



Este artigo está licenciado sob uma licença Creative Commons Atribuição-NãoComercial-SemDerivações 4.0 Internacional.

Você tem direito de:

Compartilhar — copiar e redistribuir o material em qualquer suporte ou formato.

De acordo com os termos seguintes:

Atribuição — Você deve dar o **crédito apropriado**, prover um link para a licença e **indicar se mudanças foram feitas**. Você deve fazê-lo em qualquer circunstância razoável, mas de maneira alguma que sugira ao licenciante a apoiar você ou o seu uso.

Não Comercial — Você não pode usar o material para **fins comerciais**.

Sem Derivações — Se você **remixar, transformar ou criar a partir** do material, você não pode distribuir o material modificado.

Sem restrições adicionais — Você não pode aplicar termos jurídicos ou **medidas de caráter tecnológico** que restrinjam legalmente outros de fazerem algo que a licença permita.



This article is licensed under a Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License.

You are free to:

Share — copy and redistribute the material in any medium or format

Under the following terms:

Attribution — You must give **appropriate credit**, provide a link to the license, and **indicate if changes were made**. You may do so in any reasonable manner, but not in any way that suggests the licensor endorses you or your use.

NonCommercial — You may not use the material for **commercial purposes**.

NoDerivatives — If you **remix, transform, or build upon** the material, you may not distribute the modified material.

No additional restrictions — You may not apply legal terms or **technological measures** that legally restrict others from doing anything the license permits.

Restoration public works in Brazil: The costs analysis based on Federal Decree 7983/2013

Marco Aurélio da Silva Máximo¹, Maria Amélia Mello Galvão², Sylvio Carneiro de Farias³

¹ Institute of National Historical and Artistic Heritage - Iphan, Brazil. e-mail: marco.aurelio.maximo@gmail.com, web: <http://www.iphan.gov.br>

² Institute of National Historical and Artistic Heritage - Iphan, Brazil. e-mail: ameliabmg@gmail.com, web: <http://www.iphan.gov.br>

³ Institute of National Historical and Artistic Heritage - Iphan, Brazil. e-mail: sylviofarias@uol.com.br, web: <http://www.iphan.gov.br>

ABSTRACT

The Brazilian Federal Decree 7.983/2013 lays down rules and criteria for the preparation of costs reference of works and engineering services, contractors and executed with federal funds, in addition to verification criteria of costs and the priority use of the National System of Costs Survey and Indexes of Construction - SINAPI, as the cost base reference. The guidelines established by the Brazilian Federal Court of Accounts - TCU, in particular the judgments 2.369/2011 and 2.622/2013, set the limits for all indirect costs - Budget Different Income – BDI. Restoration public works, executed with federal funds, must conform with the Federal Decree 7983/2013 and with the Federal Court of Accounts. How to do it if this kind of works is so particular and different from usual civil construction works? This paper intend to discuss if these requirements are possible to apply in restoration works and how to adapt this application, considering the particularities of this type of work. The proposed methodology, for analyzing the costs, includes the use of the following tools: ABC curve of services, evaluation of the BDI, criteria of the Federal Decree, use of SINAPI reference and other costs bases. It is possible that preservation institutes and designer professionals find a way to reduce distortions between different regions of the country and systematize cost compositions of restoration services. This article has the objective to disseminate the discussion about the similarities and the differences between restoration and civil construction works and to present a possible way to analyze the costs, and discuss the need to develop a cost reference to this type of public work in Brazil.

Keywords: Cost Engineering, Brazilian Cultural Heritage, Restoration Works, Cost analysis

1 INTRODUCTION

1.1 National System of Costs Survey and Indexes of Construction - SINAPI

In 1969 the Brazilian government created this database to provide information about costs e productivity in civil construction, to the National Housing Bank - BNH. The survey was first conducted for the housing sector. After the extinction of the National Housing Bank, in 1986 CAIXA, nowadays the third largest financial institution in total assets in Brazil started to use SINAPI as a standard to finance and to control housing works. The System is produced in partnership with CAIXA and with the Brazilian Institute of Geography and Statistics – IBGE, the main provider of data and information about the Country.

The SINAPI produces costs and indexes for civil construction through the data collection of prices of material and wages paid in civil construction for the housing sector. The System was expanded in 1997, when it started to include the sanitation and infrastructure sector.

It has as collection unit the suppliers of construction material and the construction companies of the sector. Information on sanitation and infrastructure only includes data relative to prices.

In 2009, CAIXA shall publish on the Internet the services and costs reference database, then becoming the main source of public consultation of the construction costs. In 2013, starts in CAIXA the process of measuring the compositions of SINAPI database.

1.2 Federal Decree 7.983/2013

In 2003, the Budget Guidelines Law defined the SINAPI as price limit for services contracted with funds from the Federal Budget. In 2013 the theme was removed from the Budget Guidelines Law and was treated by Federal Decree 7983/2013.

This Federal Decree lays down rules and criteria for the preparation of costs reference of works and engineering services, contractors and executed with federal funds, in addition to verification criteria of costs and the priority use of the National System of Costs Survey and Indexes of Construction - SINAPI, as the cost base reference. SINAPI became the benchmark cost for construction and engineering services, including restoration works contracted with federal funds.

1.3 Brazilian Federal Court of Accounts - TCU

The Brazilian Federal Court of Accounts – TCU audits the accounts of administrators and other persons responsible for federal public funds, assets, and other moneys, as well as the accounts of any person that causes loss, misapplication, or other irregularities that result in damages to the Brazilian public treasury. The main concern of the Brazilian Federal Court of Accounts is the incessant fight against corruption, waste, and the misuse of federal resources.

Therefore, besides carrying out audits that are directed by Congress or originated by denunciations or petitions, twice a year the Court establishes a schedule of audits to verify the correct use of public funds

by the organizations and entities under its jurisdiction.

Such inspections are called compliance audits. Worthy of note are, as an example, audits carried out to scrutinize public works that have received federal funds in order to report their status to Congress. This allows members of Congress to form an opinion as to the convenience or not, of disbursing budgetary funds for the maintenance or for resuming the works.

The Brazilian Federal Court of Accounts – TCU conducts studies that support the establishment of standards to assess the costs of public works. Among these studies, some resulted in judgments 2622/2011 and 2369/2013, which set the limits for all indirect costs - Budget Different Income – BDI rate, or Indirect Expenses and Bonification. This rate for the construction industry is the sum of all indirect expenses necessary for the administration of the work, including the builder profit.

1.4 Growth Acceleration Program for Historical Cities - PAC CH

The Growth Acceleration Program (PAC), launched in 2007, is an initiative of the federal government coordinated by the Ministry of Planning, which promoted the resumption of the planning and execution of great works of social infrastructure, urban, logistics and energy of the country.

In 2011, the Program has entered its second phase with more resources and more partnerships with states and municipalities.

In 2013, the Ministry of Planning authorized the creation of a line dedicated exclusively to urban historical sites protected by the Institute of National Historical and Artistic Heritage - Iphan, giving rise to the Growth Acceleration Program for Historical Cities - PAC CH.

In cooperation with several co-performers, especially universities, other federal institutions for technical support, states and municipalities, the Institute is implementing the program in 44 cities in 20 states. Investment in restoration work is \$ 1.6 billion for the 425 restoration works of buildings and public spaces.

