

Building Management in Brazil

The transition between high inflation and the stability of the currency

Rejane Maria Tubino Geyer

MSc Civil Engineer
EEC/UFG, Civil Engineering School
Federal University of Goiás, Brazil

Summary

After a long period of economic instability Brazilians are facing a new experience with a stable currency and a low inflation rate.

Since 1993 the “Real Plan”, created by then Business Minister Fernando Henrique Cardoso, stabilised the Brazilian currency. In 1994 this Minister was elected President of Brazil and in 1998 he was reelected, maintaining all the economic rules in the country.

Brazilian citizens must adapt themselves to this new experience in all sectors of the economy. With a high inflation rate, that used to be around 30% per month in average, planning is almost impossible. No one could predict how much would be needed to buy food, to pay the rent or to pay children’s school the next month, because all prices rose day by day. In this way, building management is a very difficult task.

This paper aims to describe and analyse Brazil’s economic situation now and before, and how it affects the construction sector.

The paper also analyses how to plan a work site, budgets, and follow it after all with this high inflation rate in order to success the stage of design and production.

Construction costs are calculated in the following way: quantities are calculated and with these data it is necessary to check all the prices. Computer is feed with all these numbers and the person in charge transform the budget using a brazilian sectorial index for construction called CUB (Basic Unitary Cost). After this only relative numbers were used and not anymore absolute ones. To control the budgets Ganttcharts were used.

The paper also discusses tendering and contract, adjustments, quality assurance used in the work sites and some aspects about this transition between the inflation and the stability of the Brazilian currency.

The conclusions are that with a high inflation rate planning is almost useless, because things happen and are decided day by day at the work sites. Also high storage of products is needed sometimes to use a good offer of some product. On the other hand with low inflation rates planning is more viable and necessary.

Introduction

The aim of this paper is to show how construction management functions in Brazil.

Nowadays I work as a professor at the Civil Engineering School at the Federal University of Goiás. So, the experience I will describe here is from the time I used to work for a private Company called RTJ-Engineering and Architecture Ltd. as a civil engineer manager between 1986-1992. Many of the clients of the company are people who own landlots and want to construct. We never enter into government competitions, because work for the government in Brazil can become very difficult if the people in power change, which they often do. Many times they don’t finish the previous works, and don’t pay the contractors.

The company I used to work for, takes responsibility for the design and construction till turnkey ready project. My responsibility was the construction management which included budget control and control of the work sites.

Normally the company build seven to ten storey buildings, either for dwellings or commercial purposes.

The experience I want to transfer here is how to make a budget and follow it properly with an inflation rate of 30% per month, which was the average inflation rate in Brazil at the time I worked for this company.

The Actors and the Projects

The company I used to work for has two owners. One is a civil engineer and the other is an architect. In this way is possible to participate in all stages of a project. They also have a labour subcontractor who works with them for more than fifteen years now. The advantage is that they know all stages of the projects by heart. The disadvantage is that the designs of the company are never sufficiently detailed. It is not a big problem if we do all the construction, but if the client wants the design to be executed by somebody else, than there is a problem. In this way more detailed designs must be done.

I used to work for them as a civil engineer manager and the computer department was under my supervision at that time.

The organisational chart of the company can be seen in figure 1.

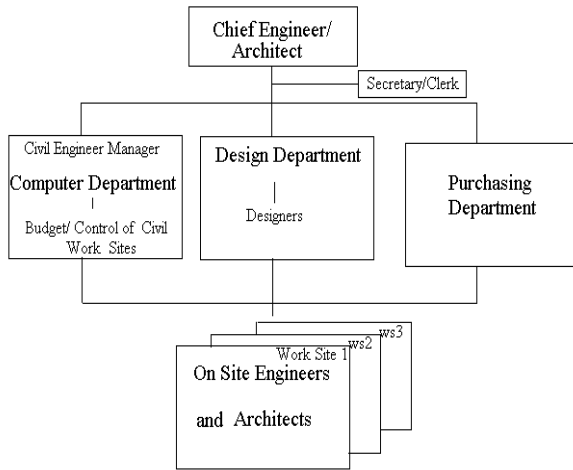


FIGURE 1- Chart of the company.

Specific Country Conditions

With a total area of 8.511.965km², Brazil is the fifth largest country in the world, after Russia, Canada, China and the United States. The country is located in South America’s central eastern area, encompassing about 47% of the continental area. It has a population of 163,4million inhabitants, composed by 55,2% of white people, 6% black, 38,2% mulato (mixture between black and white), 0,4% oriental and 0,2% nature Brazilian indians (1996 data – IBGE).

