# Office Building Design Conception Guidelines

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## Abstract

The complexity in office buildings design development is related to difficulties in incorporating the interests of all players involved (owners, designers, contractors and end-users) and to the increasing diversity of specialist designers. The clarity about key points definitions and who should make them, during the design conceptual phase, is imperative for technical, constructive and commercial feasibilities of the project itself, and design management must have complete control of these aspects. The aim is to investigate what critical information from several design subjects should be defined during this conceptual phase and its correct insertion sequence in the design process. In order to pursue this investigation, the research is based on the case study method, the studied object of which has distinctive conditions: the design team contractor is a real estate company that fully understands office building market needs, holds an experienced technical team to evaluate and select constructive solutions and, also, is a facility manager. Due to this, their design decisions actually focus on the project entire life cycle, which is not common in the Brazilian market. In conclusion, the development of an information flow is proposed, during the design conceptual phase, which indicates when each piece of information should be located in the design process, which is helpful to elucidate the correct function of each related player and to establish a useful tool for design management.

**Keywords:** office building, design management, data flow

# 1. Introduction

Office building design management is a complex task, as well as any design process, due to the diversity of the players who influence it or are influenced by it (owners, architects, consultants, contractors, facilities managers, end-users) and to their interests (in many cases, at opposite sides). Thus, it counts on an increasing number of specialist designers, owing to the development of new construction technologies and building automation systems.

Office buildings have specific needs, which distinguish them from others typologies, such as residential buildings. Open plan floors, which allow occupation flexibility, demand heavier floor loadings and specific free span between structural columns. MEP (Mechanical, Electrical and Plumbing) Systems are more sophisticated, since they deal with large populations and air conditioning central systems, which imply special care for energy infrastructure and efficiency.

The complexity in developing the office building design is reflected in the need of including the most important issues of these design specialties at the initial stages of design conception, in order to preserve their main demanded spaces and to allow feasibility studies based on realistic costs. In effect, a good design results from a correct integration of considered design specialties and from a consistent interface management of the involved team members.

# 2. Purpose

The aim is to investigate the demand of office buildings design guidelines. These guidelines consider several design aspects: the significant number of design specialties, the design management and the building, operation and maintenance aspects.

# 3. Research method

The object is the office buildings design process, focused on the initial steps, and its organization relationships. It is developed by the case study method, which comprises, according to Yin (2003), the studied object definition, the subject bibliographic review and the empirical data survey. In order to define the case study, and due to the great number of possible involved players, the one who dominates the design management as an entire process was selected, the real estate developer. This option allowed the study of a single case so as to grasp the day-by-day usual situations. Furthermore, the chosen real estate company presents an unusual aspect if compared to the market standard, because it works on all the phases of the project life cycle: business plan set up, design and construction management, and building operation and maintenance during its entire life span. The Brazilian market standard acting ends after the construction phase, leaving the operation and maintenance problems to the future end-users. This difference of the chosen real estate developer has a significant influence on the design technical decisions and the design process.

# 4. Design management theoretical aspects

Design, as well as project, can be understood as a product or as a service. Design management can be understood as the management of a process that begins with an idea and ends with a complete documentation, which allows a building construction. According to Melhado et al. (2005), design management is the group of activities related with design planning, organization, direction and control, as well as strategic and tactical activities – such as selecting and hiring design team members – in order to guarantee the supplied product and service quality.

## 4.1 Players and design coordinator importance

The real estate business type, conduction and even its location vary due to the way the involved players act in the design process. The main players are: a) real estate developers and owners, who make projects feasible; b) architects, design specialists and consultants, who translate the developers' needs into documents; c) constructors, who quantify technical solutions to costs and build what was designed; d) end-users, who use the building and supply post-occupancy information; e) facilities managers, who operate and perform the building maintenance; f) government authorities, who regulate, by laws and norms, the activities of design, construction, permits and, in some cases, financing.

The design coordinator is an important figure that gravitates around the first three players. The planning in the design process, without him, does not exist, or is performed in a precarious way. The way he establishes the relationship with the other parties, and also, the way the players establish the relationship among them depends significantly on the hiring process. The commercial relationships carried out by the developer shall allow sufficient autonomy to the design coordinator, so that he can effectively conduct the design planning and management.

Design coordination, according to Melhado et al. (2005), is a support activity to the design process development, focused on requirements integration and design decisions. The coordination shall be conducted during the entire design process in order to promote design team interactivity and to improve the design quality. In this sense, not only does the design coordinator have to dominate the technical knowledge about the issues he will coordinate, but also needs to have managing and leadership skills – since he deals with several design team members with different interests. This type of profile, very similar to that of a project coordinator, in addition to the gradual loss of the architect authority (as deduced from RIBA, 1993; Gray and Hughes, 2001), somehow explains the ascendancy of construction and design managers in the design process.