2 SIMILARITIES AND DIFFERENCES BETWEEN RESTORATION WORKS AND COMMON CONSTRUCTION WORKS

The first difference between the restoration works and construction works begins with the historical aspects that characterize the constructive production of both. In restoration works, doesn't matter if the edifices or spaces are from the past and still exist.

The decision involves factors to stablish what preserve and why. No matter the age of the object, but the importance and the historical context in which it is inserted. It is important the recognition by the preservation organs, and the exceptional nature of isolated work or of the set.

The common building works have not anachronistic construction processes. Those building works are perfectly adjusted to the production of the construction market. Even considering the forefront projects that propose new solutions have in their favor the research and the necessary tests. Not the case to deep-

en the issues of selection of what preserve, because the subject is extensive, and involves theoretical studies.

One similarity between contemporary civil work or new construction work, and the restoration works, is that both should be well-designed, with designs that provide all data necessary for the preparation of costs and physical-financial schedule.

It is necessary to consider that the object is already built, and that was also built with the choice of the party from the basic needs program in a program defined by the authorized representative of the epoch. Considering the current times what more would approach are the works of reform. Changes are not unusual changes in restoration work due to unforeseen discoveries during surveys and mapping damage (Lemos, 1989).

The archeology requirements must be monitored, especially when there are traces of constructive order or even historical events that must be investigated, also considering the opportunity of the event. Any necessity opening ditch, to pass piping or structural repairs, and consolidation works must be accompanied by experts, and therefore should be part of the budget and schedule of work.

Therefore, restoration works, as well as contemporary works of reform, may present unforeseen, because of pre-existing elements. It is not always possible to perform all the necessary surveys before the start of the work, either by difficulties in hiring or by the degraded state of conservation that does not allow access to some elements of the building for example. It is necessary to create safe conditions for such a situation.

In both cases, design changes, or paradigms may occur, but it must be considered that the decision making in the case of restoration involves exchange of information between experts, involves prior approval of the conservation body that monitors and oversees, what always demands time, more than common works.

Restoration works of edifices have a big variety of shapes and styles that will get closer or distant to contemporary techniques. The most complex examples can be seen in religious architecture, which is the most representative collection of colonial period in Brazil, with influence of European styles of the time, Dutch, French or Portuguese - mostly. Some of them are buildings from the sixteenth and seventeenth centuries, permeated by changes or adjustments, often in the eighteenth and nineteenth centuries, according to Oliveira (2015).

In this context, some parts of the building have artistic details that are integrated in facades and inside, making the rich collection of style - baroque, rococo, mannerist, neoclassical and more recent. This part of the adornments that are integrated to the walls, the door jambs and windows, is eminently artistic character and require skilled and specific labor for its restoration. Masonry walls include frescoes, “*escaiolas*” (marbling), or application of specially made tiles for that building, beyond good integrated wood carved and painted.

In this context, contemporary works that are exceptional, in terms of architectural design, may also con-

template details and specialties that will also require materials, and labor work, nonstandard, though supported by the industry of civil construction and others. Restoration works must have restorers and craftsmen trained in specialized schools.

The application of traditional building techniques is important when dealing the conservation of the built cultural heritage, and the professional who brings together the skills for such services are the craftsmen.

To understand the practice of traditional building techniques, according to Tinoco (2012), it is important to know the meaning of tradition. This term is used to describe the transmission of customs and practices through oral narratives, when habits, values and knowledge are passed from generation to generation. The construction technique term corresponds to the procedures of the art to build. It refers to the rational processes and the practical procedures for the use of natural materials, manufactured and processed to meet human needs. In the context of cultural heritage, traditional construction techniques are the processes and operating procedures of building materials, transmitted by past customs and practices from generation to generation, from father to son.

Differently of restoration works that demand special hand works, civil construction works have great offer of hand work. In the past this great offer was because of low school and professional education, with services with little or no technological incorporation. Cardoso (2009) mentions that currently the civil construction has increased the prefabrication supplies, with the use of prefabricated structures, like sealing wall using the drywall, coatings of prefabricated facades, and the degree of combined services, when suppliers of material began to offer the material with the bound service, for example, steel-ready and, most recently, ready masonry (suppliers blocks) and ready facade (providers ceramic coating).

The hand labor of civil construction is better organized in appropriate associations to defend their labor rights, such as trade unions. The bargaining power, including the use of the right to strike, is large and directly influences the costs of construction, where about 50% of the cost in the composition of a service is formed by the labor costs on average.

Construction companies are also highly organized, with employers' unions and associations with high bargaining power and influence even in National Congress, where several laws of interest to the sector are discussed. Companies in the restoration of the sector are also organized in associations such as the Restoration Companies Association - ASSEER, founded in São Paulo, in September 2011, to defend the interests of enterprises and organizations of the restoration industry.

In order to maintain the craft of artisans, in Brazil there are some institutions for local training of new specialists in restoration as the Center for Advanced Studies in Integrated Conservation - CECI in Pernambuco, which offers the course of Management and Practice of Conservation and Restoration. In Bahia, the School of the Bahia Federal University Architecture offers the course Professional Master in "Conservation and Restoration of Monuments and Historical Centers (MP- CECRE)."

But there are few institutions compared to the civil construction that has several institutions spread throughout Brazil that make labor to the market, with many technical courses and specializations. All this influenced by the fact that the labor market has more demand for construction than for restoration

work, which, incidentally, are a timid and recent demand in terms of public policy.

Many materials and many construction techniques have not changed, however became industrialized, for example, ceramic bricks and clay tiles, which are no longer handmade, but some structural and sealing elements have changed a lot. In the past, the structures could be of stone, adobe, special stone and rammed earth (ancient technique using wooden forms, as in reinforced concrete, only with clay crumpled in pestle) for example.

According to Colin (2010), wood is the material widely used in wooden structures in half-timbered, the covers and inner sealing elements, in ceilings, artfully treated with carvings and paintings. In most of the religious buildings, the wood is largely finished off with gold leaf. The sealing walls that were more used the colonial period - masonry bricks or stones hand, aggregated with mortar of lime and clay, or only clay - were replaced by sand mortar and cement in today's times.

In general the painting was lime for the mortar walls. There are specifications for adornments, whose materials are found only in specialized art shops, as gold leaf. The assembly of the worksite, for restoration works, demands conditions similar to new works, like its components.

However, because it is an edifice or place already built, often in precarious conservation status, bordering on ruin, with fragile elements whose damage during the work could not be repaired, the worksite for restoration work requires more elaborate organization, sometimes with mounting restrictively site, and internally with the need to protect floors and decorative elements.

For the integrated goods, carved wood, as liners and altars, with termite attack, it is necessary to disassemble and work on surfaces like countertops inside the building, for their recovery and replacement.

Restorations of chattels, and imaginary and furniture, such as chests, credenzas, tables and others may receive treatment on site, depending on the situation, but sometimes the removal is impossible.

The frame restoration of a painting, the restoration of a wood ceiling, and the furniture restoration can demand special spaces in the worksite, especially if this wood ceiling is an artistic painting.

This requires space and studio assembly, with appropriate lighting, and special care in the generation of dust, the transit of people, the generation of noise, because these are services requiring concentration and care, as shown on photograph 1 (frame restoration - Painting) and photograph 2 (Table restoration - strengthening the chassis and gilding with gold leaf).

