Evaluation of construction waste in Xanxerê: possibilities for a more sustainable end

Luisa Félix Dalla Vecchia*, Aryane Spadotto and Cíntia de Carli

Faculty of Architecture and Urban Design,
Universidade do Oeste de Santa Catarina,
Rua Dirceu Giordani, 696 – Bairro Jardim Universitário,
CEP. 89820-000, Xanxerê, SC, Brazil
E-mail: luisa.felix@unoesc.edu.br
E-mail: aryane.spadotto@gmail.com
E-mail: cintiadecarli@yahoo.com.br
*Corresponding author

Abstract: This research aims to study new strategies of reduction and destination of construction waste, as well as acknowledge what is being done with the waste produced in the city of Xanxerê, Santa Catarina, in order to propose actions for a better destination of the waste. In order to do so a field research was carried out, with the use of a supporting questionnaire, interviewing authorities, collectors association and companies, which have a direct or indirect link to the production of construction waste in the city. Furthermore, strategies adopted in other Brazilian cities and abroad were also studied as well as the legislation in order to understand the viability of using these strategies in Xanxerê.

Keywords: waste; construction; reduction; destination.

Reference to this paper should be made as follows: Vecchia, L.F.D., Spadotto, A. and de Carli, C. (2014) 'Evaluation of construction waste in Xanxerê: possibilities for a more sustainable end', *Int. J. Environment and Sustainable Development*, Vol. 13, No. 4, pp.354–367.

Biographical notes: Luisa Félix Dalla Vecchia is a Professor at the Faculty of Architecture and Urban Design at the Universidade do Oeste de Santa Catarina (UNOESC). Her main fields of interest in research are: architectural design methodology, sustainable design and waste management and computer aided design. She is active in national and international research projects.

Aryane Spadotto is a student of Architecture and Urban Design at the Universidade do Oeste de Santa Catarina (UNOESC). Her main fields of interest in research are: architectural design methodology, sustainable design and waste management. She has a research scholarship funded by the government of Santa Catarina to research about waste management in Xanxerê.

Cíntia de Carli is a student of Architecture and Urban Design at the Universidade do Oeste de Santa Catarina (UNOESC). Her main fields of interest in research are: sustainable design and waste management.

1 Introduction

Currently construction is responsible for the production of 685 million tons of waste in Brazil. Apart from the waste, this sector causes changes to the environments from its initial phases, in the process of material extraction, and also during the building's life span (Fraga, 2006).

According to Adam (2001, p.103) "[…] the loss in construction sites vary between 30 and 100% of the material bought, there's loss even in the replacement material. Limestone, rocks, pieces of concrete and wood… it is all piled in the construction site as rubbish."

One of the biggest problems faced is the inadequate destination of this waste. Usually the construction waste is piled in places close to the site, which leads to other kinds of rubbish to be deposited in these areas also, compromising traffic, drainage, spreading diseases, changing the urban landscape, among others (Pinto, 1999).

With the correct destination of the waste it is possible to compensate the outlay, the regeneration of areas of inadequate waste disposal, in the long run, have higher costs than the activation of recycling plants. Furthermore, construction waste can be used in other construction sites, replacing new material and making the construction cheaper (Sardá, 2003).

The worry towards construction waste is considered recent in Brazil. Recycling comes from ancient times and it was used in the reconstruction in Europe after the Second World War. In the USA the waste management policy started in the late 1960s. In this context, John and Agopyan (2000, p.2) claim that "[…] the recycling of construction waste is in a relatively advanced stage in the aspect of reducing the waste during the construction activity, public policies for the management of the waste and also technologies for recycling".

The lack of appropriate places for the disposal of waste leads to the construction waste being piled up in urban areas, degrading these areas creating future sanitation costs as well as causing environmental problems.

In some Brazilian cities recycling construction waste is already a reality. In the city of São Paulo there have been examples of recycling since the 90's, such as the use of waste for road paving using either asphalt of concrete. In Belo Horizonte the recycled waste is used as the base for paving and also in the production of plaster. Beside the recycling techniques used in these cities, the waste, after being ground, can also be used in slope retention, concrete paving, concrete blocks, drainage tubes, among others (Noronha et al., 2005).

