stone, superior to all the synthetic materials. For these reason we think that the choice of the granite like material for the pavement is correct.

The concrete is a prefabricated material therefore with good quality to support the traffic of the persons, animals and vehicles at least for 40 years. His resistance will have to be calculated to support the graze due to the traffic since the wear caused in the pieces by the step of the persons or animals is equal or worse than that of the vehicles. His resistance is verified by means of a test to flexion realized by a laboratory. On having treated itself about a prefabricated material and with a calculated resistance we think that it is a good choice, in addition his condition of conservation is good at the studied streets.

4.2. SUITABILITY OF USE. CLIMATOLOGY.

Poland's climate is humid continental, halfway between ocean climate and continental climate. Winters are cold and summers are usually mild.

In general, and due to both its geographical location and the fact that most of the country has a flat relief and is exposed to the winds, makes the weather is quite changeable and unpredictable from one day to another. A sunny day can lead to another cold and rainy day.

Szczecin, being in the west of the country, bordering the Baltic Sea has a more moderate climate, influenced by air masses from the Atlantic Ocean and the Baltic Sea, with mild, wet winters and cool summers with greater amount of precipitation.

As we can observe in the graphics and, as we have said, the clime of Szczecin it's very different, depending of the season in which you are. Temperatures range from a low of -5 ° C in February to a high of 23 º C in July and August. Because of these thermal cycles, when rain or snow wet pavement, it undergoes an increase in volume due to capillary absorption. When the water evaporates, the pavement material is dried and shrinkage occurs exceeding the expansion by increasing moisture. This causes stresses on the material causing erosion and fissures in it.

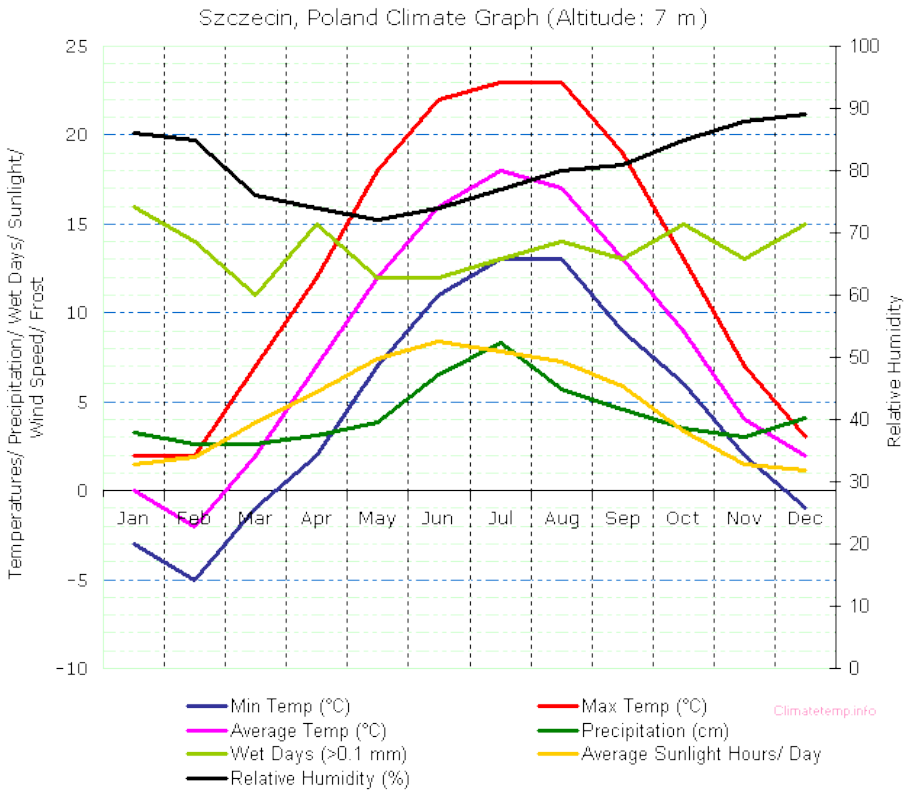
We can see the coefficient of expansion of the different materials used in the execution of pavements in Szczecin:

MATERIAL	Concrete	Granite
THERMAL DILATION	0.3-0.4 mm	0.25 mm

Pieces with 1m long with thermal variation of 30ºC

Low temperatures are a problem because during the hard winter months, low temperatures impede take place works outdoors. The snow during the winter months is another reason to limit the work at this time of year, even more so in our case because it works on the pavement. This low temperature also may cause the water absorbed by the material is frozen, and that causes a dilation of about 9% of the volume of the material, which causes appearance of cracks.

These low temperatures can also cause the expansion of the earth, by freezing, causing movement of parts, and consequently the appearance of fissures and even breaks in them.



Graphic with temperatures, precipitations and humidity of Szczecin [4]

In Poland, precipitations generally are usually low. Szczecin in particular, receives on average 511 mm of precipitation annually, or 43 mm each month. This affects the wear of pavement which erodes the particle dragging over it, especially if the pavement material has a high porosity. It also affects the deterioration of the joints executed with sand, as sand particles drag and causes the progressive emptying of the joint.

The low temperature is one reason for execution of joints by sand. Maybe at first sight can seem wrong because many of the pieces are loose easily. But the main reason for this type of execution is the amount of water that receives this pavement to be in a city with sudden temperature changes, with a lot of snow in winter and some rains in autumn and spring. Rainwater and snow, along with other environmental aspects, such as wind, finally get the joints are less grouting material than necessary. Using the sand got the parts are not completely rigid, one with the other, and can, through the action of expansion and contraction, increase and decrease volume without damaging adjacent pieces. The sand allows free movement and therefore is an efficient solution for pavement joints in this region.

Due to these low temperatures also present in Poland during the colder winter months, there is zoning, according to the depth range of frost under the ground. This determines, in our case, the depth at which drains should be executed as they are drivers of water, and we must prevent it from freezing inside. According to this division, Szczecin is located in zone I, the lowest area in frosts of the country where the minimum depth to which you have to install the drains is 0.8 meters.

Poland divided in zones depending its deph of frost [5]

4.3. ABRASION, WEAR AND OTHER EXTERNAL ACTIONS

To explain the different typologies of pathologies that we can find in Szczecin's pavement we will divide the pathologies that we found in the stony materials, in our case granite and granite with basalt, and in the concrete, since they are both materials that we find in the production of the sidewalks of the city.

PATHOLOGIES OF THE STONY MATERIALS

The problems that we face exposing the stone materials to the environment are the processes of alterations and wear that start suffering from the first instant that they are placed.

"The processes of alteration originate because the new conditions in which they find the stony materials are far much from those thermodynamic conditions in those who were formed.

Thus, the rocks suffer structural and compositional readjustments tending to find a new balance, though many of these processes can derive in hurts of the stony materials."

Encyclopedia BROTO of construction pathologies

The reasons of the stony produced injuries have to be corrected to solve the process pathological that concerns the stone, since to repair the injury implies the elimination of the origin of the same one, since they will continue demonstrating symptoms of the pathological process.

Once placed the material, one of the phenomena that more helps to his with degradation is the utilization of the coal and the oil as fuel. The particles of these fuels, deposit big quantities of residues, transported by the air, on the rocky surfaces, altering them.

<u>Alterations of the stony materials</u>

Dampness

Spots or change of color in the pavement produced by the infiltration of the water in the material or in the joints.

Weathering for abrasion

Originated by the movement of persons' traffic, animals and vehicles, that can translate in detachments, peeling, disintegration and fissures.

Fissures

Clefts or fractures with variable dimensions. The range goes from microfissures up to cracks. They can be formed by mechanical efforts, by processes of putting in work and placement, by corrosion of metallic elements in touch with the stone or by the cycles hydrothermals.

Erosion

Abrasion or the wear that takes place in the stony materials, behaves a loss of volume and a disappearance of the original forms that they were presenting originally. The principal agent of erosion is the wind combined with the passage of time, the water and other environmental agents. The erosion includes the stings, the disintegration and arenisation.

Breaks

It is necessary to distinguish the position of the break, being able to place in the union of elements stony - joint (due to the lack of adherence between them) or in the own element. In our case the joints are realized with sand, for what cracks do not exist in the joints. The choice of the joints with this material can be for the sudden changes of temperature that originate in this city, if a joint is realized with mortar or some type of more rigid material this it would be translated in more pathologies as fissures, cracks and even breaks.

Damage in the sealed one of joints

It arises when they enter incompressible materials and / or water inside the joints.

Patina

The patinas are the thin layers that cover the stones superficially. It is a question of an alteration and superficial modification that they do not imply necessarily that exists a process of deterioration of the material. It produces variations of the superficial aspect of the stone, as consequence of his exhibition to the environment during a considerable time.

- Patinas of ageing

It is a question of the typical tonality that he acquires a stone with the passage of time and with the effects of his exhibition to the environment.

- Patinas of discoloration

It is the natural or artificial discoloration that they can suffer, is the loss of color of the stone. Consequence of the continuous wash of the stony ones with the water of the rain, for example. It is associated with the loss of stony material of the surface normally.

- Biotic patinas

Thin superficial layers of organic character with variable tonalities, composed by alive organisms as lichens, algae or mosses. They award a coloration that can change from the dun dark one to the yellow one, besides green and reddish.

- Patinas of dirt, black patinas

They take place for soiling of the rocky surfaces..

Superficial deposits

It takes place with the accumulation, across the time, of materials of diverse origins on the surfaces. It can be powder, soot, birds excrements, smoke or any type of biological organism. The tonality can change from dark gray (accumulation of powder of the environment) up to white (they come from rocky powdery desinterested materials).

Efflorescence

Are layers or crystalline additions of soluble salts. Whitish, without great consistency and are formed on the surface of porous materials because the phenomena of migration and evaporation. Can cause disintegration and pitting.

- Subefflorescence

Are efflorescence that form under the surface, but near it.

- Criptoeflorescence

Are produced if efflorescence are located in deep layers of the material.

Raising pieces

Superelevation of the surface of pavement, placed generally in zones near to the joints or transverse fissures.

Sinking

Hollow or decrease of the surface of the pavement located in an area. It can be accompanied by a fissuring due to the settlement of the pavement.

Landslides

- By compressing the gripping layer

It is due to the irregularity or low quality of the layer of grasp.

- By dilating infiltrated elements

Infiltrated elements may be salts or water from the ground or salts contained in the grasp layer. When these dilate can even break the pavement.

Disintegration

Landslides of rocky material when a coherence loss exists between the components of the stones. It is recognized by the retraction that is observed with regard to the level and original volume of the external surface. When the disintegration appears, the material alteration is high.

- Disintegration granular or arenisation

The grains are about the size of sand.

- Disintegrating powder or pulverization

The grain size is finer than the sand.

Subdivided slabs

Localized upward movement of the floor surface in areas of joints or cracks, accompanied by fragmentation.

PATHOLOGY OF CONCRETE

Being a prefabricated element we avoid possible pathologies which arise derived concrete components and fabrication and application thereof.

Concrete is a quasi-brittle materials with low deformation capacity under tensile stresses. Mechanical stress, damaging reactions and the environment can cause the development of tensile stresses in the concrete. These tensile stresses result in a cracking that can adversely affect the performance of concrete. However, you can minimize the potential for cracking with proper precautions in the design practices, materials and construction.

Alterations of concrete

Efflorescence

Are layers or crystalline additions of soluble salts. Whitish, without great consistency and are formed on the surface of porous materials because the phenomena of migration and evaporation. Can cause disintegration and pitting.

- Subeflorescence

Are efflorescence that form under the surface, but near it.

- Criptoeflorescence

Are produced if efflorescence are located in deep layers of the material.

Fissures

Clefts or fractures of variable dimensions. The range goes from microfissures up to cracks. They can be formed by mechanical efforts, by processes of putting in work and placement, by corrosion of metallic elements in touch with the stone or by the cycles hydrothermals.

Disintegration

This damage is characterized by a disintegration of the pavement surface by loss of fine material, leaving exposed the coarse aggregate.

Rise of pieces

Superelevation of the road surface, usually located in areas close to transverse joints or cracks.

Organisms in the joints of the pavement

The appearance of organisms in the joints deteriorates pavement surface layers, exposing the sealing and grip material to aggressive agents.

Sinking

Hollow or decrease of the surface of the pavement located in an area. It can be accompanied by a fissuring due to the settlement of the pavement.

Damage in the sealed one of joints

It arises when they enter incompressible materials and / or water inside the joints.

Dampness

Spots or change of color in the pavement produced by the infiltration of the water in the material or in the joints.

Weathering for abrasion

Originated by the movement of persons' traffic, animals and vehicles.

Staggering of joints and cracks

Unevenness two pavement surfaces separated by a transverse joint or crack.

Erosion

Abrasion or wear that behaves a loss of volume and a disappearance of the original forms that they were presenting originally. The principal agent of erosion is the wind combined with the passage of time, the water and other environmental agents.

Breaks

It is necessary to distinguish the position of the break, being able to place in the union of elements stony - joint (due to the lack of adherence between them) or in the own element. In our case the joints are realized with sand, for what cracks do not exist in the joints. The choice of the joints with this material can be for the sudden changes of temperature that originate in this city, if a joint is realized with mortar or some type of more rigid material this it would be translated in more pathologies as fissures, cracks and even breaks.

Stings

Small cavities or holes through erosion or corrosion. Inside can accommodate dispersed stone materials, efflorescence or microorganisms.

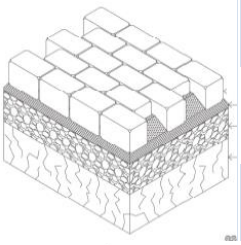
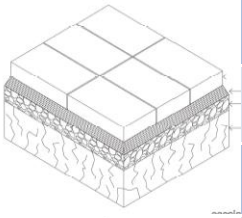
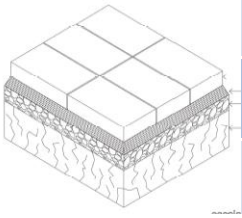
4.4. ENERGY ASSESMENT

Energy saving is a current concern worldwide, spreading all sorts of activity including roads, particularly the various types of pavements.

The power supply conditions have forced both designers, contractors, construction managers, and employers, to worry about the issue and saving alternatives present in pavement construction. For all the above, a new selection criterion has joined the traditional such as investment costs, mechanical properties, performance, durability, construction and maintenance technologies, etc.

The environmental assessment calculates carbon dioxide emissions CO2 and energy consumption for the production of one square meter of floor. For each category attaches pavement as pavement resistance to the action of the loads: A (resistance to light loads and foot traffic), B (medium load resistance and vehicle traffic means) and C (load resistance heavy, and truck traffic). In our case we only have pavement type A, being pedestrian pavements.

The results are shown in the following table:

Typology of pavement	Image		Materials	Medium thickness	Volum	Weight	Embodied energy	CO2 emissions	Class
				(m)	(m3)	(kg)	(MJ)	(kgCO2eq)	
Cobblestone, pedestrian traffic		1	Cobblestone	0.12	0.62	645.6	127.98	15.05	A
		2	Sand	0.05					
		3	Base	0.45					
Flexible tiling		1	Stone tile	0.08	0.63	513.31	118.51	16.07	A
		2	Sand	0.05					
		3	Base	0.5					
Prefabricated concrete tiled		1	Concrete tile	0.07	0.6	423	392.75	39.36	A
		2	Sand	0.03					
		3	Base	0.5					

From calculations of the environmental impact of the pavement, we developed some auxiliary graphs (Figure 1 and Figure 2) for a better understanding of the overall results. Figure 1 reports data on CO2 emissions (kgCO2eq) of pavement per square meter. Figure 2 shows the embodied energy (MJ) and weight (kg) of pavements.

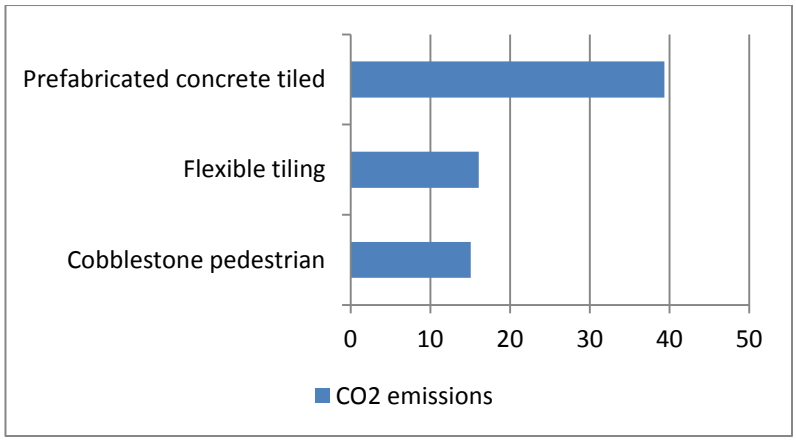


Figure 1: CO2 emissions (kgCO2eq) per square meter of the types of pavements [2]

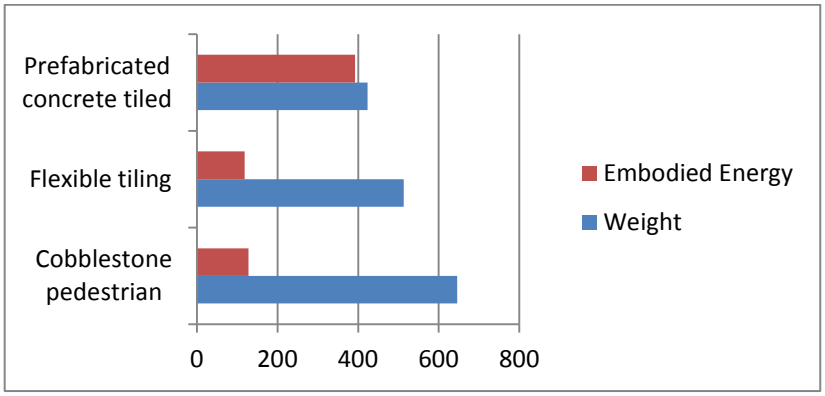


Figure 2: Embodied energy (MJ) and weight (kg) per square meter of the types of pavements [2]

From these graphs we extract the pavement executed with prefabricated concrete tiles releases much more CO2 than when dealing with natural stone paving. Besides the energy it contains concrete pavement, equal to 40%, rather than containing natural stone tiles, and 36% more than natural stone cobblestones.

To conclude, we can say that the type of flooring used more respectful of the environment is executed based on natural stone. The values of the concrete pavement are far stony material, and we believe that is not a material that should be of having to execute pavement, while we can use natural stone.

The life of the materials used is linked to the use that is given and the factors that may attack its condition. Regarding the use, we can refer to the pathologies that appear in the pavement caused by the execution of the (4.1), or alternatively, to the fact that during cold with snowfall using salt water to thaw and prevent people from slipping.

Crystallization of soluble salts, such as salt (NaCl) is the most important process in regards to alterations in rock material. Once the salt is deposited on the pavement, as the temperature increases stones water evaporates and crusts poducen, efflorescence and patina.

4.5. MAINTENANCE ASSESMENT

Perform proper maintenance of pavement, with cleaning operations planning and regular monitoring and documentation of all interventions over the life of the pavement, directly influences the useful life that it can have.

This maintenance tries to that the deterioration of the elements slowdowns. It should include periodic reviews and monitoring of pavement alteration factors.

A proper maintenance plan allows preventive measures such as protecting and strengthening without resorting to global replacement pavement.