The city where I live is called Goiânia (GO) and its location is showed in figure 2.

Brazil is a Federative Republic, with 9,274 districts distributed by 4,974 municipalities, combined into 26 states and a Federal District. The Federal District, where Brasília- the Republic’s capital- is located, as the seat of government, housing the Executive, Legislative and Judiciary powers.

The states form five major regions:

1. North- 45,2% of the national territory. Including the states of Rondônia, Acre, Amazonas, Roraima, Pará, Amapá and Tocantins;
2. Northeast- 18,2% of the national territory. Formed by the states of Maranhão, Piauí, Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Alagoas, Sergipe and Bahia;
3. Southeast- 10,8% of the national territory and includes the states of Minas Gerais, Espírito Santo, Rio de Janeiro and São Paulo;
4. South- 6,7% of the territory, including the states of Paraná, Santa Catarina and Rio Grande do Sul;
5. The States of Mato Grosso do Sul, Mato Grosso, Goiás and the Federal District form central West Region- 18,8% of the territory.

Its boundaries run through 23,086 km, of which 7,367 on the east shape the shore of the Atlantic Ocean. To the north, west and south Brazil has boundaries with almost all South American countries except for Chile, Ecuador and Trinidad and Tobago.



FIGURE 2- Brazilian Map.

Economic and Political Conditions

The economy of Brazil changes a lot. Between 1986 and 1992 the inflation was about 30% per month. So it is quite difficult to control a budget with such a high inflation rate. What did we do? We calculate all the quantities, with reference prices of specific week. After this week we only work with indexes of all the prices since the inflation was so high. In this way we are able to control the budget in a better way.

Due to devaluation of the Brazilian’s currency, the money has changed names four times since 1986 and in each time 2 or 3 “zeros” were cut out. Before 1986 Brazilian’s currency was called “Cruzeiro”. In 1986 changed to “Cruzado”, according to a whole of laws called “Cruzado Plan”. In 1988 name changed again to “Cruzado Novo” (“Summer Plan”), and since 1993 it is called “Real” (“Real Plan”). The exchange rate of the 1st of January 1999 was 1US\$ = 1,23 R\$.

In Brazil there is a sector index called CUB (*Custo Unitário Básico*- or Basic Unitary Cost) which we use for that transformation. So people has to pay monthly for their apartments instead of “X” reais (Brazilian currency), “Y” CUB’s.

The reference CUB in Goiás in january/99 was R\$ 426,21/m² (about US\$ 350,00/m²).

Labor

Due to the increasing participation of women in the labour market, the gender composition of the labor force shows a very clear change.

Although still far from the adult male population activity rate, the female rate has showed, from 1981 to 1990, an expressive growth, from 37.0% to 48.0%, while this indicator for the male contingent remained stable in 86.7%.

Among the factors explaining this increase of the female participation in the labor force, the decrease in fertility rates and the higher education attainments have given women better conditions of entrance and competitiveness in the labor market.

The employed population continues to show a market improvement in educational attainment, with a more accelerated rate of change for women, who have already achieved a higher educational level.

In 1990, employed persons having finished at least high school constituted 25.8% of females and 16.1% of the male.

Housing and Basic Sanitation

Housing conditions in Brazil show great improvements in basic sanitation infrastructure. Although the annual rates of housing supply increases above population growth rates, serious problems due to the growing demand for new housing and basic sanitation are still observed at present. This fact is partly associated to the intense process of urbanisation that occurred in the Country from the sixties onwards, causing the urbanisation rate to increase from 47.0% in 1960 to 78.2% in 1991.

During that period, the stock of urban housing units increased four times, with the addition of 20,807,142 units, partly because former rural dwellings became an integral part of new urban areas, but this growth is especially attributed to the intense migration from rural areas towards the cities. The rural areas showed an increase of only 429,750 domiciles during the same period.

In the short period during which the Brazilian economy and territorial organisation changed from agro-exporter to urban-industrial, the urbanisation process took place without the corresponding investment to create the necessary dwelling conditions. As to residential construction, houses are the most common type of building (86.3%), mostly situated in distant suburbs around large cities, without the necessary infrastructure and many still without due maintenance. Apartment buildings constitute of 13.7% of these dwellings.

Government Housing Policy and Financing Facilities

There used to be in Brazil the National Banking for Housing (BNH), controlling the whole Housing Financing System. This Bank was extinguished in 1964, but the System itself exists until nowadays, controlled by the Federal Savings Bank.