Photograph 1 Example of restoration service - Painting.
Author: Marco Aurélio da Silva Máximo



Photograph 2 Example of restoration service – Frame painting.
Author: Marco Aurélio da Silva Máximo



There are many special tools developed and used in restoration works: surgical scalpel, and stainless steel tweezers. Some unusual materials in the common construction and widely used in restoration services are: acetone, oxalic acid, cotton wool, Armenian cake, gold leaf, rabbit glue, dental plaster, isoparaffin, micro glass ball, bamboo toothpick, Japanese paper, tracing paper, agate pot, permethrin and various pigments, for example.

Many common services in restoration are not found in cost bases usually used in works of common construction.

Many elements of stone, marble, used in pillars, floors and decoration are not found as input of service compositions in the costs basis.

Restoration of portuguese tiles and special pavings, as the so-called feet-of-tomboy and others are also special, and there is not in the cost base SINAPI any similar services that can be used. The replacement materials can even be extremely difficult to achieve, by the difficulty of finding materials in the same specifications and conditions, requiring replacements that have to be approved by Heritage organs. Some examples of special materials and special structures are in photograph 3 and photograph 4.

Photograph 3 Example of restoration service – Portuguese tiles.

Author: Marco Aurélio da Silva Máximo



Photograph 4 Example of restoration service – Paving with stones.
Author: Marco Aurélio da Silva Máximo



3 METHODOLOGY AND RESULTS

3.1 Sampling selection for the methodology application

In general it is not feasible to conduct research and studies in all the population or universe of interest. So, the solution is to get a representative sample of that universe, so the results can be generalized for the population. When the population is made up of sub-groups or strata, it is reasonable to assume that the variable of interest has different behavior in different strata, we are dealing with a stratified random sampling. Therefore, so that the sample is representative, it must have the same stratification of the universe that is being studied (Callegari-Jacques, 2003).

Due to the constructive and architectural features quite varied, it is possible to assume that the alignment and approach of the services of the budgets of restoration works with SINAPI has varied behavior according to the type of architecture. The definition of the type of buildings and monuments that were the subject of application of the proposed methodology took as a basis the list of actions of the PAC Historical Cities Program, established in Ordinance number 383/2013 - Iphan, published in the Official Gazette and on the site of the institute (IPHAN, 2013).

Of the 344 remaining shares, 18% are of restoration of buildings of the official architecture (Chamber houses and jail, palaces, town halls and fortifications), 52% of civil architecture buildings (houses) and 30% of examples of religious architecture (convents, monasteries, Jesuit sets, churches and chapels). The Growth Acceleration Program for Historical Cities - PAC CH is running, with shares in several stages, many of them in project preparation, with other works in progress and some already completed.

From the projects that have available material for the study, was then established a sample of 18, ie, equivalent to 5% of the total shares related to the official, civil and religious architecture, because they represent the most commonly types of architecture of restoration works in Brazil. Applied the methodology to the costs of 3 edifices of the official architecture (1 Chamber House and Jail, 1 Fortification, 1 Hall), 8 edifices of civil architecture (4 mansions, 2 theaters, 1 Market and 1 Warehouse) and 5 edifices of the religious architecture (all churches with and without integrated goods), seeking thus to approach the same stratification between the sample and the list of PAC CH for the three aforementioned types. The values of the budgets of these restoration works ranged in magnitude from 900,000 reais to up to 14 million, totaling approximately 77 million reais the sample budgets.

3.2 ABC Curve of services

According to Cardoso (2009), in general the budgets in engineering works has a large number of items, which prevents complete verification of the entire cost. The analysis is done only for the items considered important. Thus, the identification of these items is critical and the appropriate tool for this identification is the ABC curve.

The origin of the ABC curve is linked to the concept established by the Italian economist Vilfredo Pareto, who in 1897 had observed in his studies on income distribution, that this distribution not occur uniformly, concluding that there was a high concentration (80%) on the hands of a small portion of the population (20%), and observed this in several countries (Ivančić, 2014).

It was established the principle called Pareto or also known as the 80/20 rule, which statistically means that for every phenomenon, about 80% of the effect is 20% of the causes, that is, most of the results in any status is determined by a small number of causes. The Pareto principle has many applications such as quality control, the risk management, audits in general, and budget analysis, among other applications.

The ABC curve is nothing but the graphical representation of the hierarchy of cost items, by affecting the cost. The curve shows that a relatively small quantity of items is responsible for a large impact on cost.

According to Meneses Filho (2014), ABC curve is an important tool to be used in the phases of budgeting and management, guiding the acquisitions and management optimization effort. It is because the curve indicates the services and supplies which should be given greater attention.

While there may be variations, generally adopts the following classification: The items in the range A (top) covers the items that together represent 50% of the total cost of the work; items in the range B (intermediate) include items between 50% and 80% on the percentage scale of the accumulated cost, thus representing 30% of the total cost; and finally the range C (base) contemplating the rest of the items. In general, the range A has fewer items than the range B, and B less than the range C, so the ranges A and B together account for 80% of the total cost of the work.

3.3 Requirements of the Federal Decree 7.983/2013

The Federal Decree 7.983 / 2013 establishes rules and criteria to be followed by agencies and entities of

the federal public administration for the preparation of reference works and engineering services cost, contractors and executed with the Union cost resources. Its purpose is to standardize the methodology for the establishment of the reference cost and establish parameters to control the use of federal funds (Decreto Federal 7.983, 2013).

Another intention of the decree is to gain greater control of spending and ensure greater advantage, efficiency and quality in contracting works and engineering services. For this must obtain all the necessary elements arising from the preparation of basic and executive projects, descriptive memorials, specifications and all other essential documents for the perfect understanding and quantitative calculations required for the preparation of the cost. In the wake of legal responsibilities, the budget that will be included in the bidding documents shall be prepared and signed by a qualified professional with an indication of their technical responsibility record. The reference budget is a breakdown of the global reference price expressing the description, quantities and unit costs of all services, including their unit costs compositions necessary to perform the work and compatible with the design that integrates the bidding.

In preparing the cost, the decree also establishes the reference base to be employed, and this cost base is the National System of Costs Survey and Indexes of Construction - SINAPI. However, the decree opens the possibility of obtaining other reference values, and allows forming other specific compositions. In the case of restoration works, it is often necessary to develop their own compositions using SINAPI price indices for inputs and labor rates from other sources, for example. Only after exhausting the previous possibilities is that the market prices may be used, following rule specifies of minimum of three quotations.

Another important aspect of the decree is the establishment of elements of Indirect Expenses and Bonification - BDI applied to the cost resulting in the overall price of the worksheet, being aligned with the Brazilian Federal Court of Accounts - TCU, in particular the judgments 2369/2011 and 2622/2013, and to apply these judgements, restoration works should be considered as reform. Also regarding the BDI should highlight the need for development and application of a reduced and differentiated rate for equipment and specific materials. To carry out the transfer of funds, the holder body of resources must use the reference budget, and other technical documents, and analyze at least 10% of the relevant cost items, that correspond to a minimum of 80% value of the total value of works and engineering services, excluding the cost of services for the mobilization and demobilization, construction site and local administration, which should be fully analyzed. For this analysis, the manager is induced to use the Pareto principle to the classification of budget items by ABC curve. Thus the analysis accurately should prioritize the ranges A and B as they present the most relevant items to check specifications, quantity and unit costs compositions, especially when they result in own compositions, a common situation in the restoration works. Items with “overpricing” are evidenced, thus facilitating further analysis.