There is great worry in preserving the environment and sustainable development. In the scope of construction, several aspects influence in determining whether a construction site is more or less sustainable, such as use of water and the use of bioclimatic strategies. In this context the construction waste is responsible for a great part of the solid waste produced in urban areas, which represents a high cost for the constructor and a great impact for the environment because it means an increase in the use of products and also the increase in the volume sent to areas of destination, such as landfills and inadequate areas, such as empty lots, streams and slopes (Cardoso and Araújo, 2007).

Several studies show ways of reducing, reusing and recycling the construction waste. However, for this to be possible, it is important to know what kind of waste is being produced in order to point out solutions directed to the local reality.

In order to adopt new procedures of waste management it is important to diagnose what kind and the amount of construction waste produced in the cities, because each region uses different materials and different constructions processes.

Therefore, this study aims to evaluate the construction waste produced in the city of Xanxerê through data collection, to reach a diagnosis which shows the situation of the city regarding construction waste. Xanxerê is a city considered small, with a population of 50 thousand. It is located in the west of the state of Santa Catarina in the south of Brazil as shown in Figure 1.

Figure 1 Location of Xanxerê (see online version for colours)

Source: Wikipédia (2012)

This research is ongoing and after analysing the data it is the intention to point to specific actions for the reduction and correct destination of construction waste in Xanxerê.

2 Current data

Construction is one of the most important activities for social and economic development since the share of this sector in the gross domestic product (GDP), both in Brazil and other parts of the world, is significant. In 2002, for example, it was about 8% of GDP. But, on the other hand, construction generates great environmental impacts, either by the consumption of natural resources, changes to the landscape or by producing waste (Pinto, 2005).

The worry about a better destination and adequate management of waste increases simultaneously with the growth of the cities. The current situation of destination of construction waste highlights the importance of its correct management, since construction is responsible for over 50% of the mass of urban solid waste. However, according to Pinto (1999) what is aggravating about the waste from construction and demolition is that the volumes generated are unknown as well as the impacts it can cause, the social costs involved, and which are the possibilities for its reuse.

Nowadays 68.5% of the waste generated, in 4,026 of the 5,507 (Barra et al., 2006) Brazilian cities, have as final destination open dumps and flooded areas (Barra et al. 2006), since construction waste has always had the same treatment as garbage (Costa and Gradin, 2006).

The worry about the correct destination of construction and demolition waste is recent, as is the science about the amount and intensity in which it is generated, although this activity has always had an active part in the world's economic development. The adequate management of construction and demolition waste, including its reduction, reuse and recycling, will make the construction process more profitable and healthier (Cunha, 2005).

2.1 International panorama

Although recycling construction waste has existed since ancient times, it was only recently that it started being used as a construction material. This method was initially used in Europe, in the reconstruction of some cities after the Second World War, and currently the fraction of recycled material can reach around 90%, like in Holland, for example, absolute leader in recycling waste (Ângulo et al., 2007).

Table 1 presents the panorama of construction waste recycling in some European countries, highlighting Belgium for its high percentage in construction waste recycling, second next to Holland (Buttler et al., 2009).

Table 1 Generation, recycling and application of construction and demolition waste

Country	*Annual production (X106 T)*	*Recycled (%)*	*Application of percentage recycled*	
Belgium	7.0 (1990)	87%	Aggregates for concrete: 19.5%	Roads: 80.5%
France	24.0 (1990)	15%	Aggregates for concrete: 10%	Roads: 80.5% Landfills: 35.3%
UK	30.0 (1999)	45%	Aggregates for concrete: 4.5%	Roads: 20% Landfills: 75.5%
Spain	38.5 (2003)	10%	Bases and sub-bases for highways: 30%	Base of ground: 35% Landfills: 35%

Source: Adapted from Buttler et al. (2009)

The variation in percentage of waste recycling is due to the natural resources available, the transportation distance between recycled and natural materials, economic and technological situation of the country and population density.