Each labor in Brazil has to pay monthly a tax called FGTS (Service Time Guarantee Fund). This represents 8% of its salary. When the labor is fired he/she has the right to have this fund back that is more or less one salary for each worked year.

All this money paid for government is kept in this Federal Savings Bank, and is one resource for Housing Financing in Brazil.

There is also other few ways of financing houses for the low-income population. Sometimes there are specific programs made by local governments. Normally they are

not enough and Brazil still has a housing deficit of approximately 10,000,000 of units.

National Accounts

In 1994 Brazil accomplished two consecutive years of economy growth, with the Growth Domestic Product (GDP) real variation rate showing a 5.7% increase compared to the previous year. With this increase, the largest since 1986, the GDP has accumulated a 10.1% expansion in the last two years, compensating the decrease suffered in the nineties.

The economic activity growth in 1994 included the whole economy, with Manufacturing, Agriculture and Services increasing 6.93%, 7.58% and 4.08%, respectively.

The economic expansion in 1994 brought about very promising effects for the labor market, especially after the prices became stable.

Considering a preliminary estimate of population growth of about 1.42%, per capita GDP variation was 4.2%, the highest in the nineties.

CUB

CUB is a Brazilian sectorial index. It belongs to the Civil Construction Sector. This index is a composition of 24 different projects. So we use the average of these 24 projects as the referential CUB value, that means how much one square meter of construction will cost (CUB/m²).

This CUB/m² average is calculated based on the NBR 12721, from 01/01/93, of ABNT – Brazilian Association of Technical Normalisation and it is composed of a basic group of 39 materials, 1 equipment and 5 labor categories.

The labor represented till June/97, in average, about 49% of the m² costs and the materials about 51%. This percentual relation went to this level due to the less changing of the prices of the materials, as a result of the “Real Plan”. Historically, the labor and the social tax of the labor used to contribute, in average, of about 35% to the CUB value.

These social taxes of the civil construction labor changes quite a lot from one state to another in Brazil. For example, in Goiás are about 126% and in Rio Grande do Sul, about 175,57%. Which means that each Real paid for a worker, it is necessary to pay R\$ 1,26 extra to the government in Goiás and R\$ 1,76 in Rio Grande do Sul.

These CUB projects consider:

- The number of floors, that can be 1, 4, 8 or 12;
- The number of bedrooms: 2 or 3 (except the maid bedroom);
- The level of the construction: low (B), normal (N) or high (A).

For example, if your project has apartments with 3 bedrooms, 7 floors and a high finishing pattern, your reference CUB would be the H8 3A (8 floors, because it is the closest to the reference, three bedrooms and a high finishing pattern).

These numbers are calculated monthly by the regional SINDUSCON (that is the Syndicate of the Civil

Construction Industry) and published in the best newspapers and sectorial magazines. It is also possible to have these values at SINDUSCON's every month. One example of how they publish this index can be seen in Table 1.

Table 1- CUB values for Goiás State- January/99.

Type	Residential- 2 bedrooms			Residential- 3 bedrooms		
	Low	Norm	High	Low	Norm	High
H1	493,6	569,6	603,0	418,8	477,9	509,2
H4	367,7	434,6	507,8	324,6	378,3	434,5
H8	360,2	426,2	495,5	312,0	367,3	423,4
H12	350,0	418,8	485,7	306,2	362,3	417,6

Obs.: Values in Reais (R\$)- Conversion rate: 1 US\$ = 1,23R\$

Also all projects are described in one normalisation in Brazil that is called NBR 12.721/92- Unit Costs Evaluation and Prepare of Construction Budget to Incorporate Buildings in Condominiums.

Design Stage

The company I used to work for made the architectural design. Then we used to subcontract and manage every other designs need for building, such as foundation, structural, electric/telephonic and hydraulically/fire prevention.

Budget

After the conclusion of all designs I and also a trainee who used to help me calculated all the quantitatives.

These quantitatives were all put into the computer. We have a program developed by us to make the budget. Nowadays there are lots of programs like this available everywhere.

We take a checklist in order not to forget anything that must be measured. Afterwards we check if there are all the compositions we need for that project inside the program. If there is a specific composition of materials and labour that had not been created yet we must put it first in the budget program. If everything is measured and all the compositions are created we can start the budget. We take all the measurements and feed the computer with the project data. When everything is in the computer, we check all the prices in one week, finish the budget and see how much all the project will cost. Afterwards we have to see how much is the CUB of the month and we transform our budget in a "CUB" budget and work with this one.