3.4 Considerations about the National System of Costs Survey and Indexes of Construction - SINAPI

The preparation of the compositions SINAPI consists of a complex process, which means the establishment of productivities, equipment and material consumption involved in the execution of certain task or service. The IBGE collects field data, measuring in several construction sites of the country, observing similar services in public and private works, in small and big works. Data collection has a volume designed

to measure and extract average rates of productivity and consumption of raw materials and design of the use of equipment, it is generally measured at least ten different works with daily measurements for at least 5 days each, aiming represent in the most appropriate way the reality of Brazilian works, standardizing the technical criteria adopted in the design of the references. These studies are already established and are constantly measured, including price surveys carried out each month on the market in several capitals of Brazil. For labor, productivity is extracted by the relationship between the effort (hours worked and idle) with the amount produced of the service. In the case of materials are considered the theoretical and real quantity, the first without the inefficiency or waste production, and the second covering losses, which are all that is consumed more than the theoretically required. Losses are classified by their effect on the receipt of materials in storage, the intermediate processing, the end processing and internal transport. As to its nature, the losses could be in the waste and built form, in addition to losses by theft. Only the latter is not included in the compositions measured by SINAPI.

To calculate the productivity of the equipment it is necessary to consider the time needed for preparation and demobilization of the teams involved at the beginning and end of each working step, in addition to the time required for maintenance. With measurements in the field then appropriates the uptime and downtime of the equipment involved in the service. The compositions have their monthly costs assessed to ensure the updated prices for users of SINAPI.

Moreover, it is essential to know the SINAPI compositions, because in the case of them not being appropriate to the restoration works of historical heritage, the exact way they are established for common work, priority should be given to adaptation of the compositions before use other baselines or market prices, so then setting compositions called “own”, replacing inputs and / or changing their consumption rates (CAIXA ECONOMICA FEDERAL, 2014)

3.5 Requirements of the Brazilian Federal Court of Accounts - TCU

According to Cardoso (2009), all the costs happen in the construction site and are divided in direct and indirect:

- Indirect costs: affect all the items during the building process generically and without distinction. These costs are associated to the administrative staff, safety equipment, tools, benefits, consumables etc. They do not vary with the quantities produced or the time.
- Direct costs: costs that can be attributed to specific, individual items used in the construction exercise and which directly affect the costs of construction. These are usually represented by the labor and materials used in the works (e.g. pipes, cement, sand, laborers needed for laying down service network etc). These costs, are also called variable costs given that they vary according to the quantities of services measured.

Indirect cost is the sum of secondary costs to support the execution, like local administration, mobilization and demobilization, and construction site.

According to TCU (2014), cost is the sum of financial resources to production and expenses are financial resources to maintenance of a company, for example. Costs can be attributed to the final product and

expenses have a general character, difficult to link to products.

Expenses happen outside the construction site. Indirect expenses are expenses arising from business activities that focus percentage form on the costs of the work. These are resources for the payment of taxes; the apportionment of central administration costs; the remuneration to the builder by the assumption of the enterprise risks; and compensation of financial expenses caused by the mismatch between spending, measuring and receiving.

The cost of a construction work is the sum of all the costs of the goods and services needed for its production, and the price of the finished development represents all the costs including the constructor profit and indirect expenses. It is necessary to quantify the indirect expenses of administration, like central office, financing, marketing, depreciation, maintenance, taxes and insurance. To find the price of a construction it is necessary to sum the costs (direct and indirect) with indirect expenses of administration (external to the building site) and the constructor profit (Cardoso, 2009).

At the budgeting stage it is a common practice, mainly for public works in Brazil, to calculate the price by applying a charge called the BDI (Indirect Expenses and Bonification/ Premium), which normally varies from 20 to 30 percent on the direct cost. This is applied to all the indirect costs (production and administration) plus profit and results in the final price (Cardoso, 2010).

The Public Administration needs to develop a reference budget to contract a public work, and this budget is the price, or the result of application of the rate of BDI over the costs.

It is important to remind that the BDI rate developed is theoretical, because the public administration is not a company.

To calculate the BDI, the Brazilian Federal Court of Accounts - TCU established the formula (1):

$$BDI = \frac{(1 + (AC + S + R + G))(1 + DF)(1 + L)}{(1 - I)} \quad (1)$$

Where:

AC – Central Administration or Central Office;

S - Insurance;

R - Risks;

G - Guarantees;

DF – Financial Expenses;

L - Profit;

I - Taxes (PIS, COFINS, ISS e CPRB).

The judgment of the Brazilian Federal Court of Accounts - TCU 2.369/2011 established the parameters of the plots and the final value of the BDI, to mark the contracting of public works in the country. On that



occasion brought in detail the limits for building works with reform, in addition for hiring infrastructure works.

In this occasion the criteria was focusing in the values of the budget, establishing different BDI rates according to the estimated price to contract a public work. Those public works were construction of edifices and reforms with until 40% of ampliation, irrigation and channels, basic sanitation, water mains, networks and pumping and treatment stations.

The judgment of the Brazilian Federal Court of Accounts - TCU 2.622/2013 excludes the works of reform and contemplates only BDI for buildings, and other infrastructure projects, and reduced BDI rate for the supply of materials and equipment. Therefore, the criteria established by TCU to the BDI rate are in table 1 and 2:

Table 1 Judgment 2.369/2011-TCU – BDI for Construction of edifices and Reforms with 40% of Ampliation

BDI – CONSTRUCTION OF EDIFICES AND REFORMS WITH UNTIL 40% OF AMPLIATION						
description	minimum		maximum		mean	
	C. admin	profit	C. admin	profit	C. admin	profit
Central administration - profit						
Up until R\$ 150.000,00	5,40%	7,00%	10,00%	9,90%	7,50%	8,75%
R\$ 150.000,00 until R\$ 1.500.000,00	4,90%	6,50%	9,50%	9,40%	7,00%	8,25%
R\$ 1.500.000,00 until R\$ 75.000.000,00	4,40%	6,00%	9,00%	8,90%	6,50%	7,75%
R\$75.000.000,00 until R\$ 150.000.000,00	3,90%	5,50%	8,50%	8,40%	6,00%	7,25%
Above R\$ 150.000.000,00	3,40%	5,00%	8,00%	7,90%	5,50%	6,75%
Financial Expenses	0,50%		1,50%		1,00%	
Insurance, Risks and Guarantees	0,35%		2,40%		1,32%	
Insurance	0,00%		0,81%		0,36%	
Guarantees	0,00%		0,42%		0,21%	
Risks	0,00%		0,00%		0,00%	
Simple buildings, under favorable conditions and proper implementation schedule	0,35%		0,85%		0,65%	
Media complex buildings in areas at / or run under normal running conditions	0,40%		0,98%		0,75%	
Complex works in adverse conditions, rapid pace of execution in restricted areas	0,48%		1,17%		0,90%	
Taxes	4,85%		6,65%		5,75%	
ISS*	1,20%		Until 3,00%		2,10%	
PIS	0,65%		0,65%		0,65%	
COFINS	3,00%		3,00%		3,00%	
BDI						
Up until R\$ 150.000,00	22,40%		31,90%		26,80%	
R\$ 150.000,00 until R\$ 1.500.000,00	21,30%		30,70%		25,70%	
R\$ 1.500.000,00 until R\$ 75.000.000,00	20,10%		29,60%		24,50%	
R\$75.000.000,00 until R\$ 150.000.000,00	19,00%		28,40%		23,30%	
Above R\$ 150.000.000,00	17,90%		27,20%		22,20%	

(*) The percentage of ISS considered 2%, 3,5% e 5% about 50% of the selling price - to observe the law of municipalities.