<table>
<tr><th>MAINTENANCE OPERATIONS</th><th>STONE PAVEMENT</th><th>CONCRETE PAVEMENT</th></tr>
<tr><td>Periodic visual inspections</td><td colspan="2">1. It is necessary to observe that there have been no damages in the stone pieces.
2. Is advisable to check the following pathological processes every two years on the floors: chemical-mechanical erosion, accidental wet hair, landslides, cracks and fissures.</td></tr>
<tr><td>Scheduled Cleaning</td><td>3. You must do the best cleaning method with appropriate frequency to avoid the appearance of injuries related to the accumulation of dirt.
4. The requirements to be taken into account regarding the method of cleaning are:
• The cleaning speed should be slow to control the effects that occur.
• The selected method not has to produce altering the stone elements.
• The method used should not damage the surface of the workpiece.</td><td>5. Periodically clean the floor made by pressure stream of water. Avoiding such cleaning during the winter to prevent frost. This cleaning is effective in removing dirt from the pavement surface.</td></tr>
<tr><td rowspan="2">Snow removal</td><td colspan="2">6. The snow removal on sidewalks must be performed by each owner of the portion of sidewalk that occupies your home. So the sidewalks are divided into portions, whose owner must be concerned with removal of snow from its corresponding section. For academic areas, the university is responsible for snow removal stretch.</td></tr>
<tr><td></td><td>8. In this case, with</td></tr>
</table>

	7. Snow removal can be carried out by hand (with shovels and brooms) and by machine. This procedure should be performed in a manner which does not damage the pavement surface.	joints resolved with mixture of sand and mortar, as well as shovels and brooms, can also carry out snow removal by anti-icing and deicing chemicals, used with care, because chemical residues left on the surface can penetrate the joints and cause staining and efflorescence.
Filling joints check	9. In the case of sand joints, that over time, due to wind, rain and other means, the sand within the top portions of joints can be eroded. Therefore, the joints should be periodically resanded.	10. It is necessary to regularly monitor the state of the joints of the pavement, checking the filling and sealing the joints.
Drainage	11. It have to check periodically that the drainage system (all of its components) find oneself in well conditions.	
Variations from the projected use	12. If the pavement was initially designed as a pedestrian zone, will be transited for example by traffic circulation, is recommended to intensify inspection and repair work on time to avoid progressive degradation of the pavement.	

4.6. PATHOLOGY SHEETS

At this point, we have to make sheets about the pathology observed. Preventive pathology consists in considering the functionality construction of the elements and units composing a construction, durability and integrity. This involves a series of measures of building design, material selection, maintenance and use, as well as a prior definition of the different possible interventions.

From here, we can decide between the most appropriate measures to reverse the pathological process and to carry out a repair that is reflected in the lesions sheets.

Lesions are each of the constructive problems manifestations, the final symptom of the pathological process. In many cases the lesions may be the source of other and not in isolation but often appear confused with each other. Therefore, it should isolate the "primary lesion," which is that which arises first, and lesions that appear as a result of this, "secondary lesions."

If the lesion is what originates the pathological process, the cause is the first object of study because it is the true origin of the lesions. A pathological process will not be solved until it is not annulled the cause.

Interventions can be repairs, to recover the state of construction, and return to the unity injured the original architectural functionality. First, it acts on the origin cause or causes and once detected and resolved is updated on lesions.

Another type of intervention is the restoration, when the repair is focused on a specific item or a decorative object.

Prevention applies when you want to avoid the appearance of new processes. In the prevention will be, above all, the elimination of the direct causes that affect the initial phase of project execution and maintenance.

DAMAGES

CORRECTIVE/CORRECTING MANTEINANCE

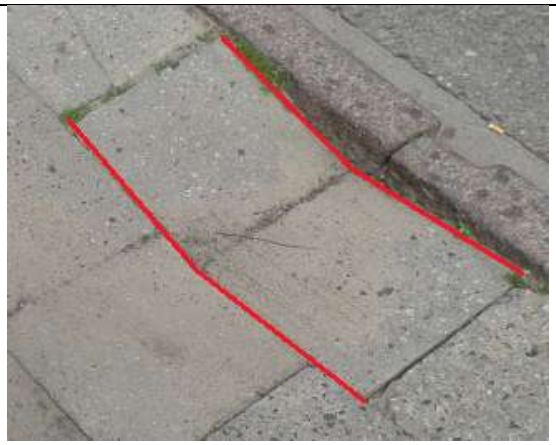
INSPECTION SHEET. DATA COLLECTION

KIND OF LESIÓN

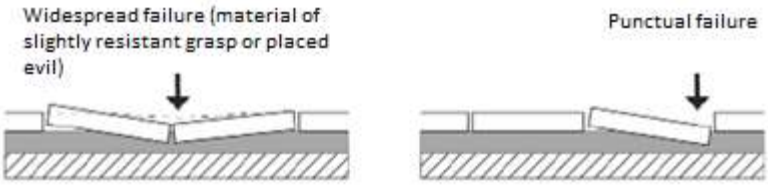
Sink. Decrease of the surface of the pavement.

N PHOTO	DATE	LOCATION
1		Aleja Piastow

DESCRIPTION OF LESION



1. Tiles have sinking, decreased pavement surface, causing a slope in the pavement. Dirt accumulates in the joint with sinking.



2. In times of rain or snow, the water remains stagnant, with no possibility evacuation, and penetrates into joints and in the porous material, such as concrete, soluble salts can be dragged and cause efflorescence, disintegration of the material, dampness or damaged seal joints.

3. Emergence of organisms in the joints of the pavement, this lesion can cause other lesions to left exposed to aggressive agents the sealing material.

4. Disintegration, erosion and weathering abrasion of the pavement surface, causing the loss of fine material.

POSIBLE CAUSES

1. The sinking of the tiles is due to the compression of the sand bed, occurs when it is mechanically weak because of lack compaction in the execution process or by a patchy distribution of the sand bed. Another possible cause overloading of use, considering that it is allowed the parking of vehicles on sidewalks and that these are not calculated to support that weight.

2. The joints have little material in the sealing of joints. By sinking the pieces the joints are exposed to the elements (water, wind, etc.), Losing its cohesion and creating dampness. The rainwater may drag sealing material from the parts as the wind. When water seeps through the joints and temperatures drop, this makes the material volume increase, eroding the joint and the pieces.

3. The appearance of organisms in the joints of the pavement is due to water or dampness accumulation in these areas. These microorganisms and plant parasites deteriorate the surface layers of the pavement.
4. The presence of wear, abrasion and disintegration in the pavement can be due to various factors, or even all of them combined.
   - The wind spear or drag particles against surfaces, wearing surface.
   - - Water from rain, hail or snow hits the pavement, wears the material and causes pilling and particle drag. In turn, the water wets the materials increasing its volume upon contact with porous materials. When the absorbed water is evaporated to dry the material, it suffers a retraction exceeding the dilation caused by increased humidity. Repetition of this phenomenon in cycles, creates tensions that end eroding the pavement and sometimes cracking it.
   - Another cause is the traffic of people and vehicles on the pavement. This translates to material wear, erosion and abrasion. Considering that the vehicles parked on the sidewalks, we can interpret that the finished pavement material is not prepared for such wear more aggressive than pedestrian traffic.

DESCRIPTION OF THE POSSIBLE INTERVENTIONS

Depending on the state of the pieces of the area the interventions to perform are as follows:

- If the failure is widespread, there is no other solution than make the replacement of pavement with one that conforms to the needs and solicitations.
- If after studying the lesion, it is concluded that its scope is punctual, will be reset and affected parts of the environment, taking into account the cut of the stones and their textural characteristics. It is advisable to make a boxing for receiving the piece.
- Where be possible, it will attempt to recover the appearance of the pavement, with a healthy superficial.

1. In the absence of material in the joints of the pieces, it will first check if the pathology also affects the sand bed, if so, it need to lift the pavement to properly compact the layer. If the problem is only in the joints, without disturbing the sand bed will be held the following interventions:
   - If the pavement is solved with sand seal material, the filling of these by sweeping sand. After this, we moisten and vibrate the area to seat properly compacted sand and tiles.

2. If the pathology is caused by the presence of organisms, the intervention will be: will proceed to the elimination of these and will value the damage caused by them. If the damage is of considerable size, will be replaced or damaged parts. In the event that damage has not occurred extremely important, apply repellents to prevent this type of lesion. Depending on the organism involved the treatment is as follows:
   - - In the case of mold, lichens and mosses, its appearance is due to the damp, so you should act on it and proceed to a thorough cleaning to subsequently apply a treatment or product that prevents new onset of these.
   - - In the case of appearance of plants, you must make a cleaned up and repair, using an anti-root treatment. New planting should be controlled to prevent new lesions.

3. The lesion caused by erosion, abrasion and disintegration on the pavement (all physical or mechanical causes) have different actions according to the damage we want to repair:
   - The lesions due to erosion may be caused by changes in temperature or the water from the rain, against what they cannot act.
   - It may also have been caused by dampness or water leakage, if so, will proceed to the replacement of damaged pieces and application of sealants and consolidation to prevent the passage of water.
   - The lesions due to abrasion, wear and disintegration, caused in most cases by traffic circulation, will proceed with a surface finish similar to the original or replacement of the damaged element when the loss of material is considerable.

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DAMAGES

CORRECTIVE/CORRECTING MANTEINANCE

INSPECTION SHEET. DATA COLLECTION

KIND OF LESIÓN

Erosion of the pavement and efflorescence.

N PHOTO	DATE	LOCATION
2		Aleja Piastow

DESCRIPTION OF LESION

1. The tiles show an advanced state of erosion and disintegration of the pavement surface, causing a loss of its original volume and shape.
2. White spots are observed on the surface of the pavement, these spots are efflorescence.
3. Cracks in the corner of the tile that intersects a transversal with a longitudinal joint.
4. Absence of joint material thickness in the pieces of the picture 1.
5. Dampness stains on the pavement and joints. The state of disintegration and wear in which are the pieces, facilitates the accumulation of water due to the cavities or holes that it presents, where the water stagnates and penetrates into the joints being able to drag soluble salts and can cause efflorescence, disintegration damaged material and sealing the joints (little seal material).
6. Stings on the surface of the tiles, small cavities or holes where dirt accumulates, efflorescence or microorganisms.

POSIBLE CAUSES

1. Erosion and disintegration of the material may be due to several factors:
   - The wind throws particles against the surfaces, or drags these particles on its surface wearing them.
   - Water from rain, snow or hail hits the pavement, wears the material and causes pilling and particle dragging.
     "Another problem caused by the action of water is manifested through wetting and drying cycle. Rain, or snow, wets building materials and porous materials experience an increase in volume by the action of water to the radial compression caused by capillary absorption. When the absorbed water evaporates the material undergoes a shrinkage which is greater than the expansion caused by increased humidity. Repetition of this phenomenon creates tensions cycles finally affect the material and cause its erosion or the appearance of cracks. The worst damage was caused when the water inside freezes, a fact that not only reaches erosions, broken also."
     "Encyclopedia of Broto Construction Pathologies"
   - Another cause is the traffic of people and vehicles on the pavement. This results in wear, erosion and abrasion of the material. Considering that the vehicles parked on the sidewalks, we can interpret that the finished pavement material is not prepared for such wear more aggressive than pedestrian traffic.

2. The whitish efflorescence stains are formed by water soluble salts drag, the water entering the pavement may come from various sources: rainwater or snow that seeps through the pores of the material and groundwater, which goes through the capillaries of the part. This water carries soluble salts when humidity evaporates; the dissolved salts crystallize forming white stains, efflorescence. These spots cause erosion of both the piece as the joint material. When temperatures drop it increases in volume and can break the pieces, or even make it go away the sealing material.

3. In the picture one we can observe the absence of material and thickness of joints. The crack observed, may be due to the expansion-contraction cycles suffered by the materials with changing temperature, the lack of joint causes collisions between tiles, causing cracks and even breaks.
   Another possible cause is the temperature increase caused by the heating of the surface, tending to expand, but its movement will be restricted to the inside, which is colder. The result is a compression in the material surface and traction on the inside. These stresses can cause cracking and breakage. It may happen that the surface of the material cool down, and the interior is hot, this results in cracks on its surface.
   It may also be due to a loss of support layer or bed of sand erosion. This causes the load transfer not be performed correctly and rupture appears in the corner of this kind.
   Another cause can be when water freezes inside the material is likely to cause fractures.

4. The absence of thickness joints of first photo is due to a bad performance of joints, and pavement in general. There is no possible physical space in which to host the grouting material, so that the cause is the poor execution.

5. Dampness may appear to absorb water from the soil, capillary water or by filtration, caused by the action of rain and wind.
   - The construction materials with porous structure with large pores communication, as is the case of concrete, they facilitate capillary rise quite marked.
   - Moisture filtration is caused by the water coming from the outside and into the interior of the pavement.

   The fact that there is a large deterioration in the pavement surface causes the water, rain or snow, can remain stagnant in the surface. If we consider that the presence of this type of pathology is in concrete tiles oldest and that this type of concrete has many pores, thus resulting in the presence of significant stains.

6. Stings appearing on the pavement due to erosion are thereof, to form the cavities leads to the accumulation of dirt in the same material, to create more efflorescence or microorganisms.

DESCRIPTION OF THE POSSIBLE INTERVENTIONS

Depending on the state of the pieces of the area the interventions to perform are as follows:

- If the failure is widespread, there is no other solution than make the replacement of pavement with one that conforms to the needs and solicitations.
- If after studying the lesion, it is concluded that its scope is punctual, will be reset and affected parts of the environment, taking into account the cut of the stones and their textural characteristics. It is advisable to make a boxing for receiving the piece.
- Where possible, it will attempt to recover the appearance of the pavement, with a healthy superficial.

1. The lesion caused by wear, abrasion and disintegration on the pavement (all physical or mechanical causes) have different actions according to the damage we want to repair:
   - The lesions due to erosion may be caused by changes in temperature or the water from the rain, against what they cannot act. It may also have been caused by dampness or water leakage, if so, will proceed to the replacement of damaged pieces and application of sealants and consolidation to prevent the passage of water.
   - The lesions due to abrasion, wear and disintegration, caused in most cases by traffic circulation, will proceed with a surface finish similar to the original or replacement of the damaged element when the loss of material is considerable.

2. If we identify efflorescence means that pieces contain some soluble salt that has been diluted by water filtration. Must be analyzed the source of the dampness and eliminate it and make a proper cleaning with suitable product type depending on the type of salt crystallized and its solubility as well as the material on which crystallizes.

3. In the absence of material in the joints of the pieces, it will first check if the pathology also affects the sand bed, if so, it need to lift the pavement to properly compact the layer. If the problem is only in the joints, without disturbing the sand bed will be held the following interventions:
   - If the pavement is solved with sand seal material, the filling of these by sweeping sand. After this, we moisten and vibrate the area to seat properly compacted sand and tiles.

4. If there is a improper performance of the joint between paving will proceed to reposition the tiles, with the necessary joint.

5. In the presence of dampness, depending on their origin will be different actions:
   - Dampness by capillarity: It must have adequate drainage to keep water off the pavement or introduce some kind of impermeable barrier to prevent direct contact with the soil.
   - Humidity by filtration: It should be sealed, the entrance of water or, if it is due to the properties of the piece due to deterioration or some other reason, will proceed to the replacement of the piece.

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DAMAGES

CORRECTIVE/CORRECTING MANTEINANCE

INSPECTION SHEET. DATA COLLECTION

KIND OF LESIÓN

Staggering of joints and cracks.

N PHOTO	DATE	LOCATION
3		Aleja Piastow and Uliecia J. Sowinskiego

DESCRIPTION OF LESION



1. The tiles are staggered with respect to the slabs of granite and gneiss, appearing, a decrease or grade than two pavement surfaces separated by a joint.

2. Little joint thickness and sealing material is eroded. In times of rain or snow water remains stagnant, with no possibility of escape, and penetrates into joints and in the porous material like concrete being able to drag soluble salts and being able to cause efflorescence, disintegration of the material, dampness or damaged sealing joints.

3. Dampness stains are seen on the finish, in addition of surface deposits, due to the accumulation over time of different materials can be soot, feces, smoke or any other type of biological organism.

4. Disintegration, erosion and weathering abrassion of the pavement surface, causing the loss of fine material.

5. Breakage corners of some parts of the pavement.

POSIBLE CAUSES

1. The sinking of the tiles is due to compression of the sand bed, occurs when it is mechanically weak for lack compaction in the execution process or by a patchy distribution of the sand bed. This cause is very likely since this lesion affects several stretches of Piastow Street, and has been observed which are stretches where repairs have been made drainage or placement of service lines. This is a poor execution of the pavement.
   Another possible cause overloading of use, given that it allows the parking of vehicles on sidewalks and that these are not calculated to support that weight.

2. Joints have different thickness, as well as little material in the sealing of joints.
   The fact that presents different thickness is due to poor forecasting of joints in the execution process, or in the execution project the gasket thickness is not specified.
   Joints are exposed to the weather (water, wind, etc), Losing its cohesion and creating dampness. The rainwater may drag sealing material as the wind. When water seeps through the joints and temperatures drop, this increase material's volume eroding the joints and the pieces. The rainwater washes away soluble salts ending in the creation of efflorescence; this erodes both parts and joints.

3. Wet spots observed are due to water infiltration by capillary material. When the material has many pores is very easy for these spots appear and especially with items placed outdoors. The pavement absorbed through his pores and capillaries groundwater and rain / snow / hail. Water containing dissolved salts as moisture is evaporated, dissolved salts are crystallized and degrades the stone. It may not be envisaged less porous material or a finish dampness resistant and therefore this type of moisture appear.
   Surface deposits are due to the passage of animals on the pavement or simply pollution. It is a direct cause of the lack of maintenance.
   Besides the pavement is no good to drain properly, so that water can be sealed on the surface when it rains and snows.

4. The presence of erosion, abrasion and disintegration in the pavement can be due to various factors, or even all of them together.
   - The wind throws particles against the surfaces, or drag over them, wearing their surface.
   - Water from rain, hail or snow hits the pavement, wearing the material and causes landslides and particle drag. In turn, the water wets the materials increasing its volume on contact with porous materials. When the absorbed water is evaporated when the material is dry, it undergoes a bigger retraction than the dilation caused by increased humidity. Repetition of this phenomenon in cycles, creating tensions that end in eroding the pavement and sometimes cracks.
   - Another cause is the traffic of people and vehicles on the pavement. This translates to material wear, erosion and abrasion. Considering that the vehicles parked on the sidewalks, we can interpret that the finished pavement material is not ready for such wear more aggressive than pedestrian traffic.

5. The corner breaks we observed may be due to various causes:
   - Shocks or hit the pavement that has made this break.
   - A poor compaction or poor pavement load transfer to the sand bed. The pieces are not supported properly, and with the passage of pedestrians or specific efforts are created breaks.
   - The lack of thickness in the joints can cause cracks and breaks in the materials. With the temperature cycling and contraction-expansion of the material, parts can get to push each other and get to the rupture of the material.

DESCRIPTION OF THE POSSIBLE INTERVENTIONS

Depending on the state of the pieces of the area the interventions to perform are as follows:

- If the failure is widespread, there is no other solution than make the replacement of pavement with one that conforms to the needs and solicitations.
- If after studying the lesion, it is concluded that its scope is punctual, will be reset and affected parts of the environment, taking into account the cut of the stones and their textural characteristics. It is advisable to make a boxing for receiving the piece.
- Where be possible, it will attempt to recover the appearance of the pavement, with a healthy superficial.

1. In the case of the pieces present sinking will be lifted the pieces to compact the sand bed properly and will reposition the pavement.

2. In the absence of material in the joints of the pieces, it will first check if the pathology also affects the sand bed, if so, it need to lift the pavement to properly compact the layer. If the problem is only in the joints, without disturbing the sand bed will be held the following interventions:
   - If the pavement is solved with sand seal material, the filling of these by sweeping sand. After this, we moisten and vibrate the area to seat properly compacted sand and tiles.

3. In the presence of dampness, depending on their origin will be different actions:
   - Dampness by capillarity: It must have adequate drainage to keep water off the pavement or introduce some kind of impermeable barrier to prevent direct contact with the soil.
   - Dampness by filtration: It should be sealed, the entrance of water or, if it is due to the properties of the piece due to deterioration or some other reason, will proceed to the replacement of the piece.

4. The lesions caused by erosion, abrasion and disintegration on the pavement (all physical or mechanical causes) have different actions according to the damage we want to repair:
   - The lesions due to erosion may be caused by changes in temperature or the water from the rain, against what they cannot act.
   - It may also have been caused by dampness or water leakage, if so, will proceed to the replacement of damaged pieces and application of sealants and consolidation to prevent the passage of water.
   - The lesions due to abrasion, wear and disintegration, caused in most cases by traffic circulation, will proceed with a surface finish similar to the original or replacement of the damaged element when the loss of material is considerable.

5. In pieces breakages will check if this lesion also affects the sand bed, not to be well consolidated:
   - If so, you should raise the pavement to compact properly sand.
     If the lesion is punctual, the piece is replaced by another with similar characteristics to the existing ones.
   - If it is by thermal expansion material inside of the stone must also be replaced or affected parts.

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DAMAGES

CORRECTIVE/CORRECTING MANTEINANCE

INSPECTION SHEET. DATA COLLECTION

KIND OF LESIÓN

Wrong constructive solution.