Nowadays our currency is quite stable and it is possible to work with the prices themselves. Another possibility would be work with another currency, such as the US dollar, that is much more stable than the "real", but it is not allowed in Brazil to use a foreign currency as a reference.

Ganttchart

To control the budget at the work sites we used to make barcharts (or Ganttcharts). We still use this tool nowadays

for ordinary work sites, such as building constructions. If we have to construct a highway or a big project as a dam for example, the best controlling tool would be the PERT/CPM, which is quite used to this kind of work sites in Brazil nowadays.

With the PERT/CPM it is possible to see clearly all the links between the activities of the construction sites. But, in my opinion as a teacher of this subject, it is not the easiest way to have an overview about the project. With the barcharts everyone in the construction site can understand which is the next step and when next activities must be done.

The barchart is done in period of great inflation as follows: first we take the budget in CUB's, so we know how much the building will cost, even if seven or ten years had passed.

For example:

$$\frac{\text{Budget (R\$)}}{\text{CUB (R\$/m}^2)} = \text{"X" CUB's}$$

The cost today will be:

$$\text{"X" CUB's} \times \text{CUB (April 99)} = \text{"Y" R\$}$$

Now we can make the estimates to check how much will be needed for the construction each month.

Project Financing

The way this enterprise works is like this:

The most current clients of the enterprise are people who own a piece of land and want to construct. They come to the enterprise and ask for the construction. Normally they have only the idea of the project and the design. Sometimes they have a lot for the construction, and sometimes they don't.

It is also possible to have a group of families and one of them owns a landlot to construct the building. So the others would pay for the lot during the construction, monthly. We call it "change for constructed area".

So these people pay for all the design stage themselves.

This enterprise makes the design and executes the construction after all. After the design stage the client can choose to have the building constructed by the company or take the projects and give to somebody else to make it.

Check the Prices in Private Works

There are basically two ways to check if the prices in the budget are correct. First, and the easiest way to do it is to compare the square meter of the budget with the CUB of one project similar of yours.

The second way to do it is to send all the projects to a consultant and ask for another budget. Of course that all specifications must be with the projects and there must be all complete designs in order to have the same basic prices and also the same criteria of measurements. This is more precise than the first way, but it is also more expensive and takes time to make the new budget.

Budget Control

When the construction starts, we have to control the budget we have made.

Normally we pay for the labour once a week. So we go to the work site and measure how much was built in that week and we can make the bill for the labour sub contractor, according to the production and also according to the foresight, that is in the Ganttchart.

There is an amount of money available every month, that is the result of the Barchart. We receive the money at the beginning of the month and we have to keep it in a special account at the bank. These accounts have a daily income in order to guarantee the value of the currency.

How do we charge our engineering services? At the end of the budget, we calculate how much it will cost to construct, and we have a percentage of the whole account to pay the engineering and architect supervision, what we call as administration rate, or a cost reimbursement contract. Each week the labour is paid, the suppliers are also paid, and the administrative percentage is calculated from the amount and is also paid weekly.

Information technology

In Brazil we have a specific law only for public tenders. This law is the 8.666 from 1994. This law says that the tenderings has as objective to give the same opportunities for everyone and must be public in all its phases. It is defined as an administrative procedure composed by sequential phases, co-ordinates and interdependents which is done to select the most advantage proposal to the Public Administration.

The most advantage proposal is the one that, independently of its value, is the most adequate, favourable and convenient to the interest of the Public Service. There must be observed the quality conditions, the production, price payment and period to finish the proposed work. There used to be a law that determined the lowest price to be the tender winner. When the lowest price tender is not chosen there must be a written justification from the Judge Commission or by the Invitation Responsible.

The Public Administration can always choose if they are going to contract the one who won the public tendering or not. The Public Tender can be cancelled if something illegal occurred in the process or in its judgement. If the contract was firmied it can also be cancelled.

Definitions about tender objects and contract.

Work: all construction, remodelling or enlargement of a building that can be direct or indirect executed.

Service: demolition, manufacturer, repair, installation, assemble, operation, conservation, transportation, communication or professional technical works.

Direct Execution: the one that is done by the administration itself.

Indirect Execution: the one that the entity contracts somebody else to execute. The way to do this can be:

- **Global Price Contractor:** when one contracts the execution of the work or service with a preestablish and total price.
- **Unitary Price Contractor:** when one contracts the execution of the work or service with a certain price of determined units.
- **Percentage over all expenses:** when one contracts the execution of the work or service paying back all the expenses and a preestablish fee for the administrative works.
- **Task:** when labor is contracted for small works, for a set price, with or without the materials supply.