What contributes for some countries to have better control over the waste produced is more grounded legislation, with harsher punishment, and taxing for irregular disposal of waste. Some actions in the UK encouraged concrete factories to diminish the amount of waste produced (Buttler et al., 2009). Germany defined as government politics objective to increase the number of recycling facilities in the country, and France defined as a goal for the year 2000 to recycle 50% of the construction and demolition waste produced (Magalhães et al., 2010).

Due to the great technological advances, Japan is recognised as the most advanced country in demolition techniques adequate to the needs of environmental management,

and the USA have a high number of recycling facilities distributed all over the country (Magalhães et al., 2010).

In developed countries the facilities are mainly large, which implicates in significant capital and the need of a minimum number of tons daily, probably between 1000 and 1600, this amount is only reached by a few Brazilian cities (Magalhãeset al., 2010).

2.2 National panorama

The worry about waste is relatively recent in Brazil, different to countries like the USA and Japan where politics of waste management have existed since the late 1960s. Compared to these developed countries, the recycling of construction and demolition waste, as a construction material, is equally still timid – with the exception of the intense practice of recycling in the cement and steel industries – even with the lack of aggregates and areas for landfills. This delay is due to the repeated economic problems and the notable social problems, which are the focus of current political discussions (Ângulo et al., 2007).

The studies which are being carried out in Brazil since the 80's and 90's, already give enough support for the propagation of the recycling processes as an alternate destination for construction waste for a high number of urban centres. But the studies need to be deepened, increasing the possibilities of reuse so that more cities, not just the big urban centres, may get close to the concept of recycling (Magalhães et al., 2010).

Data from IBGE from 2008 shows that in Brazil 1,623 cities control the management of construction and demolition waste, and that the highest concentration of cities with this service are in the Southeast region with 607. Although only 79 of these cities count on the reuse of the aggregate produced in the fabrication of constructive components. According to official statistics, only 39 of the 5,507 cities regulate their construction management plan (Admin, 2011).

Currently, recycling is a reality in the great cities of Brazil. Some cities, such as Belo Horizonte, already operate recycling plants, producing mainly base for paving (Ângulo et al., 2007). Also in Belo Horizonte a programme is being developed with the goal of reducing environmental problems caused by the illegal disposal of waste. This programme consists on the distribution of receiving units for small volumes (URPVs), destined to receive materials such as waste, bulky objects and volumes from pruning. This strategy aims to offer a viable solution for the small transportation services and waste producers in general (Chenna, 2001).

The Construction Waste Recycling Plant kept by PROHAB, in the city of São Carlos, opened in 2006, has the capacity to produce 160 ton/day, this amount is close to the total produced in the city (250 ton/day). The company points out that the production of aggregates, using construction waste, can save up to 80% regarding the price of conventional aggregates (PROHAB, 2011).

According to Ângulo et al. (2007), the biggest Brazilian experience in the area of recycling waste is conducted by the cement industry which recycles mainly basic blast furnace slag and fly ash. It is estimated that in 1996 the Brazilian cement industry reduced the CO^2 production in 29%, which meant saving 28% in fuel, with the recycling of these components.

Also consolidated in Brazil, is the process of aggregate production, although in its most simple technological form. However, even with experiences in the use of mixed aggregate (soil, concrete, stone, mortar, white and red ceramic) in the production of

paving and this procedure being in use in Brazil since the late 80's, broad and consistent technical documentation is not available to the public. The same happens with the production of mortar from the aggregates in building sites, which recently have been object of academic investigation.

The degree of knowledge of the technology of use of aggregates in the production of components such as paving blocks and curbs is even more primitive, although there is some practical experience and some systematic research being planned. Recycling aggregate in the production of concrete is only now being object of research in Brazil.

Even with research being carried out on this subject there are still several barriers to overcome in order to introduce new products containing recycled material.

3 Impacts

In the current panorama of construction waste destination, its correct management – in order not to harm both the environment and the social an economic sectors – is a matter of difficult resolution considering the growth in volume of the construction and demolition waste, the growth in population, the need for consumption and lack of worry regarding the preservation of resources. According to Diana Scillag, director of CBCS (Brazilian Board of Sustainable Construction), in Brazil construction uses up an amount between 20% and 50% of the natural resources extracted (AEC, 2011).