Table 2 Judgment 2.622/2013-TCU – BDI for Items of materials and Equipment supply only

BDI for items of materials and equipment supply only	1 ^o Quartil (minimum)	Mean	3 ^o Quartil
	11,10%	14,02%	16,80%

In 2011 the federal government in order to encourage the productive sector of the country, established the use of the exemption of the companies payroll, changing the employer contribution of 20% of payroll to social security for tax rates on revenue.

It was created CPRB (social security contribution on gross revenue) and was established the value of 2% for the CPRB in the construction sector and this amount had to be added as an additional item in the “taxes” in the formula of BDI.

With the law 13.161/2015, there was an increase of values for CPRB from 2% to 4.5% for the construction sector. Even after the creation of CPRB there is not a new edition of Judgment that contemplates and revises the boundaries of all the plots and also the final value of the BDI.

During the hiring process work, competitors must each present their BDI values. According to Meneses Filho (2014), some characteristics of the works may affect the company executing the value of your BDI, such as the type of work, the execution time, the value of the work, the geographic location of the same, and the degree of innovation technological. Indirect costs, such as the central administration, are divided among the various works that the company is running simultaneously, then with the amount attributable to each of these works the less the greater the amount of work. Therefore, in principle, a company with great volume of works tends to lower unit costs, then influence the BDI practiced by the company.

But it is important to point out that the BDI rate that should be analyzed by the proposed method differs from BDI practiced by companies because the former is an estimated value for price up to mark the resources needed to employ the work, while the second serves to the evaluation by the bidding committee, responsible for contracting the work, to instruct the future execution of the work contract and its management.

3.6 Other cost basis

According to the legislation, particularly the Federal Decree 7.983/2013, the costs of a reference budget for public works must be based on information SINAPI preferably. However, it is very common in heritage restoration work, the adoption of materials and compositions that are not part of the SINAPI table, simply because these compositions do not represent the services required for this type of work. It is necessary that engineers and architects, in the budget preparation, have to seek other sources of reference from other agencies and other basis, to market price and create their own compositions.

In the latter case, where possible it is recommended using the SINAPI compositions and adapt to the conditions that the project and the work required to better represent the reality of implementation.

Federal Decree 7.983/2013 admits the possibility to meet the peculiarities described above regarding the necessary adjustments to the special character of costs.

The main source of alternative data to SINAPI used in restoration works is the base Sergipe Works cost System - ORSE, developed and maintained by the State Company for Housing and Public Works of Sergipe - CEHOP and the Sanitation Company of Sergipe - DESO.

The ORSE was developed about ten years ago to meet the determination contained in Articles 8 and 9 of State Law 4.189/1999, which created the State System of Registration Prices for Construction and Engineering Services in the State of Sergipe. Currently the ORSE is being adjusted to meet the Federal Decree 7.983/2013, and to adapt to the methodologies and Manual Concepts SINAPI (National System of Costs Survey and Indexes of Construction), and now even incorporate SINAPI of inputs.

There are however some peculiarities and differences between the two systems: some aggregates inputs (eg sand and gravel) in SINAPI prices have collected in the field and ORSE have commercial prices for delivery in the city of Aracaju.

Therefore, by adopting ORSE compositions with these SINAPI the inputs, it is necessary to include in an automated way the budgets freight values, and the amount of freight to be adopted will be calculated as the difference between input prices in ORSE (freight) and in SINAPI (without shipping).

As a brief comparison between SINAPI, the reference required by the Federal Decree 7.983 / 2013, and the ORSE base cost, the reference that most closely matches the needs of restoration services, it is not possible to find in SINAPI the service Mortar lime and sand for example, and this service is very common in restoration works.

The ORSE base cost has a number of services related to the most common restorations, whereas the tooling used for certain services are not listed in the supplementary charges, as SINAPI. In the next page there is an example of ORSE composition (Illustration 1).

Illustration 1 ORSE – Service Composition – 03749/ORSE.

03749/ORSE		Mortar lime and sand trace 1: 4 - Mechanical Preparation and transport				m ³	
Composição de preço							
Tipo de item	Code	composition description	unit	amount	Cost unit	Total cost	
input	00367/SINAPI	Coarse sand - deposit / supplier position (taken in deposit without transport)	m3	1.216	73.50	89.38	
input	01106/SINAPI	Hydrated lime for mortar	kg	182	0.70	127.40	

composition	06111/SINAPI	Labour force		h	8	4.05	32.40
composition	10549/ORSE	Additional charges labour force	-	h	8	1.82	14.56

Totals						
Equipments	material	labor		Social charges	others	amount
0.00	228.63	32.40		36.99	2.87	300.89

Relationship Detailed Inputs						
code	Inputs description	unit	amount	Cost unit	Total cost	
00158/ORSE	lunch (participation employer)	un	0.8144	4.50	3.66	
00367/SINAPI	Coarse sand - deposit / supplier position (taken in deposit without transport)	m3	1.216	73.50	89.38	
12893/SINAPI	safety boots with steel toe and padded collar	par	0.0064	39.60	0.25	
01106/SINAPI	Hydrated lime for mortar	kg	182	0.70	127.40	
12894/SINAPI	Cover for rain with PVC lining polyester, with hood (yellow or blue)	un	0.0016	10.72	0.02	
12895/SINAPI	front flap safety helmet with polyethylene suspension without jugular (Class B)	un	0.0048	8.25	0.04	
02711/SINAPI	steel barrow capacity 50 to 60 l, tire chamber	un	0.0016	100.00	0.16	
10492/ORSE	Food Basket	un	0.036	100.00	3.60	
10517/ORSE	Exams admission / dismissal (checkup)	cj	0.0032	197.00	0.63	
00941/ORSE	uniform	un	0.012	65.00	0.78	
12892/SINAPI	Glove leather scrap, short barrel (fist * 7 * cm)	par	0.0184	7.42	0.14	
04729/ORSE	Sledgehammer 1 kg with cable	un	0.0008	15.80	0.01	
01651/ORSE	white goggles	pr	0.0064	5.36	0.03	
10788/ORSE	square Shovel	un	0.0016	17.29	0.03	
10596/ORSE	Hearing protection	un	0.036	3.20	0.12	
10599/ORSE	Sunscreen 30fps	un	0.0144	45.51	0.66	
10761/ORSE	Meal - breakfast (coffee with milk and two loaves of bread with butter)	un	0.8144	2.50	2.04	
10362/ORSE	Life insurance and accident group	un	0.036	5.65	0.20	
06111/SINAPI	Labour force	h	8	8.67	69.39	
04728/ORSE	Slitter flat 10 "	un	0.0024	7.79	0.02	
02378/ORSE	transportation vouchers	un	0.7528	3.10	2.33	

We can cite other sources of reference cost data commonly found in budgets of restoration works, such as: SEMINF (Base of City Hall data Manaus-AM), SEINFRA (Secretariat of the Database of Ceará State Infrastructure), SCO (Construction Cost System of the City of Rio de Janeiro), EMOP (Company Database of Public Works of the State of Rio de Janeiro), Setop (State of Minas Gerais Database), information SBC (SBC private company database), TCPO (private company database), market prices, own compositions.