N PHOTO	DATE	LOCATION
2		Aleja Piastow.

DESCRIPTION OF LESION

1. Break in the corner of granite slab, it intersects a transverse joint with a longitudinal joint.
2. Placing different types of pieces like broken piece solution. The consequence of this is that the pieces do not fit positioned properly in the hollow and they have other joints separation, the smaller angle corners are left without finishing material, employing the sealing material as a finish.
3. Dampness stains are seen on the finish, as well as surface deposits, due to the accumulation over time of different materials can be soot droppings or any other type of biological organism.
4. Disintegration, erosion and abrasion wear of the road surface, causing loss of its original volume and exterior finish. The surface has stings.
5. Different gasket thickness, there is no uniformity of joints, as well as erosion of the sealing material.
6. Aging patina, discoloration patinas and black patinas or dirt.

POSIBLE CAUSES

1. The corner breaks we observed may be due to various causes:
   - Shocks or hit the pavement that has made this break.
   - A poor compaction or poor pavement load transfer to the sand bed. The pieces are not supported properly, and with the passage of pedestrians or specific efforts are created breaks.
   - The lack of thickness in the joints can cause cracks and breaks in the materials. With the temperature cycling and contraction-expansion of the material, parts can get to push each other and get to the rupture of the material.

2. The pieces placed as a solution of the breakage of the main piece, do not fit the space. This is due to a bad approach to repair broken parts. A bad pavement repair project may cause other injuries. The decision to repair granite slabs with granite stones, may be due to a lack of repair project, poor pavement study, or even to low budget for the repair project.

3. Wet spots observed are due to water infiltration by capillary material. When the material has many pores is very easy for these spots appear and especially with items placed outdoors. The pavement absorbed through his pores and capillaries groundwater and rain / snow / hail. Water containing dissolved salts as moisture is evaporated, dissolved salts are crystallized and degrades the stone. It may not be envisaged less porous material or a finish dampness resistant and therefore this type of moisture appear.
   Surface deposits are due to the passage of animals on the pavement or simply pollution. It is a direct cause of the lack of maintenance.
   Besides the pavement is no good to drain properly, so that water can be sealed on the surface when it rains and snows.

4. The presence of erosion, abrasion and disintegration in the pavement can be due to various factors, or even all of them together.
   - The wind throws particles against the surfaces, or drag over them, wearing their surface.
   - Water from rain, hail or snow hits the pavement, wearing the material and causes landslides and particle drag. In turn, the water wets the materials increasing its volume on contact with porous materials. When the absorbed water is evaporated when the material is dry, it undergoes a bigger retraction than the dilation caused by increased humidity. Repetition of this phenomenon in cycles, creating tensions that end in eroding the pavement and sometimes cracks.
   - Another cause is the traffic of people and vehicles on the pavement. This translates to material wear, erosion and abrasion. Considering that the vehicles parked on the sidewalks, we can interpret that the finished pavement material is not ready for such wear more aggressive than pedestrian traffic.

5. Joints have different thickness, as well as little material in the sealing of joints.
   The fact that presents different thickness is due to poor forecasting of joints in the execution process, or in the execution project the gasket thickness is not specified.
   Joints are exposed to the weather (water, wind, etc), Losing its cohesion and creating dampness. The rainwater may drag sealing material as the wind. When water seeps through the joints and temperatures drop, this increase material's volume eroding the joints and the pieces. The rainwater washes away soluble salts ending in the creation of efflorescence; this erodes both parts and joints.

6. The patinas observed are due to the passage of time and material usage. Its appearance may be a lack of maintenance, but even so this injury always appears in all kinds of stone material over time.

DESCRIPTION OF THE POSSIBLE INTERVENTIONS

Depending on the state of the pieces of the area the interventions to perform are as follows:

- If the failure is widespread, there is no other solution than make the replacement of pavement with one that conforms to the needs and solicitations.
- If after studying the lesion, it is concluded that its scope is punctual, will be reset and affected parts of the environment, taking into account the cut of the stones and their textural characteristics. It is advisable to make a boxing for receiving the piece.
- Where be possible, it will attempt to recover the appearance of the pavement, with a healthy superficial.

1. In pieces breakages will check if this lesion also affects the sand bed, not to be well consolidated:
   - If so, you should raise the pavement to compact properly sand.
     If the lesion is punctual, the piece is replaced by another with similar characteristics to the existing ones.
   - If it is by thermal expansion material inside of the stone must also be replaced or affected parts.

2. In the case of incorrect placement of other pieces to solve breakage, will be gradually lifted the piece to place one, according to the characteristics of the other pieces around.

3. In the presence of dampness, depending on their origin will be different actions:
   - Dampness by capillarity: It must have adequate drainage to keep water off the pavement or introduce some kind of impermeable barrier to prevent direct contact with the soil.
   - Dampness by filtration: It should be sealed, the entrance of water or, if it is due to the properties of the piece due to deterioration or some other reason, will proceed to the replacement of the piece.

4. The lesion caused by erosion, abrasion and disintegration on the pavement (all physical or mechanical causes) have different actions according to the damage we want to repair:
   - The lesions due to erosion may be caused by changes in temperature or the water from the rain, against what they cannot act.
   - It may also have been caused by dampness or water leakage, if so, will proceed to the replacement of damaged pieces and application of sealants and consolidation to prevent the passage of water.
   - The lesions due to abrasion, wear and disintegration, caused in most cases by traffic circulation, will proceed with a surface finish similar to the original or replacement of the damaged element when the loss of material is considerable.

5. The lesion caused by erosion, abrasion and disintegration on the pavement (all physical or mechanical causes) have different actions according to the damage we want to repair:
   - The lesions due to erosion may be caused by changes in temperature or the water from the rain, against what they cannot act.
   - It may also have been caused by dampness or water leakage, if so, will proceed to the replacement of damaged pieces and application of sealants and consolidation to prevent the passage of water.
   - The lesions due to abrasion, wear and disintegration, caused in most cases by traffic circulation, will proceed with a surface finish similar to the original or replacement of the damaged element when the loss of material is considerable.

6. When the stone is altered because it presents a thin scab, repair consists in the elimination of such scab by mechanical or chemical means.

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DAMAGES

CORRECTIVE/CORRECTING MANTEINANCE

INSPECTION SHEET. DATA COLLECTION

KIND OF LESIÓN

Corner break.

N PHOTO	DATE	LOCATION
1		Aleja Piastow.

DESCRIPTION OF LESION

1. Break in the corner of granite slab, it intersects a transverse joint with a longitudinal joint.
2. Joints with small thickness and little sealing material, even in some case the sealing material has been completely eroded to disappear.
3. Dampness stains on sealing material.
4. Disintegration, erosion and abrasion wear of the road surface, causing loss of its original volume and exterior finish.
5. Aging patina, discoloration patinas and black patinas or dirt.

POSIBLE CAUSES

1. The corner breaks we observed may be due to various causes:
   - Shocks or hit the pavement that has made this break.
   - A poor compaction or poor pavement load transfer to the sand bed. The pieces are not supported properly, and with the passage of pedestrians or specific efforts are created breaks.
   - The lack of thickness in the joints can cause cracks and breaks in the materials. With the temperature cycling and contraction-expansion of the material, parts can get to push each other and get to the rupture of the material.

   In this case, the last cause is most likely because it is observed that the joint is practically nonexistent.

2. Joints have little thickness, as well as little material in the sealing of joints.
   The fact that presents little thickness is due to poor forecasting of joints in the execution process, or in the execution project the gasket thickness is not specified.
   Joints are exposed to the weather (water, wind, etc), Losing its cohesion and creating dampness. The rainwater may drag sealing material as the wind. When water seeps through the joints and temperatures drop, this increase material's volume eroding the joints and the pieces. The rainwater washes away soluble salts ending in the creation of efflorescence; this erodes both parts and joints.

3. Wet spots observed are due to water infiltration by capillary material. When the material has many pores is very easy for these spots appear and especially with items placed outdoors. The pavement absorbed through his pores and capillaries groundwater and rain / snow / hail. Water containing dissolved salts as moisture is evaporated, dissolved salts are crystallized and degrades the stone. It may not be envisaged less porous material or a finish dampness resistant and therefore this type of moisture appear.
   Surface deposits are due to the passage of animals on the pavement or simply pollution. It is a direct cause of the lack of maintenance.
   Besides the pavement is no good to drain properly, so that water can be sealed on the surface when it rains and snows.

4. The presence of erosion, abrasion and disintegration in the pavement can be due to various factors, or even all of them together.
   - The wind throws particles against the surfaces, or drag over them, wearing their surface.
   - Water from rain, hail or snow hits the pavement, wearing the material and causes landslides and particle drag. In turn, the water wets the materials increasing its volume on contact with porous materials. When the absorbed water is evaporated when the material is dry, it undergoes a bigger retraction than the dilation caused by increased humidity. Repetition of this phenomenon in cycles, creating tensions that end in eroding the pavement and sometimes cracks.
   - Another cause is the traffic of people and vehicles on the pavement. This translates to material wear, erosion and abrasion. Considering that the vehicles parked on the sidewalks, we can interpret that the finished pavement material is not ready for such wear more aggressive than pedestrian traffic.

5. The patinas observed are due to the passage of time and material usage. Its appearance may be a lack of maintenance, but even so this injury always appears in all kinds of stone material over time.

DESCRIPTION OF THE POSSIBLE INTERVENTIONS

Depending on the state of the pieces of the area the interventions to perform are as follows:

- If the failure is widespread, there is no other solution than make the replacement of pavement with one that conforms to the needs and solicitations.
- If after studying the lesion, it is concluded that its scope is punctual, will be reset and affected parts of the environment, taking into account the cut of the stones and their textural characteristics. It is advisable to make a boxing for receiving the piece.
- Where be possible, it will attempt to recover the appearance of the pavement, with a healthy superficial.

1. In pieces breakages will check if this lesion also affects the sand bed, not to be well consolidated:
   - If so, you should raise the pavement to compact properly sand.
     If the lesion is punctual, the piece is replaced by another with similar characteristics to the existing ones.
   - If it is by thermal expansion material inside of the stone must also be replaced or affected parts.

2. In the absence of material in the joints of the pieces, it will first check if the pathology also affects the sand bed, if so, it need to lift the pavement to properly compact the layer. If the problem is only in the joints, without disturbing the sand bed will be held the following interventions:
   - If the pavement is solved with sand seal material, the filling of these by sweeping sand. After this, we moisten and vibrate the area to seat properly compacted sand and tiles.

3. In the presence of dampness, depending on their origin will be different actions:
   - Dampness by capillarity: It must have adequate drainage to keep water off the pavement or introduce some kind of impermeable barrier to prevent direct contact with the soil.
   - Dampness by filtration: It should be sealed, the entrance of water or, if it is due to the properties of the piece due to deterioration or some other reason, will proceed to the replacement of the piece.
   -
4. The lesion caused by erosion, abrasion and disintegration on the pavement (all physical or mechanical causes) have different actions according to the damage we want to repair:
   - The lesions due to erosion may be caused by changes in temperature or the water from the rain, against what they cannot act.
   - It may also have been caused by dampness or water leakage, if so, will proceed to the replacement of damaged pieces and application of sealants and consolidation to prevent the passage of water.
   - The lesions due to abrasion, wear and disintegration, caused in most cases by traffic circulation, will proceed with a surface finish similar to the original or replacement of the damaged element when the loss of material is considerable.

5. When the stone is altered because it presents a thin scab, repair consists in the elimination of such scab by mechanical or chemical means.

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DAMAGES

CORRECTIVE/CORRECTING MANTEINANCE

INSPECTION SHEET. DATA COLLECTION

KIND OF LESIÓN

Raising pieces.

N PHOTO	DATE	LOCATION
2		Aleja Piastow.

DESCRIPTION OF LESION

1. Tile rising concrete tiles, there is the material of the gripping layer, or sand bed overhanging the sides of the raised parts.
2. Joints with small thickness and little sealing material, and sealing material are eroded.
3. Disintegration, erosion and abrasion wear of the road surface, causing loss of its original volume and exterior finish.
4. Accumulation of dirt on the pavement. Dirt is mixed with the fixing material, which has left his position.

POSIBLE CAUSES

1. The rise of the tiles can be due to various causes:
   - By the action of water. The water penetrates the pavement joints and reach the sand bed, when temperatures drop, water along with the salts it drags, increase in volume, this makes the slabs rise and the material of the sand go out of position.
   - The small thickness also affects joints, this does not allow the pieces to dilate in its expansion-contraction cycles and may cause the pieces out of position.
   - Another cause may be a bad leveling of the pavement and the sand bed. If we do not executed properly compacting and leveling it, the parts are without good leveling and can be sunken or raised over others. This makes it easier pavement erosion.
   - By the action of tree roots, tree roots are buried and if there are nearby trees these can affect the pavement raising it and creating other injuries.

2. Joints have little thickness, as well as little material in the sealing of joints.
   The fact that presents little thickness is due to poor forecasting of joints in the execution process, or in the execution project the gasket thickness is not specified.
   Joints are exposed to the weather (water, wind, etc), Losing its cohesion and creating dampness. The rainwater may drag sealing material as the wind. When water seeps through the joints and temperatures drop, this increase material's volume eroding the joints and the pieces. The rainwater washes away soluble salts ending in the creation of efflorescence; this erodes both parts and joints.

3. The presence of erosion, abrasion and disintegration in the pavement can be due to various factors, or even all of them together.
   - The wind throws particles against the surfaces, or drag over them, wearing their surface.
   - Water from rain, hail or snow hits the pavement, wearing the material and causes landslides and particle drag. In turn, the water wets the materials increasing its volume on contact with porous materials. When the absorbed water is evaporated when the material is dry, it undergoes a bigger retraction than the dilation caused by increased humidity. Repetition of this phenomenon in cycles, creating tensions that end in eroding the pavement and sometimes cracks.
   - Another cause is the traffic of people and vehicles on the pavement. This translates to material wear, erosion and abrasion. Considering that the vehicles parked on the sidewalks, we can interpret that the finished pavement material is not ready for such wear more aggressive than pedestrian traffic.

4. The dirt accumulated due to poor maintenance of pavements.

DESCRIPTION OF THE POSSIBLE INTERVENTIONS

Depending on the state of the pieces of the area the interventions to perform are as follows:

- If the failure is widespread, there is no other solution than make the replacement of pavement with one that conforms to the needs and solicitations.
- If after studying the lesion, it is concluded that its scope is punctual, will be reset and affected parts of the environment, taking into account the cut of the stones and their textural characteristics. It is advisable to make a boxing for receiving the piece.
- Where be possible, it will attempt to recover the appearance of the pavement, with a healthy superficial.

1. Depending on what caused the rising of the tiles, we proceed to the following actions:
   - If the rising is caused by the action of water should execute a proper drainage in the pavement.
   - If it is caused by the small thickness of the joints shall withdraw the pieces to replace them with a joint of sufficient width.
   - If the problem lies in the sand bed, there will lift all the existing pavement to compact the sand and place the pavement properly.
   - In the case of occurrence of plants or roots, you must make a cleaned up and repair, using an anti-root treatment. New planting should be controlled to prevent another lesion.

2. In the absence of material in the joints of the pieces, it will first check if the pathology also affects the sand bed, if so, it need to lift the pavement to properly compact the layer. If the problem is only in the joints, without disturbing the sand bed will be held the following interventions:
   - If the pavement is solved with sand seal material, the filling of these by sweeping sand. After this, we moisten and vibrate the area to seat properly compacted sand and tiles.

3. The lesion caused by erosion, abrasion and disintegration on the pavement (all physical or mechanical causes) have different actions according to the damage we want to repair:
   - The lesions due to erosion may be caused by changes in temperature or the water from the rain, against what they cannot act.
   - It may also have been caused by dampness or water leakage, if so, will proceed to the replacement of damaged pieces and application of sealants and consolidation to prevent the passage of water.

   The lesions due to abrasion, wear and disintegration, caused in most cases by traffic circulation, will proceed with a surface finish similar to the original or replacement of the damaged element when the loss of material is considerable.

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DAMAGES

CORRECTIVE/CORRECTING MANTEINANCE

INSPECTION SHEET. DATA COLLECTION

KIND OF LESIÓN

Raising and removed pieces.

N PHOTO	DATE	LOCATION
2		Aleja Piastow.

DESCRIPTION OF LESION

1. Raised and broken tiles, and even seen many holes where there were tiles that now are removed.
2. Different gasket thickness, there is no uniformity of joints, as well as erosion of the sealing material. In times of rain or snow water remains stagnant, with no possibility of escape, and into joints and in porous materials such as concrete, and can drag soluble salts and may cause efflorescence, disintegration of the material, dampness or damaged seal joints.
3. Dampness stains on sealing material.
4. Disintegration, erosion and abrasion wear of the road surface, causing loss of its original volume and exterior finish and eroded tile edges.

POSIBLE CAUSES

1. The rise and break of the pieces is due to the action of tree roots, roots push the pavement, causing the lifting of these, breakage, and even push causes have parts removed. The roots grow water searching for food, which means that if it hits the pavement, it is likely that these roots absorb moisture, making the sand bed loses its consistency to run out of water. This case creates other injuries, such as thrust between tiles, erosion and destruction of the sand bed.

2. The fact that the joints present different thicknesses, is because the roots of the trees push the pavement making the sealing material is moved out of position and finally the joints are practically nonexistent in some cases. Another cause may be due to a poor forecast in the execution of the joints or, maybe, the thickness of the joints is not specified in the execution project.

3. Wet spots observed are due to water infiltration by capillary material. When the material has many pores is very easy for these spots appear and especially with items placed outdoors. The pavement absorbed through his pores and capillaries groundwater and rain / snow / hail. Water containing dissolved salts as moisture is evaporated, dissolved salts are crystallized and degrades the stone. It may not be envisaged less porous material or a finish dampness resistant and therefore this type of moisture appear.
   Surface deposits are due to the passage of animals on the pavement or simply pollution. It is a direct cause of the lack of maintenance.
   Besides the pavement is no good to drain properly, so that water can be sealed on the surface when it rains and snows.

4. The presence of erosion, abrasion and disintegration in the pavement can be due to various factors, or even all of them together.
   - The wind throws particles against the surfaces, or drag over them, wearing their surface.
   - Water from rain, hail or snow hits the pavement, wearing the material and causes landslides and particle drag. In turn, the water wets the materials increasing its volume on contact with porous materials. When the absorbed water is evaporated when the material is dry, it undergoes a bigger retraction than the dilation caused by increased humidity. Repetition of this phenomenon in cycles, creating tensions that end in eroding the pavement and sometimes cracks.
   - Another cause is the traffic of people and vehicles on the pavement. This translates to material wear, erosion and abrasion. Considering that the vehicles parked on the sidewalks, we can interpret that the finished pavement material is not ready for such wear more aggressive than pedestrian traffic.

DESCRIPTION OF THE POSSIBLE INTERVENTIONS

Depending on the state of the pieces of the area the interventions to perform are as follows:

- If the failure is widespread, there is no other solution than make the replacement of pavement with one that conforms to the needs and solicitations.
- If after studying the lesion, it is concluded that its scope is punctual, will be reset and affected parts of the environment, taking into account the cut of the stones and their textural characteristics. It is advisable to make a boxing for receiving the piece.
- Where be possible, it will attempt to recover the appearance of the pavement, with a healthy superficial.

1. If the pathology is caused by the presence of organisms, the intervention will be: will proceed to the elimination of these and will value the damage caused by them. If the damage is of considerable size, will be replaced or damaged parts. In the event that damage has not occurred extremely important, apply repellents to prevent this type of lesion. Depending on the organism involved the treatment is as follows:
   - - In the case of mold, lichens and mosses, its appearance is due to the damp, so you should act on it and proceed to a thorough cleaning to subsequently apply a treatment or product that prevents new onset of these.
   - - In the case of appearance of plants, you must make a cleaned up and repair, using an anti-root treatment. New planting should be controlled to prevent new lesions.
   -
2. In the absence of material in the joints of the pieces, it will first check if the pathology also affects the sand bed, if so, it need to lift the pavement to properly compact the layer. If the problem is only in the joints, without disturbing the sand bed will be held the following interventions:
   - If the pavement is solved with sand seal material, the filling of these by sweeping sand. After this, we moisten and vibrate the area to seat properly compacted sand and tiles.