Currently Brazil produces 241,614 tons of solid urban waste per day, which is almost all disposed of in open dumps (De Alcantara, 2005). To Pinto (2005) this makes evident the lack of effectiveness, and in some cases the inexistence of public policies to discipline and order the destination of construction waste in the cities, associated to the lack of commitment in management by the producers.

The negative impact caused by the extraction of raw material is also huge. All over the world mining and mineral processing play a significant role in the arising of environmental problems such as deforestation, erosion of soil and pollution of air and water. Globally, mining is one of the activities which uses the biggest amount of energy, contributing, thus, to air pollution and global heating (Schneider, 2003).

Schneider (2003) says that "the main sanitary and environmental impacts related to construction and demolition waste may be those regarding irregular disposal", since the construction waste can present remnants of oil from machinery used in the construction, paint among others which are considered dangerous. Moreover, the gathering of construction waste in inappropriate areas may attract non-inert waste, making this place excellent for several species vectors of pathogens to live in, such as rats, cockroaches, flies, worms, bacteria, fungus and viruses.

According to the 2010 edition of the ABRELPE's Solid Waste Panorama, the Brazilian cities collected around 31 million tons of construction and demolition waste, 8.7% more than in 2009, this amount is worrying considering that the cities only collect waste abandoned of placed inadequately in public streets.

Before this chaotic situation of waste disposal in the cities, the city's public power frequently acts with palliative measures, carrying out collection services and bearing the costs of transport and final destination. Such practice does not solve the problem definitively; on the contrary, it encourages this incorrect action to continue (Pinto, 2005).

According to Hamad and Wien (2006) it is the responsibility of the city to formulate and implement policies for the management of the environment, as well as to share these environmental policies with the state and country. However, most Brazilian cities do not have departments to deal specifically with environmental matters.

Thus, it is the responsibility of the administration to evaluate the correct destination and to make sure the companies responsible for producing construction waste give the waste this correct destination. "There are laws and public policies, as well as technical standards which are fundamental in the management of construction waste, contributing to minimize environmental impacts" (Pinto, 2005).

4 Legislation

The construction waste is sorted as belonging to the group of urban waste, because most of it is produced in the urban environment (Rocha, 2006). Currently construction waste is sorted according to resolution n° 307 from 5 July 2002 from the National Environment Board (CONAMA) and by the standard NBR 10004 of 2004 – Solid Waste Assortment – from the Brazilian Association of Technical Standards (ABNT).

Resolution n° 307 from CONAMA has the aim of establishing guidelines, criteria and procedures for the management of construction waste, whereas NBR 10004 from 2004 aims to sort the solid waste according to its potential risks to the environment and public health in order to make it possible to manage the waste adequately (Brasil, 2002, 2004).

Both of these – CONAMA and ABNT – have different ways of sorting the construction waste. CONAMA considers how to reuse a material, how recyclable it is, new uses and how dangerous it is. Whereas NBR 10004 sorts the materials according to its originating process, its proprieties, physical and chemical characteristics, its sources of raw material, its impact on health and the environment and its applicability, thus, by considering mainly the material's chemical composition, it is a more detailed and thorough selection.

CONAMA sorts construction waste into four groups, the first, class A, is any material which can be recycled and reused as aggregate, for example: remains of brick, mortar, rocks, concrete, etc.; class B waste are materials which can be recycled, however destined to other uses such as: plastic, paper, metal, glass, wood, etc.; class C are the materials which do not have a process for recycling of reuse due to high cost or lack of technology; the last group, class D, are the materials from construction which are directly harmful to human health, such as: paint, solvent, oil and others, or contaminated material resulting from the demolition or repairs to radiology clinics, industrial facilities and others.

The 10004 standard from 2004 sorts the solid waste according to its risks to the environment and public health. According to NBR 10004, waste can be sorted into the following groups:

- Class I waste: waste which is dangerous such as inflammable, corrosive, reactive, toxic or pathogenic
- Class II waste: waste which is not dangerous; it is subdivided into
  - Class II A: non-inert, waste which may be biodegradable, combustible or soluble in water

- Class II B: inert, waste which does not present any of its components solubilised in concentrations superior to the standards of potable water, except for aspect, colour, turbidity, hardness and flavour (Brasil, 2004).