ORSE has several specific services for restoration work, but other cited bases are directed to the works of common construction, and the ORSE, are regional basis, local or methodology and gathering information (prices, etc.) very specific, and mostly without nationwide as SINAPI.

As already mentioned, the Federal Decree 7.983 / 2013 admits the possibility of using other bases besides SINAPI, but the priority remains the use of SINAPI, the adapted SINAPI (“own composition”) and official data from government agencies bases.

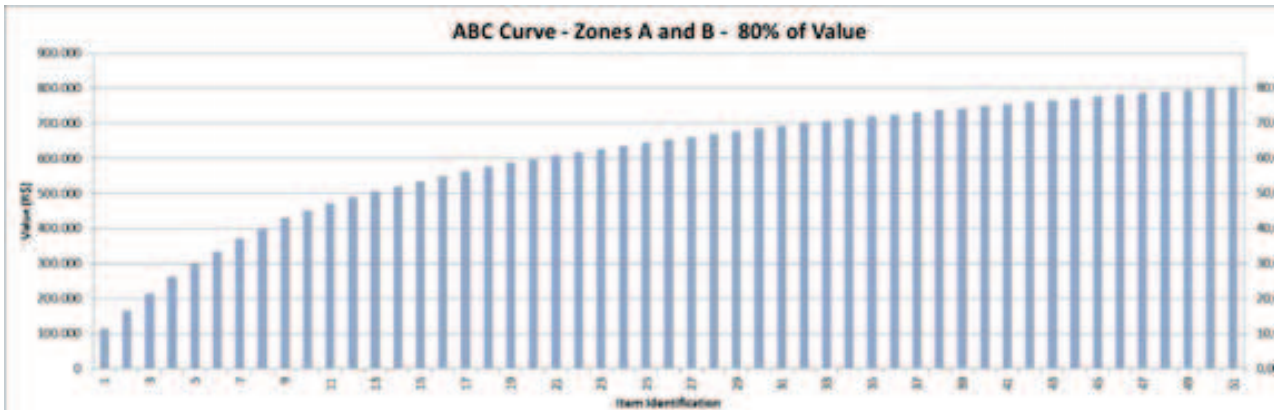
3.7 Methodology

The methodology aims to support the representative of federal funds in their task of analyzing the reference budget before making the transfer, and therefore before bidding to contract the work. Considering then as a starting point the survey of the main requirements of Federal Decree No. 7.983/2013 of Judgments 2.369/2011 and 2.622/2013 of the Brazilian Federal Court of Accounts – TCU, of best practice for analyzing costs and the SINAPI base, It is proposed a methodology that consider the verification of the maximum number of key requirements. First, with respect to the budget, it is necessary to verify the format of the cost table (sequence execution logic, proper organization of items in the code of service in the various bases of reference costs, the quantities and unit costs and subtotal, a clear indication of the base date and the BDI rates applied, the identification of the responsible technician), the existence of calculation memory, the compositions of BDI (for construction work and, reduced rate), the compositions of the laws and social charges applied, and the bases of cost compositions different from SINAPI. After an initial check of compatibility between designs (architectural, restoration, engineering and complementary - installations and others), technical specifications and related budget, and considering that sufficient compatibility, applies the methodology described below:

- The budget must be in editable electronic means, for example, in the EXCEL spreadsheet software. Divide the cost into two parts: one with items of mobilization, demobilization, construction worksite and local administration, and another with all service items. Although all contribute to the total cost of the work, are the services (second part) that in fact characterize the restoration work or construction work;
- Items of mobilization, demobilization, construction worksite and local administration are then analyzed completely, ie all costs are assessed for the specification, the referenced databases, quantification, unit and total costs and unit compositions. As for the local administration of the work is observed if your quantification is appropriate, if the necessary professionals are related. Mobilization and demobilization must only include the need to cover transportation costs
- Then it is necessary to analyze the service items. Therefore, one should draw the ABC curve of services, ordering in decreasing services for their total costs, and then proceed to the analysis of the

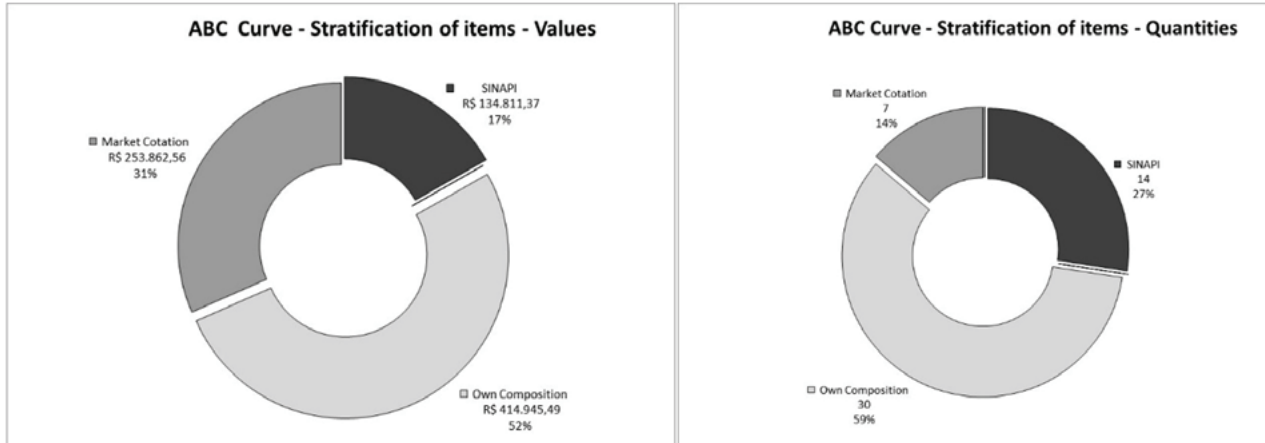
items considered most relevant, i.e. those of the tracks A and B, totaling about 80 % of the total cost of the work, and representing at least 10 % of the total amount of (Illustration 2).

Illustration 2 Graphics of ABC Curve.