3. In the presence of dampness, depending on their origin will be different actions:
   - Dampness by capillarity: It must have adequate drainage to keep water off the pavement or introduce some kind of impermeable barrier to prevent direct contact with the soil.
   - Dampness by filtration: It should be sealed, the entrance of water or, if it is due to the properties of the piece due to deterioration or some other reason, will proceed to the replacement of the piece.

4. The lesion caused by erosion, abrasion and disintegration on the pavement (all physical or mechanical causes) have different actions according to the damage we want to repair:
   - The lesions due to erosion may be caused by changes in temperature or the water from the rain, against what they cannot act.
   - It may also have been caused by dampness or water leakage, if so, will proceed to the replacement of damaged pieces and application of sealants and consolidation to prevent the passage of water.
   - The lesions due to abrasion, wear and disintegration, caused in most cases by traffic circulation, will proceed with a surface finish similar to the original or replacement of the damaged element when the loss of material is considerable.

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DAMAGES

CORRECTIVE/CORRECTING MANTEINANCE

INSPECTION SHEET. DATA COLLECTION

KIND OF LESIÓN

High thickness's joints.

N PHOTO	DATE	LOCATION
2		Aleja Piastow.

DESCRIPTION OF LESION

1. Different gasket thickness, there is no uniformity of joints, as well as erosion of the sealing material.
2. Dampness stains on sealing material.
3. Disintegration, erosion and abrasion wear of the road surface, causing loss of its original volume and exterior finish and eroded tile edges.
4. Wear was observed on corners and edges of granite slabs in picture 2.

POSIBLE CAUSES

1. Joints have little thickness, as well as little material in the sealing of joints.
   The fact that presents little thickness is due to poor forecasting of joints in the execution process, or in the execution project the gasket thickness is not specified.
   Another cause may be when erosion acts together with the expansion-contraction cycles of the pieces. When joints are eroded the pieces lose strength capacity, causing possible disintegration. During the expansion-contraction cycles, the pieces expand and if this is not foreseen in the thickness calculation joints, can eventually cause that the pieces fit together more than they should. The same applies to the separation of these with the contraction of the pieces. The result of this is that the pieces change their positions with different joint's thicknesses.

2. Wet spots observed are due to water infiltration by capillary material. When the material has many pores is very easy for these spots appear and especially with items placed outdoors. The pavement absorbed through his pores and capillaries groundwater and rain / snow / hail. Water containing dissolved salts as moisture is evaporated, dissolved salts are crystallized and degrades the stone. It may not be envisaged less porous material or a finish dampness resistant and therefore this type of moisture appear.
   Surface deposits are due to the passage of animals on the pavement or simply pollution. It is a direct cause of the lack of maintenance.
   Besides the pavement is no good to drain properly, so that water can be sealed on the surface when it rains and snows.

3. The presence of erosion, abrasion and disintegration in the pavement can be due to various factors, or even all of them together.
   - The wind throws particles against the surfaces, or drag over them, wearing their surface.
   - Water from rain, hail or snow hits the pavement, wearing the material and causes landslides and particle drag. In turn, the water wets the materials increasing its volume on contact with porous materials. When the absorbed water is evaporated when the material is dry, it undergoes a bigger retraction than the dilation caused by increased humidity. Repetition of this phenomenon in cycles, creating tensions that end in eroding the pavement and sometimes cracks.
   - Another cause is the traffic of people and vehicles on the pavement. This translates to material wear, erosion and abrasion. Considering that the vehicles parked on the sidewalks, we can interpret that the finished pavement material is not ready for such wear more aggressive than pedestrian traffic.

4. Wear on corners and edges we observed may be due to various causes:
   - Shocks or hit the pavement that has made this break.
   - The lack of thickness at the joints causes cracks and breaks in the materials. With the temperature cycling and contraction-expansion of the material, parts can get to push each other and get to the rupture of the material. This along with the abrasion by the pedestrian vehicle sometimes causes the breakage of the material.

DESCRIPTION OF THE POSSIBLE INTERVENTIONS

Depending on the state of the pieces of the area the interventions to perform are as follows:

- If the failure is widespread, there is no other solution than make the replacement of pavement with one that conforms to the needs and solicitations.
- If after studying the lesion, it is concluded that its scope is punctual, will be reset and affected parts of the environment, taking into account the cut of the stones and their textural characteristics. It is advisable to make a boxing for receiving the piece.
- Where be possible, it will attempt to recover the appearance of the pavement, with a healthy superficial.

1. In the absence of material in the joints of the pieces, it will first check if the pathology also affects the sand bed, if so, it need to lift the pavement to properly compact the layer. If the problem is only in the joints, without disturbing the sand bed will be held the following interventions:
   - If the pavement is solved with sand seal material, the filling of these by sweeping sand. After this, we moisten and vibrate the area to seat properly compacted sand and tiles.

2. In the presence of dampness, depending on their origin will be different actions:
   - Dampness by capillarity: It must have adequate drainage to keep water off the pavement or introduce some kind of impermeable barrier to prevent direct contact with the soil.
   - Dampness by filtration: It should be sealed, the entrance of water or, if it is due to the properties of the piece due to deterioration or some other reason, will proceed to the replacement of the piece.

3. The lesion caused by erosion, abrasion and disintegration on the pavement (all physical or mechanical causes) have different actions according to the damage we want to repair:
   - The lesions due to erosion may be caused by changes in temperature or the water from the rain, against what they cannot act.
   - It may also have been caused by dampness or water leakage, if so, will proceed to the replacement of damaged pieces and application of sealants and consolidation to prevent the passage of water.
   - The lesions due to abrasion, wear and disintegration, caused in most cases by traffic circulation, will proceed with a surface finish similar to the original or replacement of the damaged element when the loss of material is considerable.

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DAMAGES

CORRECTIVE/CORRECTING MANTEINANCE

INSPECTION SHEET. DATA COLLECTION

KIND OF LESIÓN

Breaks on the pavement.

N PHOTO	DATE	LOCATION
2		Aleja Piastow and Uliecia Bugoslawa X

DESCRIPTION OF LESION

1. Cracks are observed on the surface of the tiles. The picture 1 shows transverse break, which subdivide the slab in two. In picture 2 there is a mesh type and transverse break.

2. Small thickness is observed, and little sealing material between joints in photo 1.

3. Aging and discoloration patinas are observed.

4. In photograph 2 dampness stains are observed on the finished surface, as well as surface deposits, due to the accumulation over time of different materials can be soot droppings or any other type of biological organism.

5. Disintegration, erosion and abrasion wear of the road surface, causing loss of its original volume and exterior finish and eroded tile edges.

POSIBLE CAUSES

1. The corner breaks we observed may be due to various causes:
   - Shocks or hit the pavement that has made this break.
   - A poor compaction or poor pavement load transfer to the sand bed. The pieces are not supported properly, and with the passage of pedestrians or specific efforts are created breaks.
   - The lack of thickness in the joints can cause cracks and breaks in the materials. With the temperature cycling and contraction-expansion of the material, parts can get to push each other and get to the rupture of the material.

2. Joints have little thickness, as well as little material in the sealing of joints.
   The fact that presents little thickness is due to poor forecasting of joints in the execution process, or in the execution project the gasket thickness is not specified.
   Joints are exposed to the weather (water, wind, etc), Losing its cohesion and creating dampness. The rainwater may drag sealing material as the wind. When water seeps through the joints and temperatures drop, this increase material's volume eroding the joints and the pieces. The rainwater washes away soluble salts ending in the creation of efflorescence; this erodes both parts and joints.

3. The patinas observed are due to the passage of time and material usage. Its appearance may be a lack of maintenance, but even so this injury always appears in all kinds of stone material over time.

4. Wet spots observed are due to water infiltration by capillary material. When the material has many pores is very easy for these spots appear and especially with items placed outdoors. The pavement absorbed through his pores and capillaries groundwater and rain / snow / hail. Water containing dissolved salts as moisture is evaporated, dissolved salts are crystallized and degrades the stone. It may not be envisaged less porous material or a finish dampness resistant and therefore this type of moisture appear.
   Surface deposits are due to the passage of animals on the pavement or simply pollution. It is a direct cause of the lack of maintenance.
   Besides the pavement is no good to drain properly, so that water can be sealed on the surface when it rains and snows.

5. The presence of erosion, abrasion and disintegration in the pavement can be due to various factors, or even all of them together.
   - The wind throws particles against the surfaces, or drag over them, wearing their surface.
   - Water from rain, hail or snow hits the pavement, wearing the material and causes landslides and particle drag. In turn, the water wets the materials increasing its volume on contact with porous materials. When the absorbed water is evaporated when the material is dry, it undergoes a bigger retraction than the dilation caused by increased humidity. Repetition of this phenomenon in cycles, creating tensions that end in eroding the pavement and sometimes cracks.
   - Another cause is the traffic of people and vehicles on the pavement. This translates to material wear, erosion and abrasion. Considering that the vehicles parked on the sidewalks, we can interpret that the finished pavement material is not ready for such wear more aggressive than pedestrian traffic.

DESCRIPTION OF THE POSSIBLE INTERVENTIONS

Depending on the state of the pieces of the area the interventions to perform are as follows:

- If the failure is widespread, there is no other solution than make the replacement of pavement with one that conforms to the needs and solicitations.
- If after studying the lesion, it is concluded that its scope is punctual, will be reset and affected parts of the environment, taking into account the cut of the stones and their textural characteristics. It is advisable to make a boxing for receiving the piece.
- Where possible, it will attempt to recover the appearance of the pavement, with a healthy superficial.

1. In pieces breakages will check if this lesion also affects the sand bed, not to be well consolidated:
   - If so, you should raise the pavement to compact properly sand.
     If the lesion is punctual, the piece is replaced by another with similar characteristics to the existing ones.
   - If it is by thermal expansion material inside of the stone must also be replaced or affected parts.

2. In the absence of material in the joints of the pieces, it will first check if the pathology also affects the sand bed, if so, it need to lift the pavement to properly compact the layer. If the problem is only in the joints, without disturbing the sand bed will be held the following interventions:
   - If the pavement is solved with sand seal material, the filling of these by sweeping sand. After this, we moisten and vibrate the area to seat properly compacted sand and tiles.

3. When the stone is altered because it presents a thin scab, repair consists in the elimination of such scab by mechanical or chemical means.

4. In the presence of dampness, depending on their origin will be different actions:
   - Dampness by capillarity: It must have adequate drainage to keep water off the pavement or introduce some kind of impermeable barrier to prevent direct contact with the soil.
   - Dampness by filtration: It should be sealed, the entrance of water or, if it is due to the properties of the piece due to deterioration or some other reason, will proceed to the replacement of the piece.

5. The lesion caused by erosion, abrasion and disintegration on the pavement (all physical or mechanical causes) have different actions according to the damage we want to repair:
   - The lesions due to erosion may be caused by changes in temperature or the water from the rain, against what they cannot act.
   - It may also have been caused by dampness or water leakage, if so, will proceed to the replacement of damaged pieces and application of sealants and consolidation to prevent the passage of water.
   - The lesions due to abrasion, wear and disintegration, caused in most cases by traffic circulation, will proceed with a surface finish similar to the original or replacement of the damaged element when the loss of material is considerable.

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DAMAGES

CORRECTIVE/CORRECTING MANTEINANCE

INSPECTION SHEET. DATA COLLECTION

KIND OF LESIÓN

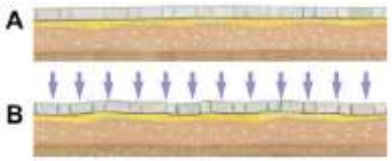
Dampness and landslides.

N PHOTO	DATE	LOCATION
1		Aleja Piastow.

DESCRIPTION OF LESION

1. See spots of dampness on the finish and the joints, as well as surface deposits, due to the accumulation over time of different materials can be soot droppings or any other type of biological organism. See spots of dampness on the finish and the joints, as well as surface deposits, due to the accumulation over time of different materials can be soot droppings or any other type of biological organism.

2. Are observed granite stones with differential settlement, causing steps or potholes. Being small sized stones the gap generated is almost negligible when you are walking on the pavement, but is perceptible to the naked eye.



3. Disintegration, erosion and abrasion wear of the road surface, causing loss of its original volume and exterior finish and eroded tile edges.

POSIBLE CAUSES

1. Wet spots observed are due to water infiltration by capillary material. When the material has many pores is very easy for these spots appear and especially with items placed outdoors. The pavement absorbed through his pores and capillaries groundwater and rain / snow / hail. Water containing dissolved salts as moisture is evaporated, dissolved salts are crystallized and degrades the stone. It may not be envisaged less porous material or a finish dampness resistant and therefore this type of moisture appear.
   Surface deposits are due to the passage of animals on the pavement or simply pollution. It is a direct cause of the lack of maintenance.
   Besides the pavement is no good to drain properly, so that water can be sealed on the surface when it rains and snows.

2. The differential settlements may be caused to two causes:
   The failure to execute the pavement for not having performed prior compaction and leveling of the sand bed, not do these jobs, field plasticity and flexibility of pavement can produce deformations in it, which inevitably forces us in its total replacement.
   Another possible cause is dilation of infiltrated elements as water or water with salts from the sand bed.

3. The presence of erosion, abrasion and disintegration in the pavement can be due to various factors, or even all of them together.
   - The wind throws particles against the surfaces, or drag over them, wearing their surface.
   - Water from rain, hail or snow hits the pavement, wearing the material and causes landslides and particle drag. In turn, the water wets the materials increasing its volume on contact with porous materials. When the absorbed water is evaporated when the material is dry, it undergoes a bigger retraction than the dilation caused by increased humidity. Repetition of this phenomenon in cycles, creating tensions that end in eroding the pavement and sometimes cracks.
   - Another cause is the traffic of people and vehicles on the pavement. This translates to material wear, erosion and abrasion. Considering that the vehicles parked on the sidewalks, we can interpret that the finished pavement material is not ready for such wear more aggressive than pedestrian traffic.

DESCRIPTION OF THE POSSIBLE INTERVENTIONS

Depending on the state of the pieces of the area the interventions to perform are as follows:

- If the failure is widespread, there is no other solution than make the replacement of pavement with one that conforms to the needs and solicitations.
- If after studying the lesion, it is concluded that its scope is punctual, will be reset and affected parts of the environment, taking into account the cut of the stones and their textural characteristics. It is advisable to make a boxing for receiving the piece.
- Where be possible, it will attempt to recover the appearance of the pavement, with a healthy superficial.

1. In the presence of dampness, depending on their origin will be different actions:
   - Dampness by capillarity: It must have adequate drainage to keep water off the pavement or introduce some kind of impermeable barrier to prevent direct contact with the soil.
   - Dampness by filtration: It should be sealed, the entrance of water or, if it is due to the properties of the piece due to deterioration or some other reason, will proceed to the replacement of the piece.

2. Depending on the scale of settlement different actions are performed:
   - If the injury occurs all over the pavement, it is necessary to lift and replace it in its entirety.
   - If the lesion occurs in a point on the pavement, if it occurs inside the pavement, the affected pieces must be replaced, but if it occurs at the edge thereof, will recover the affected pieces and protect the edge of the pavement by kerbstones.

3. The lesion caused by erosion, abrasion and disintegration on the pavement (all physical or mechanical causes) have different actions according to the damage we want to repair:
   - The lesions due to erosion may be caused by changes in temperature or the water from the rain, against what they cannot act.
   - It may also have been caused by dampness or water leakage, if so, will proceed to the replacement of damaged pieces and application of sealants and consolidation to prevent the passage of water.
   - The lesions due to abrasion, wear and disintegration, caused in most cases by traffic circulation, will proceed with a surface finish similar to the original or replacement of the damaged element when the loss of material is considerable.

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DAMAGES

CORRECTIVE/CORRECTING MANTEINANCE

INSPECTION SHEET. DATA COLLECTION

KIND OF LESIÓN

Removed pieces

N PHOTO	DATE	LOCATION
2		Aleja Piastow.

DESCRIPTION OF LESION

1. The picture 1 shows that some of the granite stones that formed the pavement have disappeared, leaving the fixing material or sand bed to the weathering, facilitating erosion and adjacent parts undergo a change position.

2. The concrete tile on picture 2 shows internal efflorescence, whitish stains.

3. Different gasket thickness, there is no uniformity of joints, as well as erosion of the sealing material.

4. Disintegration, erosion and abrasion wear of the road surface, causing loss of its original volume and exterior finish and eroded tile edges.

POSIBLE CAUSES

1. The pieces are loose, and the gaps with the lack of them, is due to erosion of the joints. When the joints are eroded, it can even stay the pieces without joint material. When the joint sealing material disappears, environmental aggressive agents and rain, snow and all the elements act directly on the stone and the base of this. Sand bed is eroded, causing the grasp being possible disappears and pieces removed.
   Water is a factor in this erosion, together with wind and particles that carry both. Water in the form of snow and rain, penetrating through the joints of the pieces dragging with it soluble salts. When temperatures drop, moisture and salts increase in volume, causing erosion of the joints, and the sand bed. This may cause breakage of material, cracks and even parts removed.

2. The whitish efflorescence stains are formed by water soluble salts drag, the water entering the pavement may come from various sources: rainwater or snow that seeps through the pores of the material and groundwater, which goes through the capillaries of the part. This water carries soluble salts when humidity evaporates, the dissolved salts crystallize forming white stains, efflorescence. These spots cause erosion of both the piece as the joint material. When temperatures drop it increases in volume and can break the pieces, or even make it go away the sealing material.

3. Joints have different thickness, as well as little material in the sealing of joints.
   The fact that presents different thickness is due to poor forecasting of joints in the execution process, or in the execution project the gasket thickness is not specified.
   Joints are exposed to the weather (water, wind, etc), Losing its cohesion and creating dampness. The rainwater may drag sealing material as the wind. When water seeps through the joints and temperatures drop, this increase material's volume eroding the joints and the pieces. The rainwater washes away soluble salts ending in the creation of efflorescence; this erodes both parts and joints.

4. The presence of erosion, abrasion and disintegration in the pavement can be due to various factors, or even all of them together.
   - The wind throws particles against the surfaces, or drag over them, wearing their surface.
   - Water from rain, hail or snow hits the pavement, wearing the material and causes landslides and particle drag. In turn, the water wets the materials increasing its volume on contact with porous materials. When the absorbed water is evaporated when the material is dry, it undergoes a bigger retraction than the dilation caused by increased humidity. Repetition of this phenomenon in cycles, creating tensions that end in eroding the pavement and sometimes cracks.
   - Another cause is the traffic of people and vehicles on the pavement. This translates to material wear, erosion and abrasion. Considering that the vehicles parked on the sidewalks, we can interpret that the finished pavement material is not ready for such wear more aggressive than pedestrian traffic.
   -

DESCRIPTION OF THE POSSIBLE INTERVENTIONS

Depending on the state of the pieces of the area the interventions to perform are as follows:

- If the failure is widespread, there is no other solution than make the replacement of pavement with one that conforms to the needs and solicitations.
- If after studying the lesion, it is concluded that its scope is punctual, will be reset and affected parts of the environment, taking into account the cut of the stones and their textural characteristics. It is advisable to make a boxing for receiving the piece.
- Where possible, it will attempt to recover the appearance of the pavement, with a healthy superficial.

1. In the absence of any parts form the pavement; proceed to its immediate replacement by a piece of similar characteristics.

2. If we identify efflorescence means that pieces contain some soluble salt that has been diluted by water filtration. Must be analyzed the source of the dampness and eliminate it and make a proper cleaning with suitable product type depending on the type of salt crystallized and its solubility as well as the material on which crystallizes.

3. In the absence of material in the joints of the pieces, it will first check if the pathology also affects the sand bed, if so, it need to lift the pavement to properly compact the layer. If the problem is only in the joints, without disturbing the sand bed will be held the following interventions:
   - If the pavement is solved with sand seal material, the filling of these by sweeping sand. After this, we moisten and vibrate the area to seat properly compacted sand and tiles.

4. The lesion caused by wear, abrasion and disintegration on the pavement (all physical or mechanical causes) have different actions according to the damage we want to repair:
   - The lesions due to erosion may be caused by changes in temperature or the water from the rain, against what they cannot act. It may also have been caused by dampness or water leakage, if so, will proceed to the replacement of damaged pieces and application of sealants and consolidation to prevent the passage of water.
   - The lesions due to abrasion, wear and disintegration, caused in most cases by traffic circulation, will proceed with a surface finish similar to the original or replacement of the damaged element when the loss of material is considerable.