Many authors use, in their data collection, the standards defined by CONAMA and NBR 10004. Both resolutions select the materials allowing them to be recycled and reused in the same way in a determined group. However, some researchers sort the waste by material establishing the best way to group the materials for that research, and not necessarily the same as those resolutions.

Data regarding the advances of recycling worldwide show that currently there is great worry about recycling and diminishing the production of construction waste. This worry leads to the establishment of goals towards less production of waste, and the recycling of larger amounts of waste. With this, the number of researches related to new techniques and ways of reducing and recycling waste is growing.

However, Brazil is relatively late in construction waste management policies when compared to some European countries which, for example, already have laws to determine the destination of solid waste since the 1980s.

According to Schneider (2003, p.98), "from 2002 it is notable the production of public policies and technical standards regarding the equating of the problems caused by construction waste".

Public policies are guidelines in the form of a law, aimed at addressing the problems caused by the construction waste. Whereas the technical standards are documents which set standards for products in order to guarantee quality, rationalisation in the production and uniformity (Schneider, 2003).

In 5 July 2002, resolution n° 307 from CONAMA was created specifically to deal with construction waste. It considers the Law of Environmental Crimes, from February 1998, which provides penalties for whoever disposes of waste in a way which disagrees with the legislation, it also considers the City Statute – Law n° 10257, from 10 July 2001.

This resolution defines and sorts the different kinds of waste produced in construction sites, as well as, establishes possible destinations for them, it also attributes responsibility to the cities' public power and the waste producers.

This same resolution defines the waste producer as the main responsible for the destination given to the waste, however, the management is up to the city's administration as well as making the means for the correct disposal of this material viable.

In the Integrated Plan of Construction Waste Management, it is the responsibility of the city to supply the technical guidelines and procedures for waste management plans to be made by the waste producers. The cities should also register the areas, public or privet, and say if they are fit or not to receive temporarily small volumes of waste for posterior final disposal of this waste. The government should support the insertion of recycled waste in the production of construction materials, as well as guide, supervise and carry out educational actions aiming to reduce the production of waste and its segregation in the process of production. The resolution also considers how the waste should be stored and destined according to how it is sorted.

ABNT has had since July 2004, five technical standards regarding this subject, establishing guidelines for the management and correct use of construction waste, especially those from Class A.

- NBR 15112: Construction waste and bulky waste. Triage areas. Guidelines for design, building and operation. Indicates procedures for handling the waste from different classes in triage, including regarding environmental protection and control.
- NBR 15113: Solid construction waste and inert waste. Landfills. Guidelines for design, building and operation. Procedures for preparing the area and disposal of class A waste, protection of water and environment, control and monitoring plans.
- NBR 15114: Solid construction waste. Recycling areas. Guidelines for design, building and operation. Procedures for the isolation of the area and for receiving, sorting and processing class A waste.
- NBR 15115: Aggregate recycled from solid construction waste. Execution of paving layers. Procedures. Shows the characteristics of aggregates and the conditions for use and control in the execution of strengthening of subgrade, sub-base, base and primer coating (graveling).
- NBR 15116: Aggregate recycled from solid construction waste. Use in paving and preparing of concrete without a structural function. Requirements. Points out the conditions for production, requirements for aggregates for use in paving and concrete, and the control and quality of the recycled aggregate.

Resolution n°307 from CONAMA became effective in 2 January 2003 and established deadlines for cities and waste producers to conform to the new law. From that date the cities and the Federal District had twelve months to make their Integrated Plans of Construction Waste Management, contemplating the City Programs of Construction Waste Management (from small producers), for the implementation of the plan the cities and Federal District had a deadline of eighteen months, also in eighteen months they had to stop placing waste in residential landfills and 'send-off' areas. Large waste producers had a deadline of twenty four months to include their Construction Waste Management Projects along with designs submitted for approval or licensing.