Basic Project: group of elements which defines a work or service or a group of work or services that makes part of the tendering process, and that make possible to estimates its final cost and execution period.

Executive Project: group of elements necessary and sufficient to the complete execution of the work.

Client: part of the government who signs the contract.

Contractor: physical or juridical person who signs the contract with the government.

Tendering kinds

Tendering: everyone interested can participate in a tendering since they can prove, at the initial phase of preliminary habilitation, that they have the minimum requirements needed for qualification asked by the client documents to execute its objective.

Tendering is for any construction values.

Price check: can participate in this kind of tendering contractors that are previously registered. Qualification must be checked also.

Price check can be used to contracts until US\$ 1.000.000,00.

Invitation: between at least three contractors, previously registered or not, chosen by the administrative unit.

Invitation can be used to contracts until US\$ 50.000,00.

Competition: all interested for a choice of a technical or artistic work, by the institution of a prize to the winners.

Auction: all interested to sell goods and also legally apprehended goods, to those that offer the highest price, equal or superior of the evaluation price.

Tendering and price checks must be published at the Union Official Diary (DOU) and in another newspaper that circulates in the country.

Bidding documents

- Legal capacity
- Technical capacity
- Financing suitability
- Fiscal regularity

Proceedings of the tenderings

Tender starts with the opening of administrative and registered process. The contents of this process are:

- Authorisation of the process
- Summary of its object

- Own resources for expenses
- Documents of tender publication
- Bidders
- Judge Commission actions
- Appeals, if they happen
- Contract.

All tenders will have its own publication that must be published as the follow minimum periods, counted by the first publication of it:

- 30 days for tender and competition
- 15 days for price check and auction
- 5 days for invitation.

Judgement of the tenderings

- Opening the envelopes with the documents and the possibility to participate in the tendering;
- If there are contractors not capable to do the work, the envelopes with the bidders will be given back, still closed;
- Opening of the bidders envelopes;
- Judgement and classification of the bidders.

Assurance ways to the contract execution

The client can choose which assurance he wants to use in each contract between the follow possibilities:

- a) Security, in money, in Union public debt papers or as a bail;
- b) Bank bail;
- c) Guarantee insurance.

The maximum value of the guarantee is 5% of the contract value for case a) and b). After the winner is known it is paid back to the other participants. To the winner it will be released after the conclusion of the work or in a proportion of its execution.

Contract adjustment

The contract adjustment is regulated by the law n. 94684 (24july87) and determines that:

- a) It is only possible to have an adjustment if it was previously fixed, and can be used a sectorial index if it is a work or service. It is forbidden the use of international currency as a reference or the minimum salary;
- b) The adjustments can be higher or lower, depending on the variation of the index;
- c) In case of delays: if the prices rised, the payment will be done related to the time the service should have been done. If the prices diminished the payment will be done by the execution date values.
- d) In case of anticipation: prices valid at the time of execution;
- e) In case of prorogation, prices valid at the new dates.

Adjustments calculations:

$$R = V \times (I_a - I_i) / I_i$$

Where:

R= adjusted value

V= initial value

I_i= initial index

I_a= current index.

Experiences to use in future projects

Private sector in Brazil doesn't have a specific tendering law. Some requirements of this law could be easily adapted and used at the private sector.

Production Stage

After the design stage is completed we have the beginning of the work site.

Tendering and contract

Normally the group of people who wants to construct comes straight to the company for the construction and the design. If they decide to change the ones who will construct there are some necessary considerations. The most important is: if they want to somebody else make the construction, then the design must be more detailed and they have to pay for it. But everything must be written in a contract previously.

The construction contract we usually work with is the cost reimbursement contract with a percentage fee. The cost reimbursement contract is a form of contract in which the contractor is paid for those costs which he can show have been incurred, plus a previously agreed additional fee called BDI- Indirect Expenses Profit. The contractor is paid the full cost of all labour, materials, plant and services used on the site plus a fee for his overheads and profit. The fee can be either fixed or a percentage of all the costs. Our way of working is normally the percentage over all expenses in the work site, which varies depending on the size of the project. If it is a big construction, the percentage fee is smaller (around 15%). If the project is small, or even a remodelling of a house or apartment, then the percentage increases (around 30%) or we charge a fixed fee for the work. In this way it is very important to be careful on mentioning in a contract exactly what is going to be done during the construction and all the modifications out of the contract must be charged separately. Anyway, there is a model of calculation to determine the BDI.