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DAMAGES

CORRECTIVE/CORRECTING MANTEINANCE

INSPECTION SHEET. DATA COLLECTION

KIND OF LESIÓN

Weathering for abrasion

N PHOTO	DATE	LOCATION
2		Aleja Piastow, Uliecia Bugoslawa X and Runek Sienny.

DESCRIPTION OF LESION

1. The cobblestones have an erosion and abrasion of the surface layer.
2. Aging and discoloration patinas are observed.
3. Dampness stains are seen on the finish, as well as surface deposits, due to the accumulation over time of different materials can be soot droppings or any other type of biological organism.

POSIBLE CAUSES

1. The presence of erosion, abrasion and disintegration in the pavement can be due to various factors, or even all of them together.
   - The wind throws particles against the surfaces, or drag over them, wearing their surface.
   - Water from rain, hail or snow hits the pavement, wearing the material and causes landslides and particle drag. In turn, the water wets the materials increasing its volume on contact with porous materials. When the absorbed water is evaporated when the material is dry, it undergoes a bigger retraction than the dilation caused by increased humidity. Repetition of this phenomenon in cycles, creating tensions that end in eroding the pavement and sometimes cracks.
   - Another cause is the traffic of people and vehicles on the pavement. This translates to material wear, erosion and abrasion. Considering that the vehicles parked on the sidewalks, we can interpret that the finished pavement material is not ready for such wear more aggressive than pedestrian traffic.

2. The patinas observed are due to the passage of time and material usage. Its appearance may be a lack of maintenance, but even so this injury always appears in all kinds of stone material over time.

3. Wet spots observed are due to water infiltration by capillary material. When the material has many pores is very easy for these spots appear and especially with items placed outdoors. The pavement absorbed through his pores and capillaries groundwater and rain / snow / hail. Water containing dissolved salts as moisture is evaporated, dissolved salts are crystallized and degrades the stone. It may not be envisaged less porous material or a finish dampness resistant and therefore this type of moisture appear.
   Surface deposits are due to the passage of animals on the pavement or simply pollution. It is a direct cause of the lack of maintenance.
   Besides the pavement is no good to drain properly, so that water can be sealed on the surface when it rains and snows.

DESCRIPTION OF THE POSSIBLE INTERVENTIONS

Depending on the state of the pieces of the area the interventions to perform are as follows:

- If the failure is widespread, there is no other solution than make the replacement of pavement with one that conforms to the needs and solicitations.
- If after studying the lesion, it is concluded that its scope is punctual, will be reset and affected parts of the environment, taking into account the cut of the stones and their textural characteristics. It is advisable to make a boxing for receiving the piece.
- Where possible, it will attempt to recover the appearance of the pavement, with a healthy superficial.

1. The lesion caused by wear, abrasion and disintegration on the pavement (all physical or mechanical causes) have different actions according to the damage we want to repair:
   - The lesions due to erosion may be caused by changes in temperature or the water from the rain, against what they cannot act. It may also have been caused by dampness or water leakage, if so, will proceed to the replacement of damaged pieces and application of sealants and consolidation to prevent the passage of water.
   - The lesions due to abrasion, wear and disintegration, caused in most cases by traffic circulation, will proceed with a surface finish similar to the original or replacement of the damaged element when the loss of material is considerable.

2. Dampness may appear to absorb water from the soil, capillary water or by filtration, caused by the action of rain and wind.
   - The construction materials with porous structure with large pores communication, as is the case of concrete, they facilitate capillary rise quite marked.
   - Moisture filtration is caused by the water coming from the outside and into the interior of the pavement.

   The fact that there is a large deterioration in the pavement surface causes the water, rain or snow, can remain stagnant in the surface. If we consider that the presence of this type of pathology is in concrete tiles oldest and that this type of concrete has many pores, thus resulting in the presence of significant stains.

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DAMAGES

CORRECTIVE/CORRECTING MANTEINANCE

INSPECTION SHEET. DATA COLLECTION

KIND OF LESIÓN

Lack sealing material

N PHOTO	DATE	LOCATION
2		Uliecia J. Sowinskiego

DESCRIPTION OF LESION

1. This pavement is just finished and is possible to see that there is not sealing material on the joints of the concrete pieces with granite finished.

2. The thickness of the joints of the pieces is insufficient in many cases.

POSIBLE CAUSES

1. In this case we must consider that the pavement is just finished, so that there is no joint material is not due to possible erosion.
   The direct cause is the poor execution of the pavement, without make step of joint material placement. It is clear that this step has not been realized and has exposed the sand bed through the addition of the pieces together. This will cause large number of pathologies in the pavement from erosion of the sand bed to efflorescence.

2. Considering that this is just executed, present different thickness is due to poor forecasting execution of joints in the pavement, or in the project execution the thickness of the joints is not specified.
   Another possible cause is because there are not sealing material, pieces have been moved from their original position and have modified the thickness of each joints.

DESCRIPTION OF THE POSSIBLE INTERVENTIONS

Depending on the state of the pieces of the area the interventions to perform are as follows:

- If the failure is widespread, there is no other solution than make the replacement of pavement with one that conforms to the needs and solicitations.
- If after studying the lesion, it is concluded that its scope is punctual, will be reset and affected parts of the environment, taking into account the cut of the stones and their textural characteristics. It is advisable to make a boxing for receiving the piece.
- Where be possible, it will attempt to recover the appearance of the pavement, with a healthy superficial.

1. The lesion is caused by poor execution has not been grouted parts with sand. Grouting shall be performed at the end and vibrated sand sweeping.

2. The solution to this lesion, is the relocation of the pavement, with a thickness of joints suitable for the needs of this type of pavement. With no pieces joint material, this can be a cause of displacement of parts and therefore of the modification of the thickness of joints, so after placing the pieces correctly will proceed to fill sand for sealing of the joints and their subsequent vibration.

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CHAPTER 5 . CAUSES ANALYSIS

5.1. STUDY RESULTS

To get the pavements meet predetermined life, one must start from a suitable design that ensures rapid water evacuation from the area of the road, with a stable base and subbase, with materials that ensure optimum quality in each employees stage and construction process to ensure the achievement of the objective.

After studying the lesions found, it appears that the main causes of walkways deterioration are the effect of water, along with the change of temperature, for different materials, and poor execution work made.

Knowing the weather presented by the city of Szczecin we can assume that the water has great destructive effect on the pavements. The road almost all year round receives water, either as rain or snow.

During the winter season the roads are covered with snow, so it is important the work of the staff responsible for snow removal, since it is impossible to walk on the pavement in that state. One of the products used to undo the snow from walkways is salt, being important mention the countless problems this leads to the condition of the pavement when it comes into contact with water.

It is inevitable to mention the drain, aggressive direct consequence of the effect of water on the pavement. For efficient water drainage from walkways is necessary to have enough slope to prevent stagnation of the agent on the pavement. Many of the roads lack enough slope or have slopes that help the water stagnation directly.

The lesions observed by the effect of water on the roads are these:

Efflorescence. Direct effect of water filtration with soluble salts.

Rising pieces of pavement. Effect caused by the leaking of water and salts and its consequent increase in volume with low temperatures.

Dampness. Humidities. Effect of capillarity and filtration capacity of a material failure in this type of injury can be the choice of material or permeation resistance.

Erosion. One of the most important causes in this case is water, since this together with soluble salts can erode parts even cause breakage.

Breaks. Water's effect with soluble salts.

Damage to the sealing of the joints. The gasket material is directly affected by water in all its states. This causes erosion and disintegration.

Landslides. One possible effect is dilation of infiltrated elements as water and salt with water contained in the sand bed.

Disintegration. Effect of water that erodes the material.

Organisms on the boards of the floor. These appear in damp places.

Subdivided slabs. Input by incompressible materials in the joints causing excessive thermal expansion.

Stings. These are due to erosion, and one of the effects of erosion is water.

Regarding the execution, note that the main cause could be the lack of qualifications of personnel involved in the construction stage, through ignorance, neglect, etc.. Just as the lack of control and too demanding deadlines are other factors that affect the final result of the works negatively, with consequences, sometimes severe.

The poor choice of constructive design is also a pathology observed specifically in the street Piastow. The poor design of repairing broken parts can be translated into serious pathologies. The secondary pathologies that are possible can be from efflorescence even breakage of parts. In addition, the type of material finish used in the pavement affects the state of these directly, the fact of choosing pieces with rough finish make easier the accumulation of water and dirt on the surface.

The lesions observed by the execution of the roads of the city are these:

Cracks. Many of the cracks observed are related directly to poor execution of the joints. If the joints are insufficient when the material expands causes friction, between pieces, and consequently cracks.

Breaks. One reason is the execution of the joints, by the same token that cracks are created, if the contact between pieces is very high, may result in breakage.

Rising pieces. It may result from poor execution of joints, or poor sand bed leveling.

Sinking. Effect of a poor sand bed compression or uneven distribution of this.

Landslides. A possible cause can be the same as in the sinking, a poor compression of the sand layer or an uneven distribution.

Subdivided slabs. It can be due to inadequate joint design or bad execution of these, since the pieces to expand get to bumping pushing between them.

Joint's Staggering. This is a direct result of poor compaction work and / or distribution of the sand bed.

Many of the pathologies observed in the pavement could have been avoided with maintenance work. Piastow Street specifically is the most affected by all kinds of diseases, presents a state of disrepair, in areas not rehabilitated, more advanced. Many of the pathologies observed are due to the action of water on the finishing material and their joints. To avoid them, or avoid a deterioration advanced state, it could have done restocking sealing material work. This would avoid the direct attack of the erosion agents on pieces and on the sand bed. Other work to be done would clean them to prevent that the organisms enter into the joints or create surface deposits on the pavement.

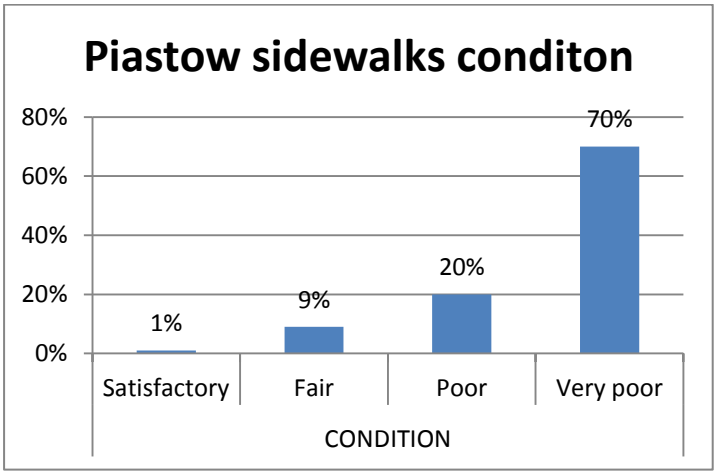
On Bugoslawa X Street and Sienny Rynek Square, the effect of the maintenance lack is significant but it is not a critical problem. These streets would require a replacement of the sealing material, since they are observed joints eroded. This reason does not affect the street J. Sowinskiego, because it has just been executed and all pathologies are caused by poor execution.

Bearing in mind that the roads are designed for pedestrian trafficit is noted that on the street Piastow and J. Sowinskiego is allowed the parking of vehicles on these. Without bear in mind, this causes damage, often important: breakage, abrasion, disintegration and sinking.

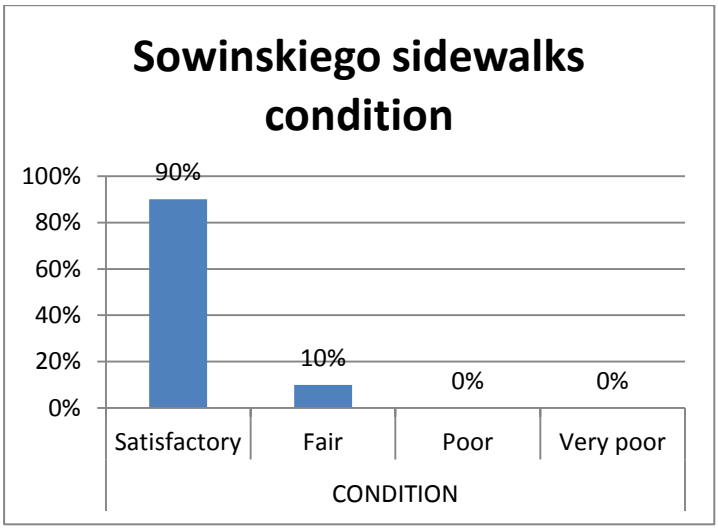
Finally, another cause, with important consequences is the effect of tree roots. These are growing looking for water to feed, consequently if they come into contact with the pavement, it is most likely to absorb this humidity, causing that the sand bed loses its consistency and weakening it. Besides this, is an important thrust that causes the rise of pieces, breakage, even, exist parts removed.

To conclude, to avoid many of the causes that generate the observed diseases should to make major maintenance work, this eventually, avoid the economic cost of the pavement repair. Given the significant effect of water on the walkway, existing drains should be improved and, to repair or construct sidewalks, you could choose a special finishing material, with better resistance to permeation. Finally, the repair work and enforcement should be supervised by a competent technician.

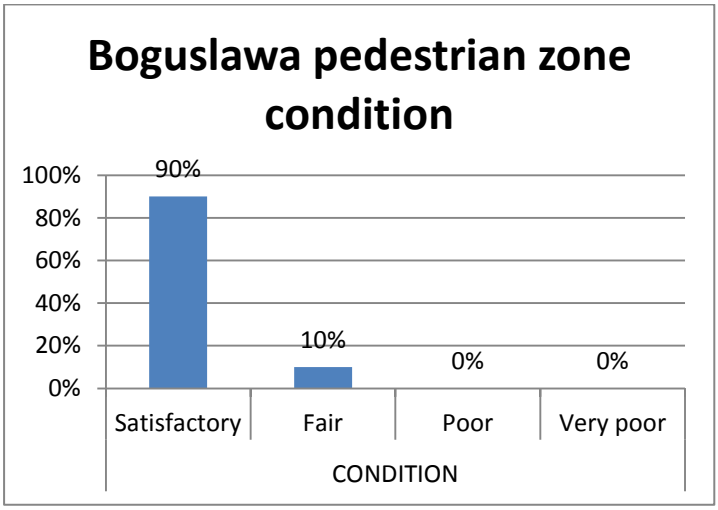
We can see the following graphics to know immediately the conditions of each streets studied.



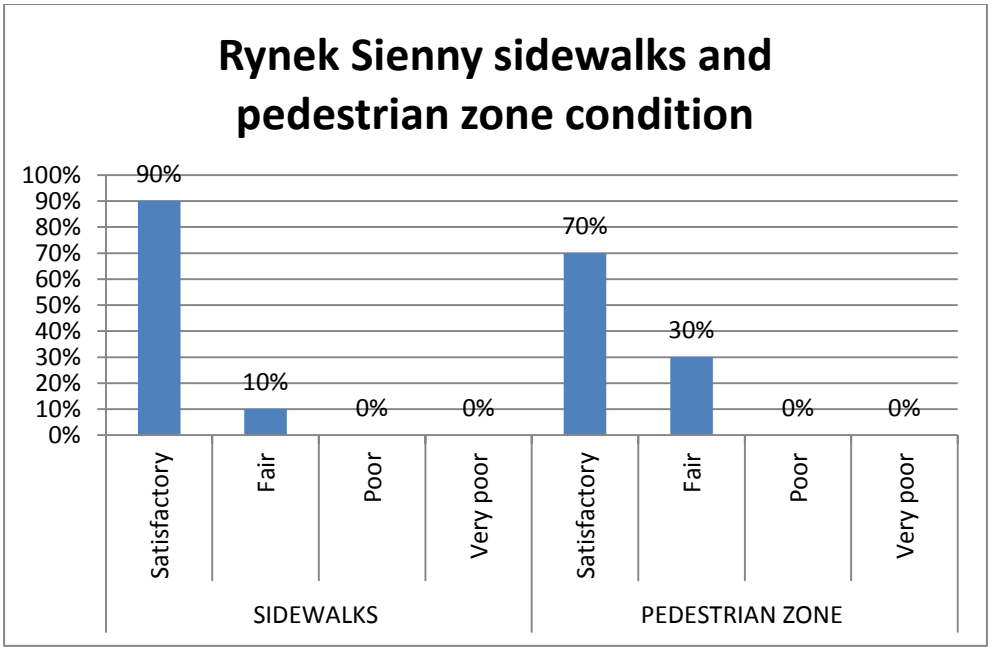
Condition graphic Piastow Street [1]



Condition graphic J. Sowinskiego Street [1]



Condition graphic Boguslawa Street [1]



Condition graphic Rynek Sienny Square [1]

RANKING DEFINITION

Very Poor Pavement: reconstruction is recommended. This includes replacement of the entire pavement structure from the subbase to the wearing course. This also includes modifications to drainage and pavement base drain, and minor alignment modifications.

Poor Pavement: Rehabilitation is recommended. This includes reconstruction, overlay, or milling, as well as minor drainage repairs and alignment modifications.

Fair pavement: Resurfacing should be considered in the near future. This may include milling and overlay of the wearing and/or binder courses.

Satisfactory pavement: No improvements are required at this time, although preventative maintenance measures should be considered in the near future.

Very Poor Sidewalk: Replacement is required.

Poor Sidewalk: Replacement is recommended.

Fair Sidewalk: Patching may be necessary in the near future.

Satisfactory sidewalk: No improvements are required at this time, although preventative maintenance measures should be considered in the near future.

5.2. COMPARISON ACCORDINF TO ZONES, USE, TYPOLOGIES AND MAINTENANCE

		BOGUSLAWA STREET	RYENYK SIENNY SQUARE	PIASTOW AVENUE	SKORSKIEGO STREET	
USE	Use of the zone	Public concurrence zone	Public concurrence zone	University and residential zone	Residential zone	Number of pathologies is much higher in the case of university areas, mainly caused by the high pedestrian traffic and vehicle parking on the sidewalk.
	Characteristics	Pedestrian street	Pedestrian square	Pedestrian and cycle traffic Avenue	Pedestrian Calle con tránsito peatonal	
		Moderate pedestrian traffic	Moderate pedestrian traffic	Pedestrian an cycle higher trafic	Moderate pedestrian traffic	
		Parking of vehicles allow	Parking of vehicles forbidden (was permited before)	Parking of vehicles allow	Parking of vehicles allow	
	Level of lesions	Low	Medium	Very high	Low	
TYPOLOGY	Type of pavement	Stone pavement	Stone pavement	Stone pavement	Concrete pavement	Concrete pavement	The number of pathologies, is much higher in areas where the pavement is made of large stone blocks.
	Characteristics	Sand joints	Sand joints	Sand joints	Sand with mortar joints	Sand joints	
	Shape	Big block / Cobblestone	Big block / Cobblestone	Big block / Cobblestone	Tiles	Tiles	
	Level of lesions	Low / Low	Low / Medium	Very high / High	High	Low	
MAINTAINANCE	Time since it was executed	10 years	10 years / More than 50 years	Moret than 50 years	Less than 1 year	The number of pathologies, is much higher in university zones, solved with large blocks of stone. This is due to the time that has passed since its execution so far, barely any maintenance.
	Manteinance until now	Cleaning (not with appropriate frequency)	Cleaning (not with appropriate frequency)	Cleaning (not with appropriate frequency)	Cleaning (not with appropriate frequency)	
	Level of lesions	Low	Low	Very high	Low	

5.3. COMPARISON WITH OTHER CITIES. VALENCIA.

The different lesions present on the pavements of Szczecin are quite common to those that can present almost all public outdoor pavements, can observe similar damages (erosion, dirt, humidity ...) on the pavements of other geographical areas.

The variation will be found especially in the origin of the causes of such lesions. These causes will be different in one place or another, and also the relationship with lesions they may cause.A continuación desarrollaremos una comparativa entre las lesiones y causas estudiadas en las aceras de Szczecin y las que se encuentran en Valencia (España).