In Xanxerê the International Organization from Standardization (ISO) standards are used as a parameter.

As said before, Brazil is late compared to other countries in the matter of destination of solid waste, including construction waste. Germany is pioneer in this area, it has had regulation about it since 1986 (Law for Minimizing and Elimination of Waste).

The policy in Germany consists, first, in avoiding the production of waste, and what can't be avoided must be valued and recycled, finally, what cannot be recycled must be eliminated in the most environmentally correct way possible. In 1994 the law from 1986 was edited and substituted by the Law of Full Cycle of Waste Management, which gives greater responsibility to manufacturers, who are responsible for their product since they are made, passing through distribution and use until its disposal. Due to this new law, companies started creating non-profit groups and associations which would be responsible for the collection of the waste from their products.

In France the legislation is similar to Brazil, there the local authorities manage the destination of solid waste, however, for certain areas of industry, the producers are responsible for the destination of their waste, which is the case of construction, nevertheless, the government offers means for the waste to be eliminated correctly.

In Spain the legislation is more recent and has some measures with different characteristics. The company which produces has the responsibility for its products, like

in Germany, and must from manufacturing to commercialisation and use, create the means to prevent producing waste. Furthermore, the products must make recycling easier or allow them to be eliminated in a less harmful way to the environmental and human health. If the company does not want to obey these rules, it must contribute financially to the public system of waste management, in case it does not agree, the company must provide an adequate place to gather its waste. All the companies must inform the government statistics about the waste produced.

5 Reduction and recycling

Recycling construction and demolition waste is becoming more accepted worldwide, considering that these have great economic, social, sanitary and environmental advantages, most construction and demolition waste can be transformed into something useful (De Alcantara, 2005).

The first studies for the implementation of these processes were carried out in the 1980s, parallel to that, the use of kneading-mills – small equipment for exclusive use in the construction of buildings – broadened fast, it allows the grind of less resistant waste, such as brickwork and mortar, allowing its reuse in coating services in the same building. The result of its use is positive both by correctly managing the waste in the construction site and by reducing costs for having less loss in the construction process, furthermore it contributes to diminishing the impact of construction and demolition waste in urban areas (Pinto, 1999).

However, the Brazilian experience with larger equipment is more recent, having started in the early 1990s with facilities which in some cases were a result of management plans and in others just mere equipment purchase without an actions plan which compromises the results to be achieved, eliminating, in some cases, any positive impact from the presence of the recycling facility (Pinto, 1999).

One of the factors that make the adherence to policies that value recycled products as well as those which use waste in its composition is the high production of waste (Pinto, 1999). "It is estimated that around 900×10^6 t/year of construction and demolition waste is produced worldwide, 7% only in the USA, and a large part of this volume of waste is not recycled" (Buttler et al., 2009).

6 Data from Xanxerê

In order to diagnose the problems, a field research was carried out to know the current situation of the city regarding construction and demolition waste. In this stage of the research, semi-structured interviews were carried out in: the city chambers, Continetal (company responsible for collecting waste), five construction companies (COMAX, Engemix, Paulino, Planta e Obra and EG Projetos) and the Association of Recyclers in Xanxerê Friends with Nature (ARXAN).

In Xanxerê the municipal office for environmental policies and the health surveillance are responsible for supervising the destination of construction waste using the ISO standards as a reference. These standards define for each kind of material the composition and the adequate destination. Currently the cities procedures regarding

supervising and control over the producers of waste is practically inexistent, the city doesn't have a waste management plan to offer the small producers, the companies that produce large amounts of waste are not supervised and the city adopts very few strategies for the management of construction waste.

One of the reflexes of a lack of harsher environmental policies is the placement of construction and demolition waste in inappropriate areas such as green areas, empty lots, close to water streams and springs which reach 5 tons a month.

The company that collects and makes the final destination of solid urban waste in Xanxerê is Continental. It has its own landfill for construction and demolition waste, as well as domestic waste, licensed by the environmental authorities. Today the company collects between 40 and 50 tons/day of waste depending on the season and weather conditions. The materials are not sorted due to the mall amount of waste produced and the high cost of equipment. The city does not have any company that buys or receives construction waste for recycling.