For the construction itself people must have all the amount of money to pay monthly to the contractor. If they don't have all the money it is possible to ask for a loan in the banks. After the conclusion of the construction and accordingly to the contract with the bank, the payback starts. It can be taken until 25 years to pay back the loan to the bank. The tax can be pre-fixed or, what is most common nowadays, the monthly payment increases accordingly to the increase of the client's salary (normally two months after the client receives the increase of his/her salary then his/her instalment also increases in the same proportion).

The costs of the construction are composed by two kinds of costs, which are direct and indirect costs.

The Direct Costs

The direct costs are the construction costs itself, or how much will be necessary to build the construction. It is composed by the calculations of the materials consum, hours of equipment and labor consum plus the social tax. These costs are determined by the service quantity measured to be used in the work site and the amount of money necessary is measured through the unitary cost composition.

The services must be joint together in one logical and ordered execution classification.

Law number 8.666/94 (Tender Law) applied together with NBR 12.721 gives the direction on determining the direct cost of execution of a work site.

The Indirect Costs (BDI)

The indirect costs are the group of expenses with material, labor and general tax, used to the planning, organisation, management and control of a work site, plus the financial expenses, risks and unforeseen costs, liquid profit and general tax.

BDI is calculated based on the analysis of each type of construction, the construction enterprise structure and the planning of the enterprise to develop each work site.

The indirect costs can be divided in Profits (B) and Indirect Expenses (DI).

Profit is the total profit of the enterprise.

Indirect Expenses can be understood as the central administration costs, fortuitous (such as strikes, lack of products in market, accidents, etc.), the financial costs, and tax (PIS, COFINS, ISS, etc.).

Central Administration Cost (CAC)

The Central Administration Costs are the expenses with the support and supervision of the construction enterprise. Can also be called central office cost or administrative cost. These costs are the administrative expenses of each enterprise and must be analysed always due to the number of work sites in execution at the present moment by the enterprise.

Fortuitous

Fortuitous are expenses coming from unforeseen factors at the civil construction activities, such as:

- Collapse of ditch excavations;
- Remake of services damaged by rain;
- Order of non predicted holidays;
- Strikes;
- Momentary lack of materials in market, etc.

The fortuitous has also the aim of correct imperfections occurred on the determination of the work costs, since the initial calculations of the amount of services, prices compositions, prices checks, indirect costs calculation, etc.

As much as the care of the budget calculation as less will be this rate.

In a remodelling of a house or apartment, the percentual of these fortuitous tend to increase considerable in relation to new constructions.

In this item are the values of several tributes or tax that are paid over the income and the profit of the construction, such as:

a) Tax over income (IR)

These taxes are paid to the government and are applied independently if at the end the construction gives a profit or not.

COFINS =	2%
PIS =	0,65%
ISS=	2,0%
	(average index, varies accordingly to each city)
CPMF=	0,25%

Total of tax over income: 4,90%

b) Tax over profit (IL)

Over the work profit, there are the following taxes:

- Social contribution: 8% over the liquid profit
- Income tax: 15% over the real profits independently the value.

Financial Costs (CF)

Financial costs are the capital costs used by the enterprise to do the construction, cash flow. These costs are generated by the difference between the expenses used to do the construction services and the receiving of the bills related to the services done.

In order to evaluate better these costs a cash flow of the construction site should be done.

There must be considered also the preceding deadline when the materials must be at the work site for the execution of the service.

Profit (B)

Represents the total profit of the contractor. This is a specific tax and it varies for each enterprise and for each work site.

In order to define the total profit all the incident tax must be deducted to this value.

With this classification of the expenses included in BDI, can be determined a generic formula for its calculation:

$$BDI = \{[(1+E) \times (1+CAC) \times (1+CF) \times (1+B) - 1] \times 100\} / (1-IR)$$

Practical example

E= Fortuitous (adopted index = 2%)

CAC= Central Administration Cost (adopted index= 6%)

CF= Financial Cost (for this example was adopted 1% as an average cost)

B= Profit (total profit adopted 9,09% that means 7% of liquid profit)

IR= tax over the income (calculated index = 4,9%)

In the formula:

$$BDI = \{[(1+0,02) \times (1+0,06) \times (1+0,01) \times (1+0,0909) - 1] \times 100\} / (1-0,049) = 25,27\%$$

Production planning

The Ganttchart made at the design stage must be followed strictly.