## 4.2 Design process flow

Several regulations references, as well as researches, which study design development, are unanimous about the division of its process into phases, including the Brazilian norm NBR-13531 (ABNT, 1995), the phases of which are: Survey, Briefing, Feasibility Study, Preliminary Study, Schematic Design,

Legal Design, Basic Design and Construction Design. Several authors (RIBA, 1995; CTE, 1997; AsBEA, 2000) use similar approaches related to the design hierarchical and linear phases, and to the players' responsibilities throughout the process.

The investigation of alternatives to the stiffness of this linear arrangement provides models, which suggest the design development integration with the construction development process. This approach is related to the concurrent engineering, investigated by Fabrício (2002), in which the main players' representatives participate in design teams to bring their expectations and needs into the process. According to this approach, the work of Brazilian specialties design and design hiring corporate entities, which generated the issue of eleven guides of design services and design coordination scope (www.manuaisdeescopo.com.br), defined six design phases (Figure 1): Product Conception, Product Development, Solutions for Design Technical Interfaces, Detailed Design, Post-Design Delivery and Post-Construction Delivery. The work is focused on the activities developed at each phase, instead of the resulting products.

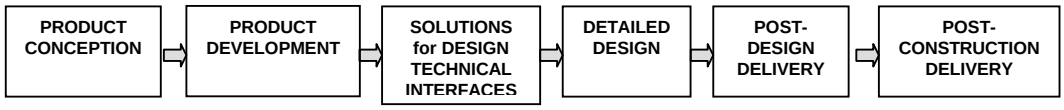


Figure 1: Main design phases

# 5. Case study

## 5.1 Introduction

The case study object was the design development process of a real estate enterprise of office buildings, located at Setor de Autarquias Norte, Brasilia – DF (Brazil). This project was developed by a private company, headquartered in USA, which has been operating in Brazil since 1996. The survey was conducted by interviews with the technical department representatives, architects, design coordinators and involved design specialists, in addition to coordination meetings attendance and design documentation reference.

## 5.2 Project description

The project to be built in Brasilia consists of two office facility towers, linked by a common basement, in which are located the parking lot, the entry lobby and a store area. Each tower is 21-story high, with a total of 42,500 sq. m. of rental area and 1,080 car parking spaces. The typical office floor has a rectangular shape and is based on the "core and shell" conception. The slab area of each floor is approximately 2,000 sq. m. and the free span is 12 m at the smaller side and 16.9 m at the larger side. The building enclosure is designed to mix masonry cladding, natural stone finishing and glazing with aluminium frames.

The structure floor framing system consists of reinforced concrete waffle slabs with incorporated post-tensioned beams. It allows flexibility to the MEP Systems distribution without significantly increasing the structural height, and presents appropriate cost-benefit to support the proposed spans. The MEP Systems accommodate saving water devices, treatment systems for rainwater and sewage, and a central HVAC (heating, ventilating and air conditioning) system, with chillers located at the basement, air-handling units at each typical floor, carbon dioxide sensors, heat exchanger wheel and variable air volume controls.

The passenger elevators, 10 units for each tower, are arranged into groups for low-rise and high-rise zones, in order to serve the occupants with comfort, based on traffic analysis criteria. Two of them are parking shuttle elevators, as a security measure. The life safety systems (emergency exits, escape routes, systems and fire resistant materials) are based on the local life safety codes and on the American NFPA (National Fire Protection Association) codes.

## 5.3 Process description

In order to support the whole chain of property development, the real estate company has a managing organization headed by the Investment Committee (IC), followed by the CEO[1], served by several departments. The ones that are relevant to this paper are: Commercial Development (CD), Design & Construction (D&C) and Facilities Management (FM).

Its production process can be summarized into four main phases: Product Conception, Design Development, Construction and Maintenance (Figure 2). The Brasilia project, a process in progress, covers the two first phases, as follows.