Five of the construction companies considered most relevant, for having the largest amount of construction sites in the city were also interviewed regarding the management and recycling of waste. Currently none of the companies has a waste management plan. All of them answered that they do not have a 'written' plan but that they follow the federal, state and city laws. Although they do not have this plan, most of them control the amount of waste produced. This control is made by the foreman, supervising so that no mistakes are made in the execution of the building which would cause demolitions, and with the distribution of 'pens' so that the materials are stored separately. Furthermore, the companies set goals regarding the amount of waste produced in which each construction must produce less than 0.7% of waste. The average amount of waste produced by these companies is between 2 and 8 m^3/month.

Material such as paper and plastic is set aside for the collectors, what is not reused in the site is collected by Continental and taken to the licensed landfill. Only one of the companies interviewed sends waste for recycling at CETRIC in the city of Chapecó about 45 km away, it is the closest place for recycling construction waste. The reason the other companies do not send waste to CETRIC is that the cost is very high compared to having it collected by Continental.

The Association of Recyclers in Xanxerê Friends with Nature (ARXAN) was also interviewed. This association controls the garbage collector in the city and sends the selected material to be recycled. The main materials collected by them are paper, dry plastic, bags and iron. They collect around 40 tons a month. This waste gets to the association all mixed and is then selected according to each kind of material. All the material is sold after selection to several companies which recycle it.

With the data collected it was possible to know the current situation of the city regarding the management and control of the solid construction waste produced and, thus, draw some conclusions. Table 2 shows the total amount of construction waste collected in the city which is sent to the landfill.

Table 2 Average amount of waste sent to landfill in the city of Xanxerê – SC

Site	*Ton/month*
Collected in inappropriate sites	5
Collected by the buckets	1,350
Total waste sent to landfill	1,355

Source: The authors

The amount indicated in the table is not the total amount of waste produced in Xanxerê since some companies send waste for recycling and reuse in other cities, such as to CETRIC in Chapecó, and some of the waste is collected by the association reducing the amount that goes to the landfill.

The amount equivalent to the waste collected in inappropriate areas is not exact since it is only collected in some places of the city. Most of the areas, in which the waste is inappropriately placed, are not monitored and many are unknown by the authorities. In larger areas the waste is not being collected, instead it is spread out as a base and the amount of waste is not verified in tons. With this information it is certain that the real amount of waste illegally dumped is much greater.

Through this data collection it is possible to know how much control the city has over the production and destination of solid construction waste and diagnose where the flaws are in the management process.

7 Conclusions

With this study it was possible to identify the deficiencies in the control and destination of solid construction waste in Xanxerê, reduction strategies used in Brazilian cities and in other countries as well as the legislation in Brazil and some European countries.

One of the problems identified in Xanxerê is the lack of a waste management plan in which to indicate strategies for the reduction and how to provide a better final destination for the waste produced. This plan could be passed on to small waste producers and used by the city as a starting point for regulation. Furthermore, the city does not have control over the amount, the kind, and what is done to the waste produced. There is a lack of monitoring and knowledge of inappropriate dumping areas which in some cases is being visually 'hidden' by the authorities using these materials as a base in the lots instead of providing an adequate solution to the problem.

Another problem identified is that most construction companies from the city know about the waste recycling company – CETRIC – in the city of Chapecó, however they do not send the waste there justifying that it is too expensive.

This research is ongoing; however it is already possible to point out some strategies which could be used by the city. Such as elaborating a waste management plan, setting goals and regulations, adopting strategies so that there is awareness of the population and especially the people who work in the construction industry through qualification courses, and advertising campaigns showing the problems caused by the deposition of waste in inadequate places. Another strategy that could be used in the city of Xanxerê to help solve the problem of waste placed in inappropriate areas is that used in Belo Horizonte in which collection units for receiving small volumes are distributed throughout the city.

However, in order to point to solutions to other problems identified a greater search of new strategies is necessary, for some of the solutions used elsewhere are not viable for Xanxerê, that is the stage in which this research finds itself.

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