Everyday in the morning the construction manager who is responsible for the specific work site (engineer or architect) goes there to check how is the working going. He/she goes there also to give the instructions for the day or the week, accordingly to the foresight.

Each work site has its own construction foreman. This person writes down everything what happens daily in the work site, such as how the weather is in that day, how many m² of masonry was done, who did it, which material was delivered and if it is according to the specifications, etc. The construction manager must check all these information and if something is not going properly he must take care of the problem and solve it.

This written document is part of the work site and it's called "work site daily". With this document is possible to detect delays on the work sites, eventual mistakes done, wrong materials delivered (out of specification), etc.

Quality Assurance

Recently Brazilian construction managers started to think about quality assurance. There are also some contractors that got the ISO 9002 certificate. These engineers say that the most important thing to do in order to obtain this certification is training the labour force. Everybody is important in the process and each of them must participate to have success in quality.

In the 80's and the beginning of 90's nobody talked about quality assurance. Then we never work thinking this way.

The most important quality control is to ensure the strength of the reinforced concrete. At least this kind of control we do for such a long time in Brazil. We collect a sample in each truck of concrete and send it to a concrete laboratory to check if the strength is according to the calculation.

Nowadays, at the university, we are in charge of doing this kind of control in the city. Our laboratory is the only one prepared to give the certification for the concrete that is being used at the work sites. We also make the proportion of the materials to be used in concrete to obtain the structural design strength using the region available materials.

Economic Control: Budget Review and Reconciliation

Each budget is done considering ready composition tables. A composition is a specific task in each part of the construction. For example:

Composition 1- Masonry of solid brick, mortar 1:2:8 (cement:lime:sand), wall thickness 10cm without covering [m²].

<u>Input</u>	<u>Unit</u>	<u>Consumption</u>
Solid brick	un	54
Cement	kg	10
Lime	kg	10
Sand	m ³	0,02
Bricklayer	h	0,50
Servant	h	0,65

Normally we copy these consumptions from the ready tables and they are all ready inside the computer. We only have to check the prices at the time of the budget and feed the computer with quantity of services to be done. The problem is that these consumptions are an average of time spends from the labour to do the service. If your labour can produce more (or less) than it is specified on that ready tables, than we must change the composition. Only after a great number of observations and measurements of the labour performance then we can modify the compositions of the budget. This can be done with an effective budget and economic control.

Experiences to use in future projects

It can be said that for future projects it is important to have the own compositions for each enterprise. The performance of the labour and the controlling of the specifications are only possible with training of the labour force and it is important to have some benchmarks to control the production.

Benchmarks are some parameters studied to control the productivity of the work sites. For example the laying joints for internal masonry should be 15mm. If in our construction we find an average of 22mm then we must do something to try to be as close as possible to the ideal value, that is 15mm. Like this there are many other numbers to help us to make better the quality of our work sites.

There are also some benchmarks to be used in design stage.

Property Management

Life-cycle Cost – Choosing between Alternatives

Only before the beginning of the work site, at the design stage, we make some alternatives to be chosen. Normally we think on costs and not in a product that would have a better maintenance.

The first budget we make is the one with all desires of the clients. At the end, if they can afford all the materials we start the construction. If not, we make some modifications, normally in relation to the covering materials, with the client acceptance, and do the budget again and again until the final sum is satisfactory for the client and with the materials specifications. Then we can start the construction.

Financial studies are seldom done in Brazil.

Maintenance Planning

In March 1998 a normalisation was created to write a maintenance-planning manual. This normalisation is the NBR 14037 named "Manual for use, operation and maintenance of buildings- contents and recommendations to the preparation and presentation". Until 1998 there were no requirements for maintenance planning, then nobody did it. I hope that with this normalisation people will start to do planning and the clients will start to require their rights.

Anyway contractors must pay attention to the civil responsibility of the construction, because if something happens after the conclusion of the building they are responsible at least during five years after the conclusion of the work site.

Civil Responsibility of the Construction

There are two important laws in Brazil related to the civil responsibility of the construction:

1. Civil Code: law 3.071 January/46 (checked with the law 3.725 January/49);
2. Consumer Defence Code: Law 8.078 July, 11th, 1990.

The civil code tells that in case of constructions, the contractor is for **five years** responsible for the entirety of the building as well as the work safety.

At the consumer defence code, the most recent law we have relating to the responsibility of the construction sites, there are some definitions and articles that are important for the contractors:

Definitions

Consumer: physical or juridical person who acquires or uses a product or a service as a final addressee.