CAUSES		SZCZECIN	VALENCIA
Weather	**Temperature**	Thermal cycles take place with big variations of temperature (-5ºC a 23ºC)	The difference between maximum and minimal temperature is not very high (10.2º C a 30ºC)
	Rain	The rainfalls are approximately 511 mm per year	The average quantity of annual rainfalls is 454 mm
	Snow	The presence of snow is habitual during the winters months	The temperature rarely falls below those 0 ° C so that it is unlikely the presence of snow
	Sun	The action of the sun is not very aggressive	The action of the sun is aggressive
Execution of the pavement	**Supporting layer**	The support of the pavement is done on bed of sand	The support of the pavement is realized on a cap of mortar
	Sealing joints	The joints are solved using sand or sand mortar	The joints are made with cement mortar
	Type of pavement superficial finishing	The pieces usually have a rough finish	Finishing of the pieces, is usually polished
Mantenimiento	**Maintenance operations carried out**	In Szczecin, the maintenance of pavements is scarce	In Valencia, daily cleaning is performed of the pavement, with pressurized water

Comparative table of different causes in Valencia and Szczecin.

1. Weather

One of the main reasons of lesion in pavement of Szczecin are the atmospheric agents, to whom it is exposed. The variation between maximum and minimum temperature is high, and this means that, in winter, are often frost and the accumulation of snow on sidewalks, a factor very harmful to them. For this reason are common lesions caused by internal stresses of the materials produced by sudden temperature changes.

In Valencia, the difference in maximum and minimum temperature is not so high as in Szczecin, but the sun does play an important role in the aging of the pavement, which can cause discoloration of the material.

Also due to rain, lesions may appear as damp and efflorescence.

Fissures by climatic causes: Valencia (picture 1), Szczecin (picture 2) [1]

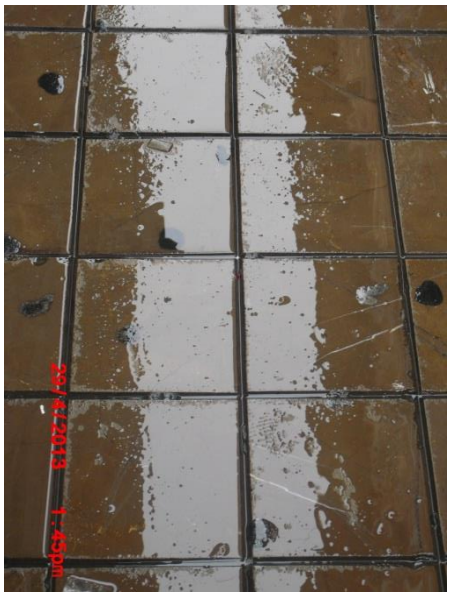
2. Execution of the pavement

The first steps of the execution process of the pavement are the same in Szczecin and Valencia (soil compaction, structural base, and sand bed). The difference is that in Szczecin, this sand layer is used as a support base for the pavement, while in Valencia is placed a layer of mortar grip 2 cm thick to receive the pieces that will form the pavement. In both cases the incorrect compacting the sand layer may produce lesions on the pieces of the pavement.

The execution of the joints of the pavement is also different, in Szczecin is solved by sand sweeping over the pavement (for ease of execution and as the solution from freezing), which makes it common the lack of material on the joints for their easily eroded and favors the formation of organisms therein.

Both Valencia and Szczecin lesions appear on the pavement, due to, incorrect forecast joins in the project or during the execution.

The surface finish of the pavement, is different in Valencia usually performed a polished finish of the pieces and it is usual in Szczecin a rough finish in order to prevent slipperiness of the pieces during periods of snow. This superficial finishing pavement makes it prone to the accumulation of water and dirt on the surface.



Joint execution difference: Valencia (picture 1) with mortar joints, Szczecin (picture 2) with sand joints. [1]

3. Manteinance

The need for maintenance of pavements Valencia is lower than in Szczecin since, in the city of study, the weather is more aggressive and cause most of the observed pathologies.

In Valencia, daily cleaning is performed of the pavement, with pressurized water and by sweeping of the streets.

In Szczecin pavement maintenance is very low, only performs work snow removal during the winter months, but with a method that is detrimental to the conservation of pavement materials. The work consists of the spreading of salt on the road, which can cause many pathologies.

Necessary maintenance operations are not carried out as the replacement of grouting material, which also causes the appearance of many lesions.

Presence of surface deposits over the pavement:Valencia (picture 1), Szczecin (picture 2) [1]

CAUSES	PATHOLOGIES	
	SZCZECIN	VALENCIA
Weather	Dampness Fissures Erosion Breaks Damage in the sealed one of joints Efflorescence Raising pieces Landslides Disintegration Organisms in the joints of the pavement	Dampness Fissures Breaks Efflorescence Decoloration
Execution of the pavement	Fissures Breaks Raising pieces Sinking Lansdlides Subdivided slabs Staggering of joints Organisms on the joints of pavement	Fissures Breaks Subdivided slabs Sinking
Mantenimiento	Patina Superficial deposits Lack of material in the joints	Patina Superficial deposits

Tabla comparativa de causas/patologías en Valencia y Szczecin.

SOURCE OF THE IMAGES OF CHAPTER

[1] Author

CHAPTER 6. PROPOSAL FOR ACTION

6.1. ALTERNATIVE CONSTRUCTION SOLUTIONS

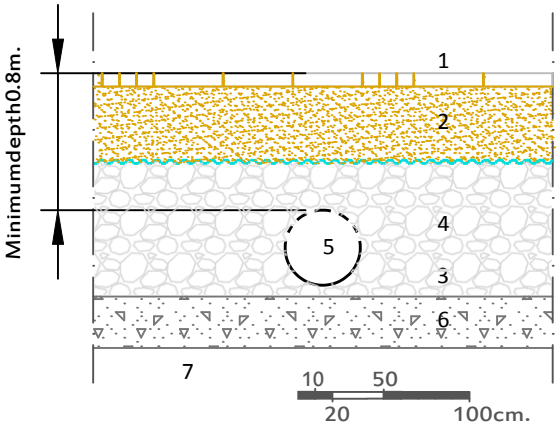
The execution process is very important in the quality, finish and durability of pavements. When performing a bad or sloppy execution, is deceased, as we have seen before, of much pathology. For this reason we will oversee that performs putting in work properly and carefully, not give rise to, the subsequent appearance of lesions.

The steps in the execution are the same that are made, but we will improve the characteristics of the pavement adding layers to help you drain the water from rain and snow.

The improvement proposal in the execution, as we have said, consists in placing an extra layer of gravel on the structural base which will improve the flow of water to drain through perforated pipes placed inside this layer, it which serves to help drain the rainwater. These items must be located at least a minimum depth of 0.8 meters, considering the depth of frost penetration because Szczecin is located, as explained above, in zone I of Poland, the minimum depth required to prevent frost affects drained water circulation.

Besides of this new layer of gravel, to improve drainage, place a geotextile sheet to prevent unwanted elements from leaking to the drain pipe. About this geotextile sheet, you will place the sand layer that will support the tiles or cobblestones.

In the middle of the sidewalk we place a row of hedges that will make as separators of the bike path and pedestrian sidewalk area. These hedges separators shall have an anti-root sheet surrounding them for its roots do not cause pathologies in the pavement. This row of hedges will help the drainage pavement as will slope towards the portion of sand intended for placement of the hedges, to use water as rain and snow irrigation.



1 Pavement
2 Sand compacted bed
3 Geotextile sheet
4 Gravel
5 Perforate pipe to drainage
6 Structural base
7 Soil

Drawing the component, layers and drainage of the pavement, according to the proposal.

6.2. MATERIALS SOLUTIONS

Material solutions that we are going to pose are made taking into account the pathologies observed in the pavement studied, the causes that provoke this, used materials, eco materials and types of materials available in the area.

According pathologies and causes studied, we know that water is a factor which acts more aggressively on the pavement. There are many and varied reasons, but above all the creation of efflorescence and consequently erosion is one of the major problems along with the problem of water drainage by joints and the material to lower layers.

Permeable pavement

The permeable pavement is a surface where filtered and / or storing the rainwater that falls. Permeable pavements can be constructed from permeable concrete, porous asphalt, permeable pavers, and other materials. These floors are especially profitable where floods or ice is a problem.

Permeable pavement in residential zone [1]

Permeable pavement layers [1]

This type of flooring is a good choice for improving water drainage on the sidewalks of Piastow, since the action of water on the pavement is accentuated when left stagnant on the surface.

However, the problem we see in the choice of this type of pavement to be placed in Szczecin is the climate of the region. Knowing the weather in the area we know the average minimum temperature is around -5 ° C, but winter days and evenings can reach -14 ° C. This is a problem for the water drainage.

Placing the permeable pavement is quite possible that during times of winter with freezing temperatures the water filters it does freeze, so tile set in the pavement can get to break, by the stresses caused by water that filters and increased volume.

With this, we conclude that the material of the tiles to be used, must be waterproof or, alternatively, apply a treatment to the piece to get it. Thus, drainage would be achieved through joints calculated to adverse conditions.

Eco pavement

As ecological offer, we think about an innovative pavement that the Spanish company Pavements of Tudela presented in 2010. Slabs and cobblestones ecological, that help control air pollution thanks to a surface fotocatalítica that eliminates harmful waste.

A prefabricated pavement concrete with two layers. One layer base and an active surface layer, causing the acceleration of a chemical reaction called photocatalysis, responsible for the degradation of air pollutants. It offers a wide variety of formats, sizes and colors, as any other pavement. But with a peculiarity of incorporating a catalyst capable of transforming the pollutant emissions from the atmosphere in the environment-friendly products. In this way, the pavement using solar energy as a source of activation of the catalytic process and its effect remains unchanged throughout his life.

Ecogranic placed on sidewalk [2]

20% of the matter prima it comes from the recycling of waste of the industry and construction. A part of these materials comes from the by-product obtained in the process of manufacture of the company.

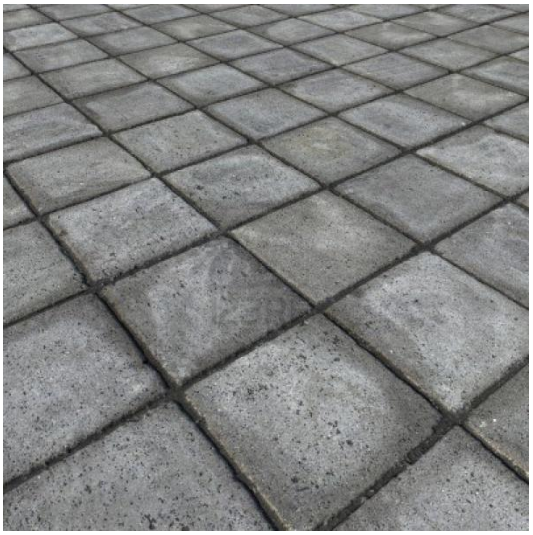
We want to stress the validity of the system of photocatalysis as decontamination tool: the natural chemical reaction that involves the absorption of light by a catalyst. In fact, during the fotocatalítico takes place a reaction of oxidation and subsequent reduction of organic and inorganic contaminants such as oxides of nitrogen, making them - after a process of mineralization - products safe for health and positive for plants.

Photocatalysis [3]

However, this type of flooring is sold by a Spanish company, so if we want to ensure sustainability and eco-efficiency of the pavement we must provide low cost and use local materials. If this type of pavement were to be placed in Szczecin, one should study the sustainability of the construction. Transportation is an economic cost, in addition to contaminant, and possible later repairs equal more demand for materials in Spain, so more transportation. With this, we conclude that will be more profitable, if we employ local materials.

Prefabricated concrete pavement

The prefabricated concrete is one of the solutions we have found on the streets of Szczecin. Currently in the reconstructions of sidewalks, is one of the most used materials, along with the granite.



Prefabricated concrete pavement [4]

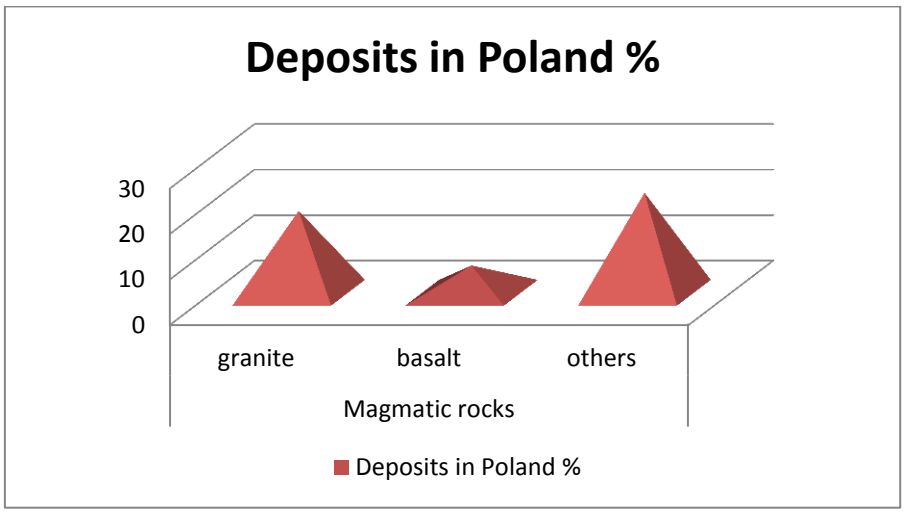
Prefabricated concrete is a material that we can control their properties. This is one of its advantages, not found in natural materials. Has a useful life of at least 40 years. Its resistance can be calculated to meet the necessary features, depending on usage. The resistance is calculated using bending tests performed by a laboratory.

However, prefabricated concrete tiles have a 329 MJ embodied energy and CO2 emissions are 30.79 kgCO2eq, compared with granite tiles, concrete emits more damaging gases to the environment that the material pieces stone.

Pavement of granite

The granite is an igneous rock with a composition that grants him a very high hardness and a great resistance to the graze. Totally recyclable and ecological, it can find in very different formats, tones and colors. His color is inalterable to the sunbeams, is resistant to the striped one and to all kinds of caustic agents. Due to his high place contained in quartz and feldspar it is the hardest natural stone, superior to all the synthetic materials.

Depending on the amount of natural stone deposits existing in Poland granite deposits represent 18% of the reserves.



Percentage Graphic of deposits in Poland [5]

It is one of the stones more extracted in Poland, is extracted mostly in Lower Silesia, where there are most deposits. Due to the need for high-cost equipment for extraction and treatment, there are not many companies that are devoted to it. One of the leading companies of natural stone is Strzegorn Granit SA, which extracts and works granite. Its product range is extensive, controls a quarter of the Polish market of this stone and exports 20%.

Granite Pavement [4]

Considering the features described, which is a fully recyclable and environmentally friendly material that is one of the most amount stone materials are in Poland, we decided that the best material for this case, is to select the material of construction of pavement, the natural stone, granite.

The surface finish better for the granite sidewalks of Szczecin should be one that will confer sufficient impermeability and a roughness to prevent slipping when it rains or snows.

To provide a homogeneous rough surface, is made hammered, hitting the rock surface repeatedly with a hammer Bujard, previously shaped with uniformly distributed small craters. It is an ancient form of surface treatment of all stone materials for exterior coatings.

Bush hammered finish granite surface [5]

To protect the grain of the action of water, you can apply clear water repellents for natural stone. A waterproof FILA house HP98, which prevents the absorption of water by preventing the formation of mold, moss, etc.. Creates a barrier against the elements and prevents aging and decomposition of the material.

6.3. EFFICIENCY AND SUSTAINABILITY PLAN

The orientation of R + D + i in the construction sector is linked to the construction process itself, its management, construction methods and environmental sustainability. The ultimate aim is to use sustainable materials and advance energy-efficient technologies, for which technological cooperation is a fundamental instrument in order to join forces.

The impact of the construction on the environment is critical. According to the European Commission, buildings are responsible for 36% of total carbon emissions to the atmosphere, urban construction represents about 60% of the extraction of raw materials in the world and its water consumption accounts for 12% of Total developed areas, although in highly urbanized areas reaches values higher than 60%.

Sustainable construction aims to ensure balance between the building and the environment, minimizing their environmental impact, in order to meet the needs of the present without compromising the needs of future generations.

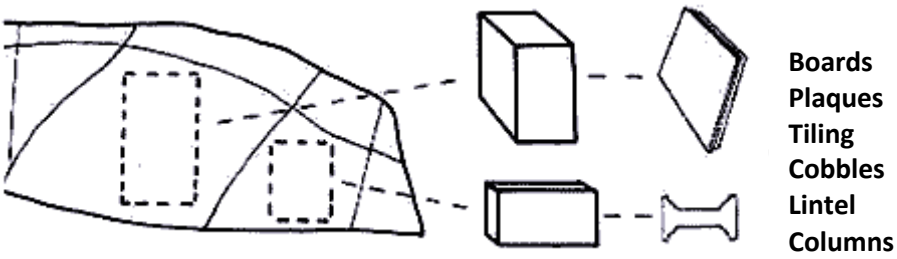
One of the essential actions to improve the sustainability of a product is to study the environmental profile throughout its life cycle as a whole. It is possible to say that a product is more respectful when along its life cycle is efficient consumption of raw materials, causes a limited environmental impact, is functionally suitable for use not harmful during the use phase, and does not generate significant environmental impacts during disposal or recovery after life.

In addition, sustainability and reducing the environmental impacts associated with the construction sector should be considered throughout the life cycle, from production of raw materials that compose it, to the stages of demolition and waste management.

To achieve the efficiency and sustainability plan, is going to study the efficiency of the use of granite as floor finishing, concrete as opposed. To do this, we will divide the study in the different phases through which they pass both materials, from granite removal phase until its demolition and from the development phase of the pieces of concrete until its demolition.

GRANIT REMOVAL PHASE

It is a natural stone, so there are not other elements required for the process, the initial work is the extraction of stone with diamond wire cutting machines, thermal lances, drilling and blasting. After obtaining the block, this is framed through drills, and transported to the factory for further processing and preparation.



Process followed by the granites [6]

PREPARATION OF THE TILES

Once the block is in the factory, to be cut to obtain boards with 2 or more centimeters thick. The sawed is accomplished by means of multi strap looms employing metallic grit as abrasive. The number of strips used depend on the thickness of the panels to be obtained. Is then applied to the desired finish by polishing and granulated.

Instead, for the production of concrete are needed various previous works, some of the most pollutants are:

- Extraction the limestone modifying the limestone hills.

- They burn a petroleum derivative. Bunker, emanating its gases into the environment.

- Transportation of the cement bags with trucks.

- Removing the plaster to mix paving (product coming out of the oven before being cement) also damages nature by modifying the land where they are.

- Additives, these are chemicals that change the characteristics of the concrete to give it properties which initially did not have.

Once the mixture is made of the constituent materials are determined, the vibration and curing. The vibrating is made by vibrator, once the mixture is in the mold and curing takes place when the tiles have hardened. Thereafter polishing is performed by grinding stones of different hardness and granulometry.

One of the main problems caused by the production of concrete, is that the use of cement to produce concrete tiles and once made, give off a fine dust which is easily inhaled, this powder contains a proportion of crystalline silica, which can cause lung diseases (silicosis). In fact, silicosis is the oldest known occupational disease around the world.

COMMISSIONING CONSTRUCTION

For the commissioning work from the tiles are moved by truck at the construction site. Once there are placed by manpower, after performing the sand bed, leaving joints provided between each of the pieces. Once placed sand is applied to the joints needed, and sweep the surface to penetrate. It can vibrate the surface of the tiles so that the sand enters inside, and gasket is compacted. For concrete tiles, the work done is the same.

USE

Granite tiles have a duration of 80 years. The work to be supported during use are the charges on them, the movement of people and vehicular traffic at times. Are good as paving material because the high abrasion resistance is one of its characteristics.

Concrete tiles have an average duration of 45 years, and works to support are the same as for granite tiles. The difference is that the concrete with its wear release particles or fine dust, which results in pollution respirable. Such particles have a specific influence on the environment. Cement dust composes a lot of calcium and magnesium oxide, also emits large amounts of dust covering nearby vegetation, endangering human health and ecosystems.

DEMOLITION

For the demolition of natural stone paving is necessary manpower and trucks for transport. The granite stones are fully recyclable and can be reused for another use and placement.

Concrete tiles are demolished in the same way and even concrete, can also be recycled, crushing it to perform other concretes.

Regarding CO2 emissions generated by each of the materials studied, we can use the tables and graphs in 4.4. Energy assessment, where we can see the amount of emissions generated by using a type of surface or otherwise.

6.4. PREVENTATIVE AND CONSERVATIVE PLAN

For increased durability of the pavement, it is necessary preventive and conservative plan, specifying the operations to be performed and how often. With this plan we extend the pavement life and retard the possible occurrence of pathologies.