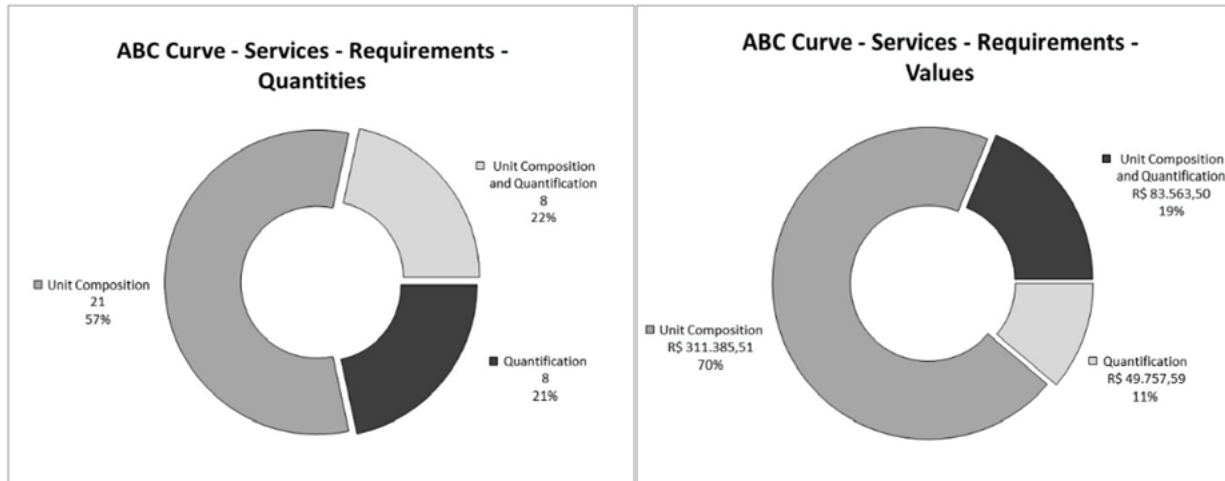
These items are then sorted and separated, as the reference source of costs, its representation (in absolute and relative percentage), values (absolute and relative), and generate graphics for better viewing (Illustration 3).

Illustration 3 Graphics of ABC Curve – Stratification – Cost Basis.



- The selected items are then subjected to thorough analysis, from the specification, the comparison between the composition of unit cost and the proper execution proposal in the project and other documents, quantification of service, unit cost of composition, value of unit cost, total costs, proper implementation of specific BDI rate for each case (BDI rate of work or BDI reduced rate and differentiated), and inconsistencies are grouped according Illustration 4. The technician responsible for the budget is the one who decides if the compositions of SINAPI meet the design, but in the analysis phase of the reference budget it is checked the choice, before the bidding to contract the work. Once validated the choice, the SINAPI compositions do not require detailed analysis, since it is the official reference base required by the Decree;

Illustration 4 Graphics of ABC Curve – Stratification – Types of requirements.



- For each service analyzed it is necessary to check the compositions of various reference costs. It is checked if the guidelines of the decree regarding the preference for SINAPI was respected, and if the proper sequence on the choice of other reference bases too;
- In the case of use of market prices to determine the cost of an input (service, equipment or material), it is necessary to adopt the median value of at least three quotations, as understanding of the Brazilian Federal Court of Accounts – TCU.
- It is necessary to check if the quotes have the same scope, if there is a perfect understanding of their information and if there is a way to guarantee the traceability. For items considered special and specific for restoration works, like in restoration of images, furniture and artistic elements, it is necessary to adopt the justifications and specifications certified by the estimator and other experts involved in the project, requesting evidences of responsibility for the information;
- About the compositions of the BDI rates, it is necessary to evaluate their installments according to the judgments of the TCU 2.369/2011 and 2.622/2013. The first BDI to assess the rate for service work and the second to evaluate the differentiated and BDI reduced rate for equipment and materials. It is also necessary to observe that the compositions of the BDI rates contain the portion related to Tax on Gross Revenue - CPRB, as another tax to consider (in compliance with Law 13.161 / 2015 with the inclusion of percentage due to the exoneration payroll). Another portion that requires verification is the one relating to Service Tax - ISS, as this portion should be on average 50% of the municipal law defined tax rate, since this tax is not levied on materials and applied equipment (in accordance Law 116 / 2003.);
- The physical-financial schedule is evaluated for logical sequence and ordering of services and their grouping, and deadlines are checked for sufficient quantification for the development of services. For common services, it is possible to use the best practices for works such as specialized magazines for verification, for example.
- For items considered special and specific restoration, adopt to the justifications and specifications certified by the estimator and other experts involved in the project. With all this information so you

can prepare reports containing the needs adjustments to the assessed cost can be fit and meet the main legal requirements associated with the reference cost for hiring public work of restoration with the use of federal funds.

3.8 Results

For local administration, mobilization, demobilization and construction worksite, the analysis performed on the sample estimates showed the following:

- In the local administration, there are several categories and professional profiles that are not found in SINAPI base. Restorers, craftsmen in general and archaeologists are examples of these categories. For some of these professionals it was used the architect reference costs or engineer (found in SINAPI), by analogy the need for advanced training, such as archaeologists.
- The ORSE base could be the reference to some professionals. Market quotations were necessary to several specific restoration services. For some professionals, like resident engineer, foreman, stockman and watchman SINAPI was enough;
- The mobilization and demobilization in general could be found in SINAPI, or were easily adapted;
- Services related to the construction worksite could also, for the most part, be found in SINAPI. Some characteristics were easily solved with the development of a simple design and their respective composition, as is the case of studio assembly;
- In the case of using market quotations it was observed sometimes the absence of a minimum of three, and even when disposing of three, the mistake of using the average and not the median (value of intermediate position in the grouping of the quotations).
- The absence of three quotations was often because of difficulties in finding the local market suppliers are able to deliver the services, or provide specific inputs related to the restoration. An example of this is the provision of inputs such as gold leaf, Armenian cake, and restoration of masonry services.
- The BDI compositions could be easily framed in TCU Judgements. The BDI rate was framed as reform, by analogy. As for the case of reduced and differentiated BDI for materials and equipment, was adopted as base the Judgment 2.622/2013.
- The disbursement schedule (physical-financial schedule) for the most part were considered adequate, the sequencing and grouping of services. In some cases it was verified the need of adjustments on the local administration of the residence time for example.
- As for the services of the ranges A and B of the ABC curve, the analysis performed on the sample estimates showed the following:
- Various services presented in SINAPI, developed for construction, might have been used, with or without adaptations in their unit cost compositions.
- Other reference databases of works costs were used or adapted to the needs and particularities of the projects. In many cases it was necessary to use market prices for both budgeting services as inputs;

- Various types of restoration services were found in the various types of buildings evaluated and also get close relatively quite to contemporary services performed in public works.
- Unit costs compositions have been developed with the establishment of the relationship of inputs (labor, materials and equipment);
- In the sample of analyzed budgets, it was possible to find the frequency of each cost base: SINAPI (92% of sample estimates), ORSE (46%), Setop (23%), CEHOP (7%), SEINFRA (in 15%) SCO (7%), SBC (31%), market quotations (54%) and suitable compositions (92%);
- In the sample of analyzed budgets, it was possible to find the frequency of each cost base: SINAPI (92% of sample estimates), ORSE (46%), Setop (23%), CEHOP (7%), SEINFRA (in 15%) SCO (7%), SBC (31%), market quotations (54%) and suitable compositions (92%);
- All the frequency of costs basis are in table 3.

Table 3 % of frequency of the costs basis - Ranges A and B.