Supplier: people who develop activities related to production, erection, creation and construction.

Product: any good, moveable or immovable, material or immaterial.

Responsibility of the Manufacturer, Constructor or Producer

(Article 12) They answer, independently of the guilty existence, for the reparation of damage to the consumers caused by design failures, manufacturer defects, construction defects or insufficient or inadequate information for utilisation.

Defective Product

When does not offer expected safety, considering its presentation, uses and risks and when it was placed.

A product has no defect if another with better quality has been placed in market.

Trader responsibility

Is the same of the manufacturer when the manufacturer cannot be identified; the product was placed without the manufacturer identification or does not store adequately perishable goods.

Responsibility of the Services Supplier

(Article 14) The services supplier answers, independently of guilty, for the reparation of damage to the consumers caused by defects related to the service, and by insufficient or inadequate information about the risks.

Definitions

Failings: anomalies that affect the performance of the product or the service.

Hidden Failings: failings that can not be recognised at the beginning.

Defects: failings that can cause effective damages.

Repairs Services

It is consider at the service the obligation of the supplier on using original spare parts, adequate and new and they must follow the manufacturer specifications.

The ignorance of the supplier about the failings of quality because of inadequate products does not diminish his responsibility.

If the damage is caused by a spare part incorporated to the service, the manufacturer, the contractor and also the one who made the service are responsible.

Complaint against Defects

(Article 26) Apparent failings or easy to detect:

- I- 30 days- no lasting products
- II- 90 days- lasting products

The expiry date starts at the delivery of the product or at the end of the service.

Exceptions:

- complaint stated by the client to the supplier, tills his answer.
- Institution of the civil inquest tills its end.

Case of Hidden Failings

The expiry date starts at the moment the defect can be detected.

(Article 27) The expiry date set in five years to repair the damages. The expiry date starts when the defect is detected.

General

(Article 34) The good supplier is responsible also with his representatives.

(Article 39) It is forbidden to the supplier:

- Deliver to the client without being asked for.
- Execute services without budget and the client agreement.
- Set in market some good or service not according to the normalisation.

(Article 40) The services supplier must give to the client, in advance, a budget with the prices of labour, materials and equipment, conditions of payment and dates of beginning and end of the services.

The budget is valid for ten days, if there is nothing telling different.

(Article 47) The agreement clauses are interpreted in order to benefit the consumer.

Connection to the Design Stage – Feedback

It is possible to learn with our own mistakes. If something goes wrong with a technology or a material used in a work site, we must correct it and learn how to make it properly next time.

That's why it is so difficult to introduce a new material in construction market. Nobody wants to try new materials and/or technologies because they could not work properly. Sometimes people can save a lot of money using a new construction technology or a new material, but to start using takes quite a long time.

Transition between inflation and stability of the Brazilian currency

In such a high inflation period the planning is made in a very precarious way. It becomes necessary to make lots of considerations and use some index to work with relative values. It also affects not to have a big economy change. Those facts make the planning task difficult to be done.

Nowadays, since currency is more stable, planning is more viable and still necessary. Materials purchasing charts, labor contracting charts, and also physical and financial bar charts are very important to be done very carefully.

With a high inflation it is useless to talk about work site logistics. There is no materials storage planning, work site lay out, etc.

Then, with high inflation sometimes we need to have a high storage of some products, only to use some good market offer, because it is not possible to know the prices the next day. If you find a good offer, you must buy the product as soon as possible and then keep it somewhere. So you have to have some place for storage. Also, the money itself must be in a special account to guarantee the value of itself during the month.

In a stable economy, this means bad logistics, waste of money, spend extra money, etc.

When the currency is stable we have to be much more careful about the management of the work sites. With high inflation it is useless to talk about good planning. Things happen and are decided day by day with no previous decision of the acts, because if you lose one day, you will lose a great amount of money.

Conclusions

It is much better and easier to live in a stable economy and with a very low inflation rate. Since 1993 it is possible to do planning in all areas and mainly it is easier to make budgets and follow them in Brazil.

On the other hand, construction managers must be much more careful to do their works in order to plan better, have not many products storage, and have a very

well planned work site lay out, in order not to lose anything.

Purchasing charts and contracting charts must be done at the beginning of the construction to have all the work going well and no labor stopped because of lack of some material.

Reading Brazilian today's newspaper (April, 17th, 1999) it is possible to see that the inflation is coming again. Today the price of the gasoline increased 11%, and it is the third time this year. I hope the inflation rates doesn't come so bad this time, but it is impossible to foresee the future.

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