The routine maintenance to be performed for life includes:

- Periodic visual inspections (at least every three months), looking for possible lesions on the pavement, and possible lack of sealing material. In the case of identification will proceed to immediate intervention by:
    - Minor and localized repairs from the surface of the pieces.
    - Sealing of fissures and cracks
    - Resanded of joints→ Keep in mind that in the case of joints solved with sand, it is much easier to produce a lack of material, due to cleaning or natural phenomena such as wind and rain.
    - Pavements edges repair

- Permanent cleaning of pavements:
    - It must perform daily brushing of the streets, with a broom or stiff brush to remove dust and other elements that accumulate above all in the recesses.
    - You must make at least one pressure water cleaning hose through every week.

- It should be observed vegetation, because it may be causing numerous lesions:
    - Must be prevented from forming plants between pavement joints by placing anti-root layer and / or general herbicides by applying two or three times a year.
    - Once formed to proceed to its removal.
    - If you identify a root, proceed to its immediate pruning, before it causes a more serious issue.

- It have to check periodically that the drainage system (all of its components) find oneself in well conditions.

- It should supervise that the use of the pavement is that for which it was designed, if it was not intended for car parking should be prohibited, such vehicle parking.

- In the presence of snow, should carry out their removal with mechanical and / or manual mediums:
    - By hand:
      Can be carried out by hand (with shovels and brooms)

- By machine:
  Care must be taken, and use rubber accessories in the plow blade to prevent damage to the paving stone surfaces.

The snow removal on sidewalks, must be performed by each owner of the portion of sidewalk that occupies your home. So the sidewalks are divided into portions, whose owner must be concerned with removal of snow from its corresponding section. For academic areas, the university is responsible for snow removal stretch.

6.5. DESIGN SOLUTIONS AND LOCATION TO THE APPLICATION

Analysing the results after study of the pedestrian pavement and sidewalks in several areas of Szczecin, we deduced that the area has more pathologies is Piastow Avenue. This is mainly due to it is a residential and university zone, especially busy weekdays during teaching hours. By their sidewalks circulated both pedestrian and bicycle traffic, as students move daily from their living areas (houses or residence halls) to universities to attend their classes.

Given this, we will expose some proposals to improve the conditions of pavements in this area.

First, regarding design, large granite stones used in many stretches of Piastow Avenue, not too appropriate, because being so large pieces, suffer many internal stresses in the material, due to radical temperature cycles to those who are exposed in a country like Poland. This is one of the reasons that most of the large blocks of stone present fissures and cracks in its surface.

The optimal proposal regarding the design of pavement would be used in one of the stretches of Piastow which replaced the original pavement pieces for other smaller pieces on their best behavior against lesions, cited above. The pieces, also of granite, are Placed in a way that imitate the design and original colors of Szczecin's pavement simulating large stones that are often used, reusing them after use them as ship ballast in antiquity.

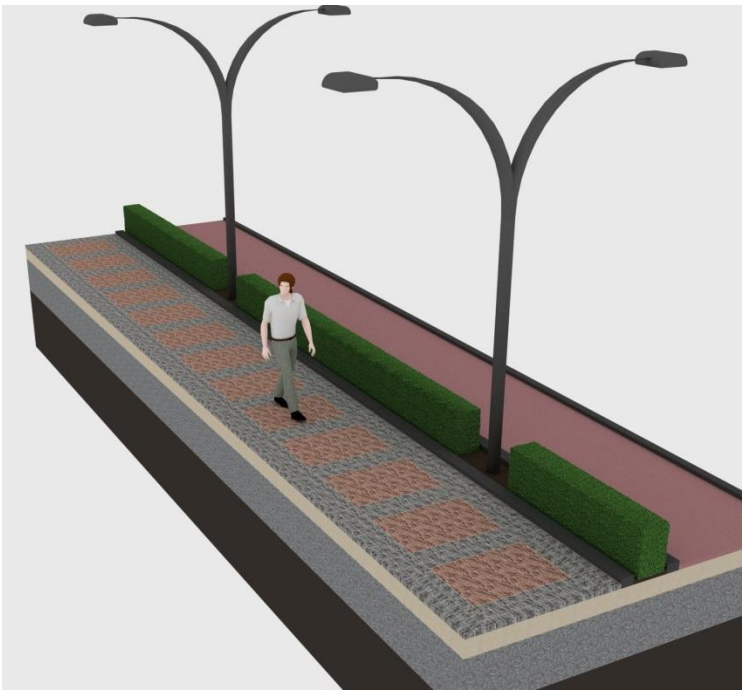
Also employ small cobblestones (also in granite) around these parts that simulate the large blocks. These small cobblestones behave well to changes in temperature, but it needs a careful execution and proper maintenance, because they are so small, run the risk of easily come off if the joint material is insufficient.

This proposal for design would improve with the implementation a bicycle path that allows division between bicycle and pedestrian traffic. This avoids the possibility of collision with pedestrians, as well as encourages the use of bicycles as transportation.

Also reduce pedestrian pavement wear because it is not designed for the demands that the bicycle traffic may cause.

As an element separator of the bike path and the pedestrian sidewalk, place a row of hedges, which will also help to drain the pavement.

This proposal would be advisable because Piastow bicycles traffic is high, although it is not possible to do maintaining the current width of the sidewalks.



Sidewalk and bycle way design solution [4]

Sidewalk design solution [4]

SOURCE OF THE IMAGES OF CHAPTER

[1]http://cfpub.epa.gov/npdes/stormwater/menuofbmps/index.cfm?action=browse&Rbutton=detail&bmp=136&minmeasure=5

[2]http://www.casabioclimatica.com/es/productos/pavimentos-sostenibles/ecogranic_91.php

[3] http://www.pvt.es/en/ecogranic/index.php

[4] http://www.google.com/imghp?hl=es

[5] Author

[6] http://www.petrecal.com/tipos-de-piedra/

CHAPTER 7. INTERVENTION PROJECT: DEVELOPMENT AND DETAILS

7.1. UNDERFLOOR HEATING

It is called underfloor heating or underfloor slab heating the electric heating system, hot water heating or heating carbon fiber yarns which emits heat by the soil surface. In water systems, heat is generated in the boiler and is carried through pipes, a pipe network embedded under the pavement, whereas the heating system of carbon fiber, the heat is emitted from ultra-fine filaments carbon fiber, installed under the floor.

The use of carbon fiber involves a high energy expenditure, which means that if we evaluate the associated emissions cycles (cycle as CO2) are high levels of pollution. Further recycling and reuse is more difficult than that of other metals.

So, discard the option of using carbon fiber as heat emitter for underfloor heating, and we proceed to the study of underfloor heating by hot water and electric heating.

Regarding floor heating with hot water, keep in mind that this is polyethylene pipes under tiles, by circulating hot water. Knowing that in Szczecin, it is recommended that drainage pipes are placed 0.80 cm deep buried to prevent freezing due to low temperatures, we discard this solution.

Electric under floor heating

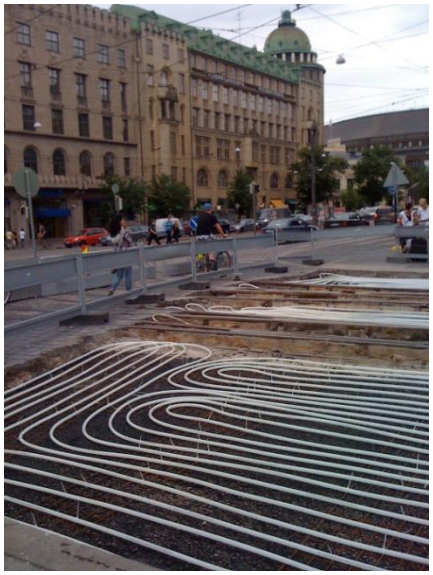
It is called electric underfloor or electric slab underfloor heating, the heating system that emits heat from beneath the soil surface. The operation is based only on the use of electric power.

This heating system is the evolution of systems with boilers and pipes with water, using a pre distanced meandering distribution in a mesh, which is inserted under the coating or final floor covering, the surface to be heated, allowing homogenous delivery and constant heat.

There are some advanced systems which possess intelligent control thermostats that anticipates, based on temperature readings, the turned on of the heating system, to achieve the requirement of the user, both in temperature and in the schedule.

This heating system, promotes the use of electricity, not only for environmental reasons but also for economic reasons, and that is perfectly suited to take advantage of changing to cleaner energy and renewable, being able to feed wind and solar energy.

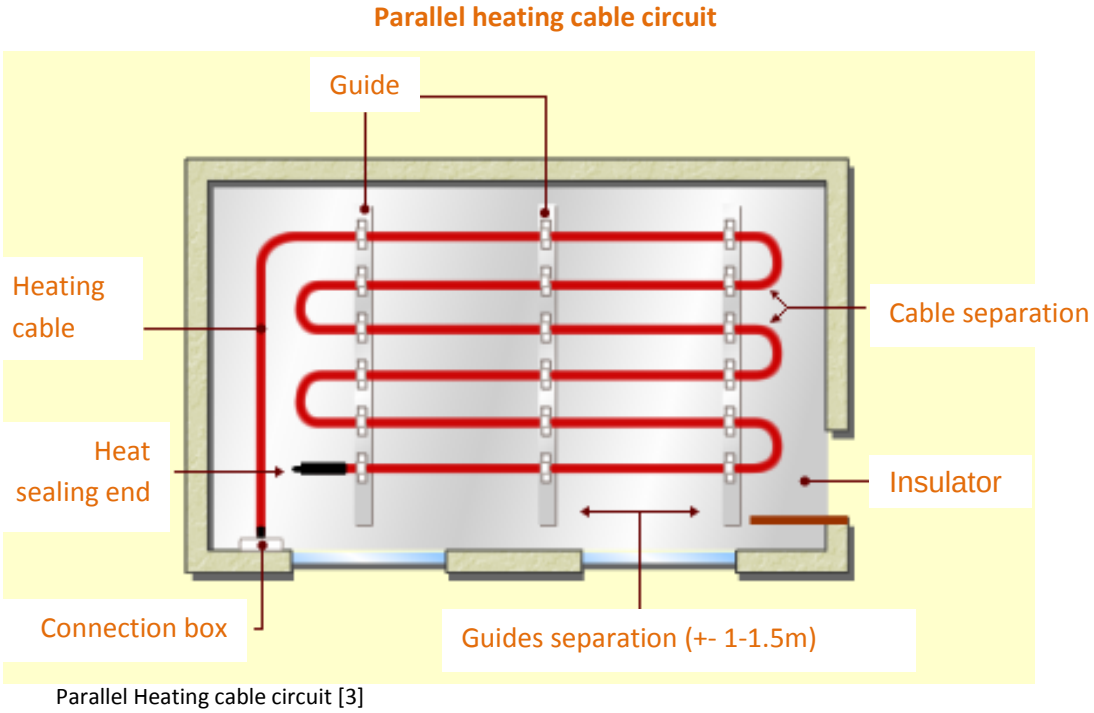
The energy used is completely transformed into heat, unlike traditional heating systems boiler, which has a waste of almost 30% of energy, which is lost through exhaust vents or chimneys, and in range retail, distribution pipeline stretches from the boiler to the heating zone.



Helsinki Street with under floor heating [1]

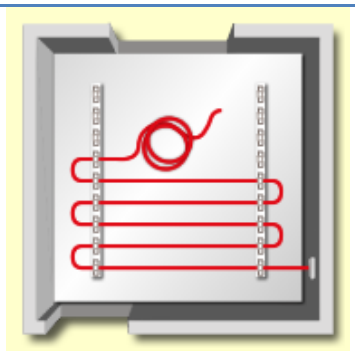
Helsinki Street without snow with under floor heating [2]

General circuit diagram

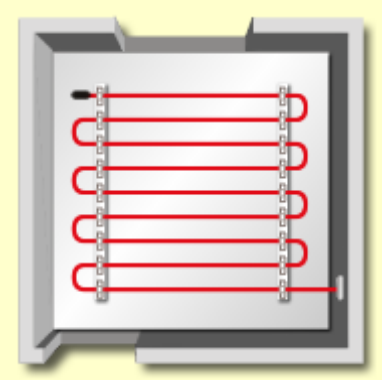
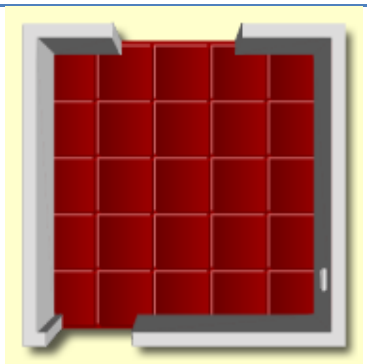


Parallel Heating cable circuit [3]

General Guide of electric underfloor heating installation

Step	Picture
We will clean the surface of the ground, to avoid having any sharp objects that may damage the insulating sheet or the heating cable.	
Placing the insulating sheet covering the total surface area, to avoid unnecessary heat loss. If it is necessary we will put sheets pieces, where it was not possible to put whole sheets.	
Place the spacer guides at 1 or 1.5 m of distance. We will fix the guide above the insulation.	
Make heating cable laying, taking care not to cross other electrical cables, pipes or other. If there were, they must pass as close to the walls, and be covered with mortar, and never covered by insulating materials.	

Images guide instalattion [3]

Step	Picture
Concluded its heating cable layout, and after verification that is well anchored to the guide, will seal one end with heat shrink tubing, and connect the other end to the electrical box.	
Heating cables are checked in the factory, but it is important to review the same before and after covering them with sand (check continuity with a multimeter and examine the condition of the insulation).	
We will cover the installation with a sand bed. Then place the tiles and put sand for the joints.	
After installation of the floor, let the soil rest for a period of 15-20 days (15 days minimum) to prevent soil cracking. After this period of time, we can connect the underfloor heating.	

Images guide instalattion [3]

Diagram of electric under floor heating

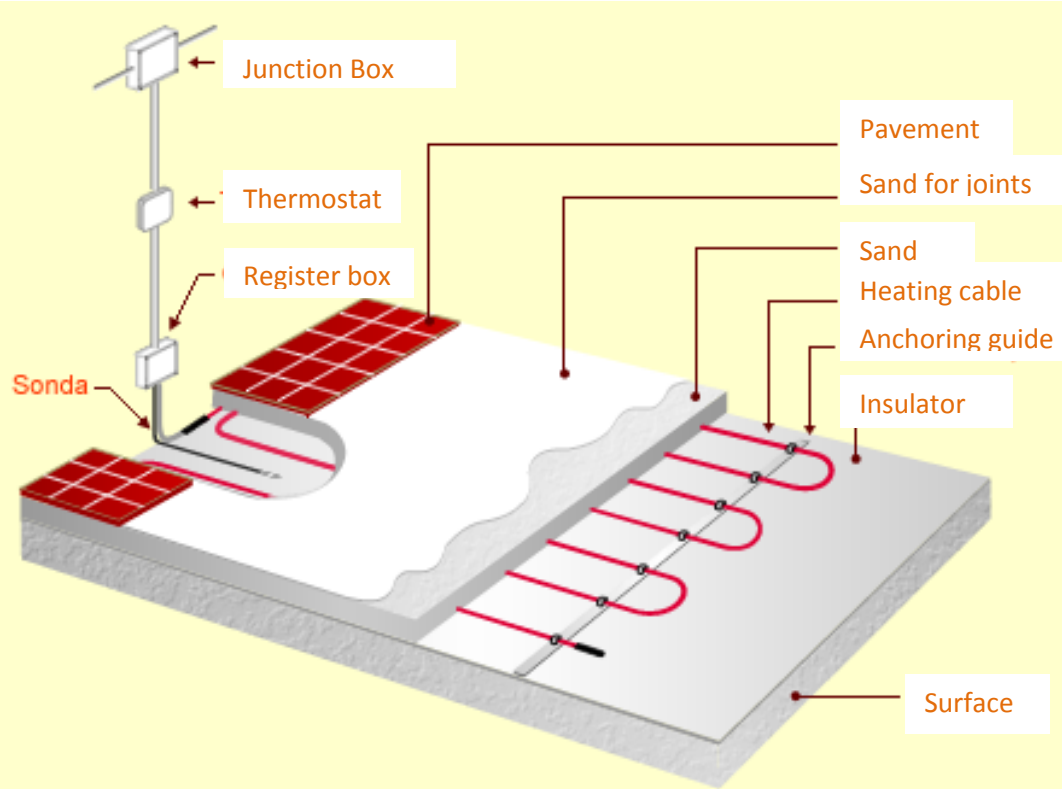


Diagram of electric under floor heating [3]

Diagram, heating cable connection to the network

Once the system installation, you must connect the heating cable to the network. The connection must be fixed (no pins or sockets), and must carry out an authorized installer.

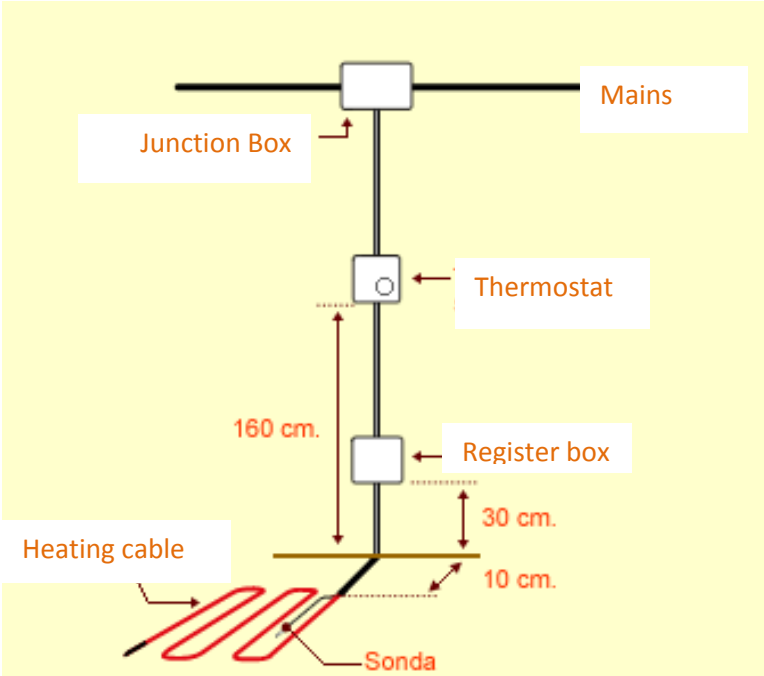


Diagram heating cable connection to the network [3]

7.2. POWER GENERATOR PAVEMENT

Along recent years, it has revealed an increase in interest in designing sustainable products that are environmentally friendly. In this way have appeared different types of flooring that save or, as in this case, generate energy sustainably.

Already there are several brands on the market that provide this type of pavement, emplaced in different parts of the world. These are:

- Innovatech (Israel)

It is a company from Israel that has developed piezoelectric generators that store mechanical energy created by the movement of railways, vehicles and pedestrians, and converts it into green electricity.

- Powerleap (United States of America)

American company that is working on the design of concrete and glass plates, tiles with a piezoelectric mechanism which converts energy. At the moment the project is only a prototype.

- Sustainable Dance Club (Holland)

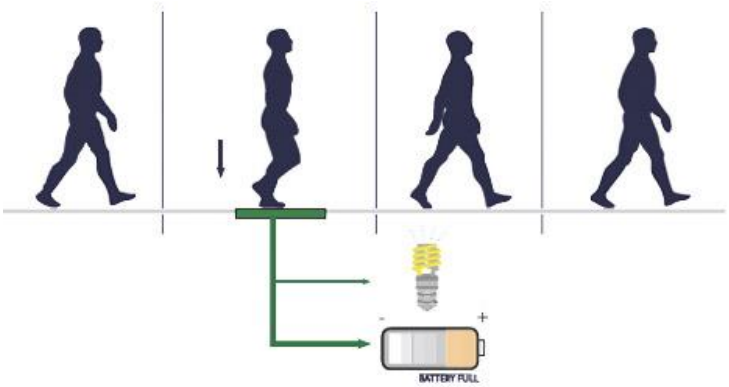
Sustainable Dance Floor tiles are flexed slightly, with every step is created movement that can be transformed into electrical energy by a small internal generator.

- Pavegen (United Kingdom)

Since 2010, supply tiles that produce electricity when these are footfalls by walking. There are several models incorporating light or connected to a system that is powered by electricity generated. There is also a model that can store energy in lithium batteries for up to three days.