Tipo	% Sinapi	% Quotation	% Own Comp	% ORSE	% Setop	% Cehop	% Seinfr	% SCO	% SBC
C 1	22	11	9	56	-	2	-	-	-
C 2	66	-	34	-	-	-	-	-	-
C 3	27	14	59	-	-	-	-	-	-
C 4	32	39	25	-	-	-	4	-	-
C 5	39	3	25	-	-	-	-	-	-
C 6	29	27	44	-	-	-	-	-	-
C 7	27	46	19	8	-	-	-	-	-
C 8	29	3	47	-	-	-	-	7	14
O 1	18	45	32	5	-	-	-	-	-
O 2	13	1	43	-	43	-	-	-	-
O 3	-	-	42	-	58	-	-	-	-
R 1	33	-	-	67	-	-	-	-	-
R 2	49	-	26	22	-	-	1	-	2
R 3	18	-	64	15	-	-	-	-	3
R 4	71	-	25	-	-	-	-	-	-
R 5	34	-	50	-	-	-	-	-	16

C: Civil Architecture

O: official Architecture

R: religious Architecture

- In none of the cases analyzed all the cost items was only the SINAPI. This reference system had its highest percentage of use in an example of religious architecture, reaching 71% of its cost (items the tracks A and B);
- It was also a church that the use of own compositions reached its highest percentage, reaching 64% of the budget items (items of tracks A and B);
- The highest percentage of use achieved market prices was 46% (items of tracks A and B) in a case of civil architecture (market);
- The ORSE system reached its highest percentage of use, 67% of the items of the tracks A and B of the

cost of a church;

- The Setop reference reached the percentage of 58% in the case of fortification;
- The SBC system reached 16% of the items of the tracks A and B in a case of church;
- In the three churches that have integrated goods (60% of the analyzed churches), one of them was used ORSE system to restore services of these elements in other two were his own compositions. Still, in these cases the reference SINAPI was used for the remaining services in each of the estimates;
- The most references present in church restoration budgets were SINAPI (present in all the budgets of the churches), own compositions (in 80% of them), ORSE (60% of them), Setop and SEIMFRA (20% each);
- For copies of the official architecture, SINAPI was present in 67% of their budgets, prices by 67%, own compositions at 100%, 67% and Setop ORSE 33%;
- For costs to official architecture, SINAPI was present in 100% of costs, as well as their own compositions and quotations. The ORSE was 40%, and CEHOP SEIMFRA 20% each;
- The own compositions were prepared both by adapting SINAPI compositions and other bases, such as those created without references, with inputs and consumption rates of those created specifically for that work, so very special for each project and construction;

4 CONCLUSIONS

The Federal Decree 7.983/2013, the judgments of the Federal Court of Accounts - TCU - and the official basis of construction costs, such as SINAPI, represent an important instrument to guide the costs analyzes of public restoration works. The SINAPI system was not enough to supply a large part of important services required for the type of restoration works. There are many similarities and differences between restoration works and civil construction works, and it is timely to develop a cost reference to restoration public works in Brazil.

On the one hand they count on the need to establish references for the craftsmen, is coming up on the fact that the costs of these professionals (considering the artisanal aspect of its services, the degree of difficulty of the service, the materials involved, etc. ...) can vary widely. For these, the most appropriate would even work with market quotations for their proper lifting costs for the work. This is also a result of low organization of these professionals in representative bodies that could at least establish minimum fees.

Demand for archaeologists in environmental licensing and monitoring of the works is new reality in Brazil. There has been a great demand for these professionals, but still not able to determine precisely the adequate remuneration, and therefore their costs for the works.

The parameters set by the TCU were apparently adequate and sufficient for the BDI of restoration. Perhaps the lack of subsidies and studies to establish different criteria TCU, detailing specific characteristics related to the indirect costs of restoration companies, the fact is that it has not found any composition or argument to defer the court's standards. It should explore this issue in future studies to actually verify

the adequacy of the BDI values established by TCU to works of common construction, the restoration works. It is important to develop other studies about the BDI rate for companies of restoration works, and verify if the reality of the market for those companies is the same or similar to the civil construction.

Faced with SINAPI gaps for restoration work and the possibility of developing compositions for various specific services, it is concluded on the feasibility of developing a proper baseline costs for restoration services, primarily when dealing with public works. Just as when using SINAPI compositions analyses are simplified and restricted quantities and unit costs, the use of a base for restoration services, duly developed and approved by most of the Heritage agency in Brazil, Iphan, and submitted to the Ministry of Planning, as recommended by the Federal Decree 7983/2013, organize the market, desing companies, construction companies, and facilitate the development and analysis of costs, in addition to the audits carried out by various bodies and society. To develop this cost base it is important to consider the most common cost basis and its frequency in the study.

The proposed methodology proved very efficient in checking compliance with the requirements of the Federal Decree 7.983/2013, with the requirements of the Brazilian Federal Court of Accounts – TCU and other legal requirements. It is an important tool in budget analysis, as required by Federal Decree, and also showed the possibilities and opportunities to develop a specific cost base for restoration.

5 REFERENCES

- BRASIL. Decreto Federal nº 7.983, de 8 de abril de 2013. Diário Oficial [da] República Federativa do Brasil, Poder Executivo, Brasília, DF, 09 abr. Seção 1, p. 4. 2013.
- BRASIL. Instituto do Patrimônio Histórico e Artístico Nacional-IPHAN. Portaria nº 383, de 20 de agosto de 2013. Diário Oficial [da] República Federativa do Brasil, Poder Executivo, Brasília, DF, 22 ago. Seção 1, p. 5. 2013.
- BRASIL. Tribunal de Contas da União - TCU. Orientações para elaboração de planilhas orçamentárias de obras públicas, Coordenação-Geral de Controle Externo da Área de Infraestruturas e da Região Sudeste – Brasília, 2014. 145p.
- CAIXA ECONOMICA FEDERAL, Manual de Metodologias e Conceitos, 2014. Disponível em <https://www.cegef.ufg.br/up/124/o/SINAPI_Manual_de_Metodologias_e_Conceitos_v002.pdf> Acesso em: 12/07/2016.
- Cardoso, L. R. A., 2009, Planejamento, gerenciamento e controle de obras. In Ações Integradas de Urbanização de Assentamentos Precários, Brasília/São Paulo: Ministério das Cidades/Aliança de Cidades, p. 279-318.
- Callegari-Jacques, S.M., 2003, Bioestatística: Princípios e Aplicações, editora Artmed. Porto Alegre. (p 144-152).
- Colin, S. V., 2010, Técnicas construtivas do período colonial – I. Disponível em <<https://coisasdaarquitectura.wordpress.com/2010/09/06/tecnicas-construtivas-do-periodo-colonial-i/>> Acesso em: 12/07/2016.
- Ivančić, V., 2014, *Improving the decision making process through the pareto principle application*. Disponível em <[file:///D:/Usu%C3%A1rios/marco.maximo/Downloads/16_Ivancic%20\(1\).pdf](file:///D:/Usu%C3%A1rios/marco.maximo/Downloads/16_Ivancic%20(1).pdf)> Acesso em: 12/07/2016.



Lemos, A. C., 1989, O que é arquitetura. São Paulo Brasiliense, 1989, p. 40.

Meneses Filho, A. S., 2014, Temas de Engenharia Civil: questões comentadas, 5ª edição, Fortaleza, Expressão Gráfica e Editora (p. 682-716).

Oliveira, M.A.R., 2015, Barroco e Rococó nas Igrejas de Recife e Olinda. Brasília, DF. Iphan, 2015.

Tinoco, J. E. L., 2012, Introdução. In Mestres Artífices de Pernambuco, Brasília, DF, org. Zerbetto, A. e Torres, R., (Iphan), p. 19-27.