In this particular study, we focus on the product manufactured by Pavegen, since it is the more commercialized company, and advanced on the subject of energy generating pavement. This company took its product to the public in 2010, and since then continues to search for product improvement, in terms of materials, operation, maintenance and costs.

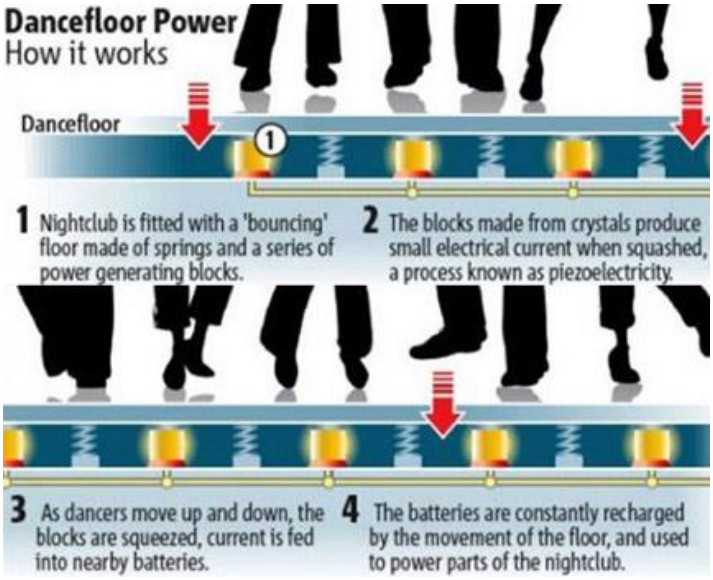
We're talking about a pavement capable of generating and storing energy from footsteps of pedestrians by walking. Every time a footprint acts on one of these tiles, pressure generates kinetic energy which is stored in a small lithium battery.



Pavegen works [4]

These tiles are designed to withstand high foot traffic on them. They are also waterproof, and resistant to outdoor weather conditions such as rain and snow, being able to put both indoor and outdoor locations.

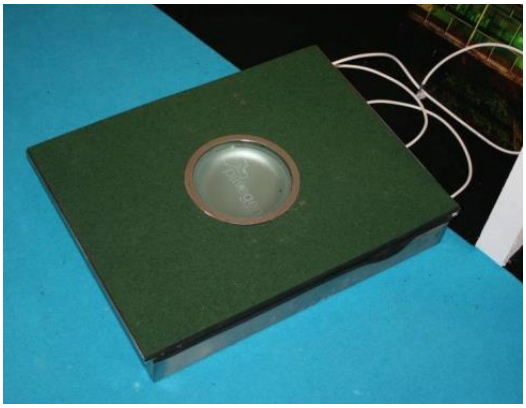
Each tile has an internal piezoelectric crystals, which when compressed with each step (5 mm), generating a potential difference which in turn generates a movement of electrons. One step depending weight of the person can produce about 7 watts of electricity. This results in storage produces 12kWh in a peak hours and 5 kWh during off hours, this considering that it is placed in a high pedestrian traffic area.



How it works Dancefloow power [5]

This energy storage can be devoted to supply equipment, low-voltage network, such as lighting, signage or battery charging, among other applications.

Marketed by Pavegen tiles have a size of 45 x 60 centimeters and are made with materials that respect the environment. The upper part is resolved with recycled rubber car tires. Internal mechanism components are made of recycled aluminum.



Pavegen tile [6]

Regarding to cost, Pavegen representatives refuse to say how much the price of acquisition and placement of these tiles is:

"A spokesman for Pavegen declined to say how much the tiles cost, but Pavegen aims to get costs down to about $76 (55.47€ or 240.70 PLN) per tile, equivalent to other high-specification flooring products."

Laurie Balbo in Architecture & Urban, Energy, Travel & Nature 2013

Some articles of 2011 according to personal communications ensure that the price had been reduced by 50% in the last six months. Is also a disadvantage product durability, estimated at 5 years twenty million steps (too low to be a pavement), plus the need for particular maintenance every year. But the high cost and short duration are not counterproductive, because then compensated by a large energy savings.

This system is already in use in several places such as:

Madrid: They was placed on a catwalk of Telefónica building in the event Keep Walking Project.

London: A place in which they were placed, was in a corridor between the Olympic stadium and the Westfield Stratford City shopping center. They are also installed at Renaissance Works Central contemporary London offices.

Dursley: In 2012 were installed in Rednock School, using its energy to feed the interactive boards are there in college.

Singapour: Were installed on the world's largest floating stage for a single event kinetic energy called "Dance2Power".

Pavegen circuit [4]

7.3. COMBINATION RADIANT FLOOR WITH POWER GENERATOR

Our proposal is centered on Piastow Street, the most deteriorated street that we have studied. As we have noted in previous points, the main causes of impairment are: poor execution, poor maintenance and the action of water on the surface.

Regarding the poor execution and lack of maintenance, we have to note that these two causes are preventable, making control and supervision. So, we understand that we must act on the principal cause that depends on the weather of the city, and one inevitable factor that we must adapt our sidewalks.

Water in Szczecin comes as rain, snow or hail. The main problem for walking on the streets in winter is the snow presence on the sidewalks. One of the maintenance work carried out on the sidewalks is remove the snow by salt or by shovel. As we know, the salt is a harmful substance that acts aggressively on the pavement material, with water, especially.

Sidewalks from Piastow Street full of snow [7]

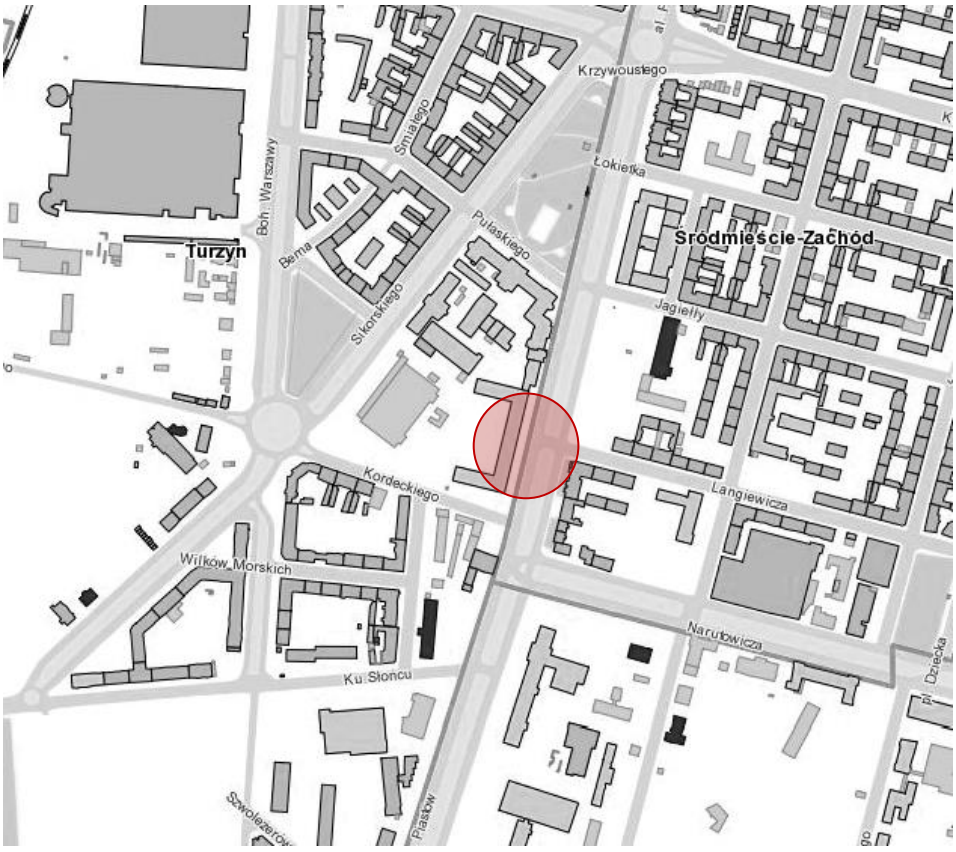
Our proposal is a combination of electric underfloor heating with pavement generator. With this what we want to achieve is that in the winter time the streets are kept of ice and you can circulate freely, preventing accidents and protecting the environment without the need of harmful substances for snow removal. Furthermore, avoiding that sidewalks stay covered with snow we avoid that water left stagnant in the surface and that when it penetrate be frozen due to the low temperatures, and causes cracks in the pavement.

The power source of electric underfloor is the mains, but in our proposal is posed use the energy generated and stored in energy generating tiles to carry it to the underfloor heating system.

Location

The proposal is projected in Piastow Street, one of the main streets of the city and very busy during the day. In this street there are universities and student residences, which make very high pedestrian traffic. That is why we chose a sector of this street where the proposed is project.

The stretch chosen is the entrance of the University of Engineering Mechanics which is observed in the following map.



Chosen area of Piastow Street [7]

Mechanical Engineering University of Szczecin has a recessed entrance on the front edge of the parcel, so it has a pavement space distinct from that of the sidewalk, which there are the main entrance of the building.

Szczecin Mechanical Engineering University in Piastow Street [7]

Design

Will be in the entrance area of the university, where we will place the power generator pavement, provided situation strategically with more pedestrian audience. Therefore will be over the entire width of the sidewalk where will be the underfloor heating pavement, networked to generator pavement. You can see the design at the following maps.

During the winter, is when the radiant pavement will be used, generated electricity will be goes by underfloor heating electrical pipes. This will ensure that the pavement will be clear og snow and the people, especially students, will walk without any danger. Also, will be save the maintenance of sidewalks. Moreover, in the entrance of the university must be done the snow removal works, which will be responsible the university.

Energy

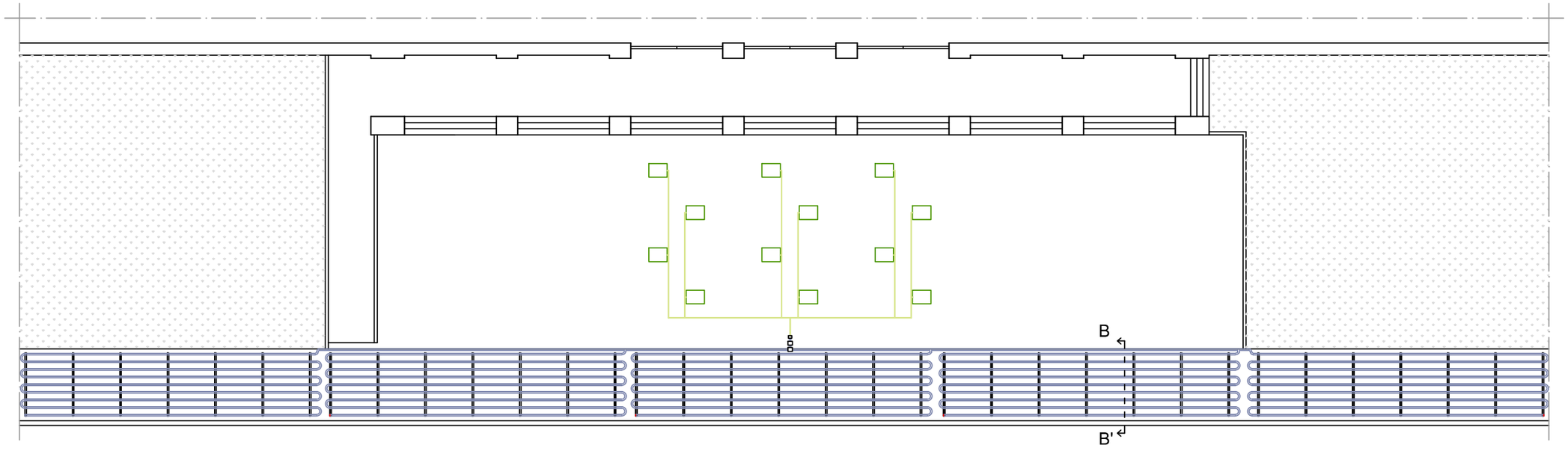
Regarding the energy produced and consumed, we know that a tile can produce 12 kWh, at peak hours, and 5 kWh during low hours. Knowing that, this is considered to high concurrency areas such as stadiums, shopping centers, etc. For our calculation, we assumed the worst value.

Therefore, a tile produce 5 kWh, we consider that are 8 working hours per weekday, because this is a university. Thus, we have a total of 40 kW per day, produced by a tile. We have 12 tiles, so 480 kW total generated in one business day.

Regarding the energy needed for the under floor heating, we have 115,5 m^2 of pavement, and according to the technical specifications, we need 300 W/m^2. Therefore, are required 34,65 kW for the electric under floor heating.

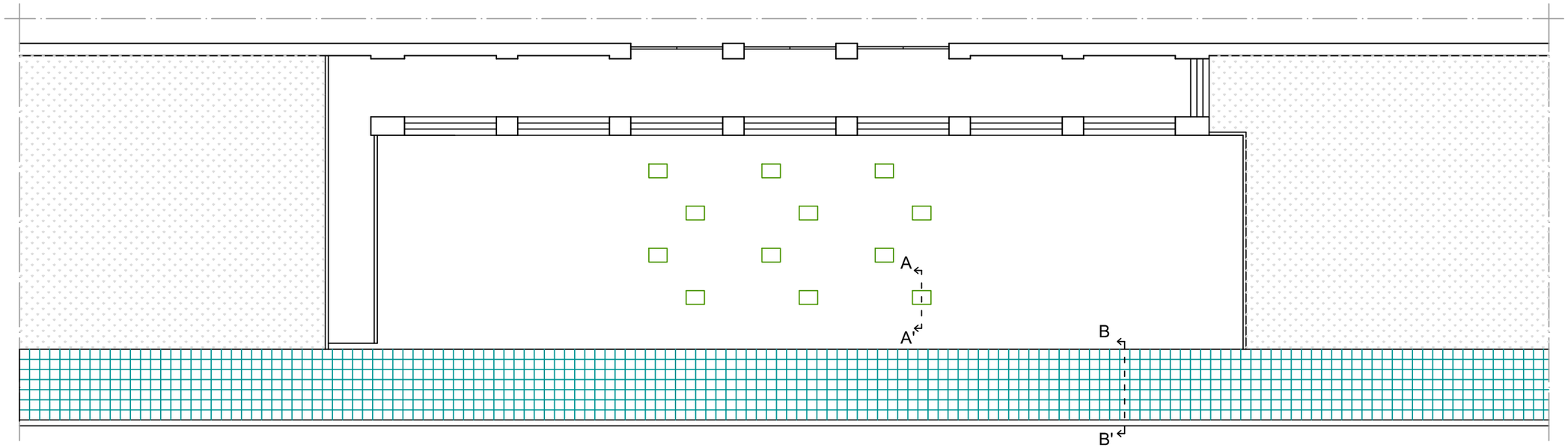
Doing this calculations we know that we have more energy than we need and in winter the under floor heating is off, the energy generated by tiles can be accumulated on them or you can use the same energy to give light to street public shines and / or to give light to he university (perfect for summer).

Furthermore, we note that the Piastow street stretch chosen has 50 m long, being a short for the entire size of the street, relatively. Redoing the calculation, we can say that, for the number of tiles we have, it could provide electricity for heating pavement along 700 m of Piastow street pavement and thus would take advantage of all the energy generated by Pavegen tiles.



PIASTOW AVENUE

WIRING DIAGRAM CONNECTION BETWEEN PAVEGEN AND UNDERFLOOR HEATING



PIASTOW AVENUE

DESIGN OF LOCATION OF PAVEGEN AND UNDERFLOOR HEATING IN PIASTOW STREET

LEGEND

Grass

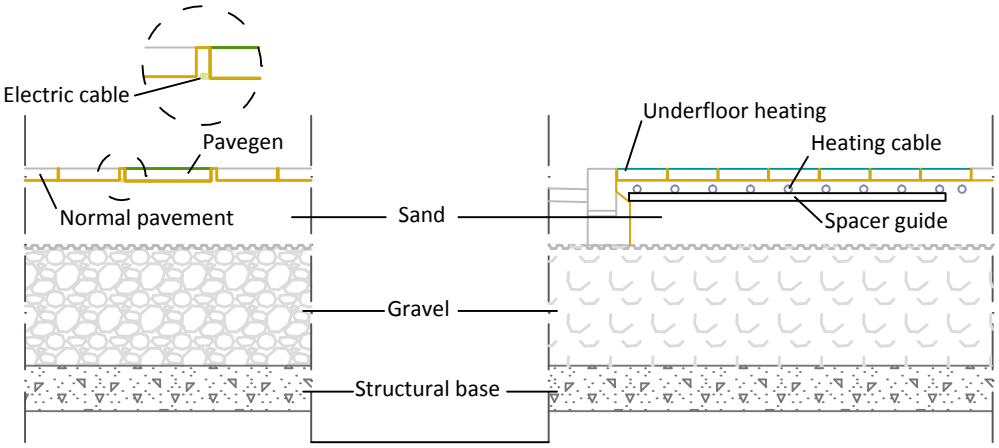
Underfloor heating

Electric cable

Pavegen

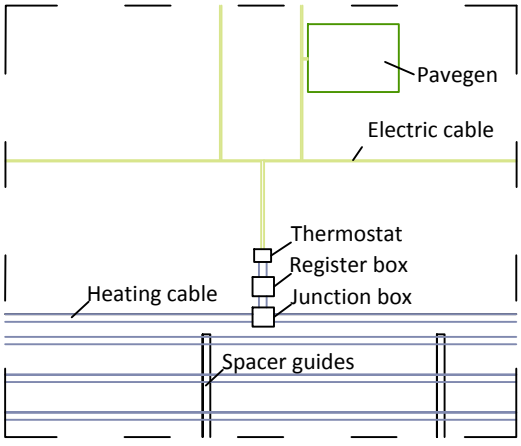
Heating cable

E 1:150



SECTION A-A' SECTION B-B'

E 1:50



DETAIL OF INSTALATION

E 1:50

SOURCE OF THE IMAGES OF CHAPTER

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CHAPTER 8 . CONCLUSION

Sidewalks, although largely forgotten by most of us, not only are a medium of pedestrian crossing are a way to connection of the city, a public space where pedestrians can walk freely, connectors for shops, and conductors of urban life.

They are usually give less importance than truly have, perhaps if we lived in a place where it is usually the absence of sidewalks, like Venezuela, we would realize of their great need.

Is for that, of vital importance the proper maintenance of these, given that, pathologies such slopes, cracked and broken pieces that compose them, produce difficulties in the use of them, complicating accessibility and making it almost impossible their use in the case of seniors, disabled, and even ladies with baby strollers.

It is also essential, as already mentioned, that in countries where temperatures below 0 ° C are common during harsh winter months, is try to keep them free from accumulation of ice and snow, a necessary operation to enjoy their utilities .

In addition to the properties mentioned above, the sidewalks are part of the aesthetics of the city to which they belong and can play with the design of their tracings, furniture and vegetation can be used for their execution natural, recycled, or ecological materials, make them plus a form of connection, a sustainable resource and even artistic of the city.

The latest innovations, have even opened the possibility that the sidewalks have other utilities that previously not have been raised. Now, with the new technologies are also becoming in functional elements, and could use as a resource to prevent from snow accumulation in transit zones, keeping in liquid heating their surface and removing the obstruction of areas with high traffic. And even with more advanced technology can serve as a source of green energy, using the energy produced pedestrians with their steps to store it or use it to other public elements like informational signs or streetlights.

And is that as said the Venezuelan writer Victor Vegas:

"Perhaps no one has stopped to think about the philanthropic service, providing sidewalks. These gray and hard creatures that eternally live tended, have a gigantic capacity for sacrifice. Much it is so we have never heard of their complaints despite the fact that we live, perhaps too often, trampling and shedding how much trash on your flat existence.

Unexplained they protect us since childhood. They trace the boundaries between common pedestrian and neurotic driver of the kids from Ford. The latter are the most unmoved and ruthless , well in his grief of bottleneck, and at the height of the inconsiderateness, pass or park their heavy babies on the gray and defenseless creatures. Neither we have understood his sadness, his loneliness. They live in complete isolation, embraced a block that has nothing to do with his nature because the indifference of asphalt denies any possible communication with the partners of opposite side. So they live like this, sad and alone. Terribly alone. "

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CHAPTER 10 . ACKNOWLEDGEMENTS

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