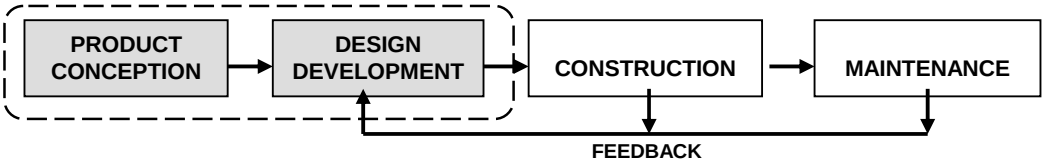


Figure 2: Real Estate company production phases

**Product Conception**

In this phase (Figure 3), the CD department prospected an opportunity in Brasilia and proposed an enterprise, the estimated cost of which was taken by the D&C department to the Investment Committee. The next step of the studies was approved, and an Architect elaborated a “Basic Mass

[1] Chief Executive Officer

Plan" based on a briefing, which included commercial type basics, such as: legal restrictions, floor areas, rental areas, floor shape and core, number of lower levels and number of stories. The submission of this plan to a cost estimate performed by the D&C department resulted in a first cost and expenditure schedule reference, which oriented the business feasibility study.

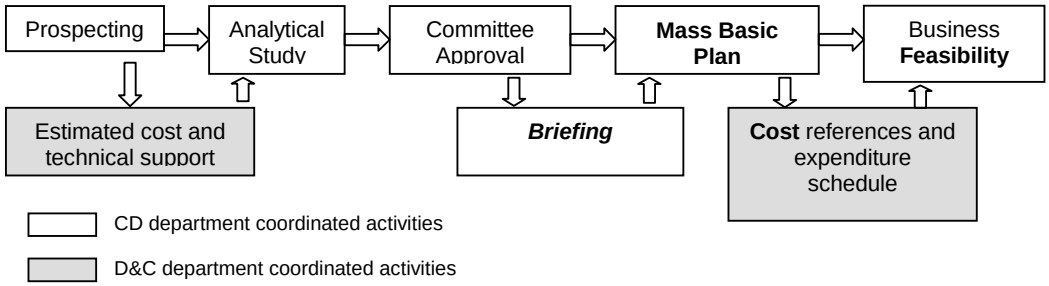


Figure 3: Product Conception phase process flow

**Design Development**

The second phase, Design Development (Figure 4), was initiated as the study concluded the enterprise was feasible, and was conducted by the D&C department. In this phase, the Architect developed the Preliminary Design, with the initial briefing ideas development, geometry definition, macro calculation of areas, and a first outline specification. Also, a local consultant was responsible for the legal parameters survey. The Preliminary Design was submitted to a cost evaluation, so as to verify the agreed initial objective with the IC.

After this verification, the Schematic Design step was initiated, with the selection of design specialties consultants, the scope or work definition and the initial planning. The design coordinator was also selected, and in this case, this responsibility was brought to the Architectural office team. At the end of this step, drawings were developed based on the available information so far, with two purposes: first, to carry out physical interferences studies among design specialties, and second, to prepare the legal design base. The Schematic Design evaluation cost was conducted with the support of the future contractor.

In order to develop the Basic Design, the coordination meetings occurred with the presence of the contractor representatives and, once, with a subcontractor of building foundations. The approved concepts design detailing brought up several new interferences among design specialties, such as: difficulties in coordinating security with life safety concepts (the first intends to control the accesses, the second intends to liberate them); locations replacement at lower levels to improve the parking flow; how to achieve sustainable performance with architectural and MEP systems design, and how to manage the use of rainwater and reuse of sewage. The technical solution validation of the design specialties and its incorporation to the architectural design constituted this step developed products, which originated the Initial Budget. This budget was the basis for the first phase of the future construction.

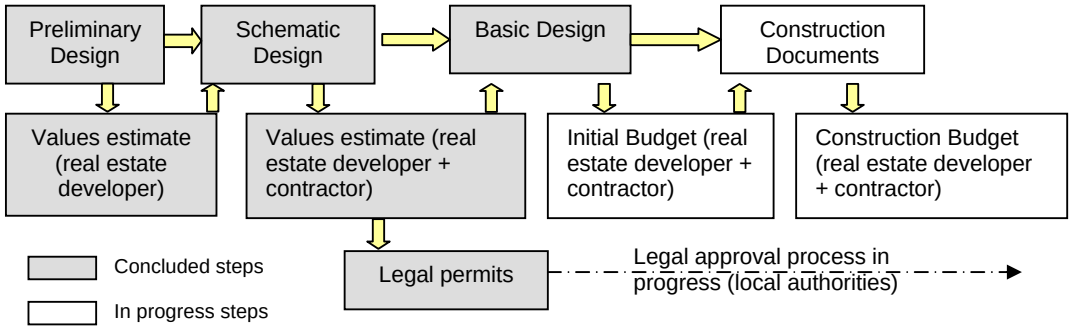


Figure 4: Design Development phase process flow

The design natural detailing continues with the development of the Construction Documents, with which the Construction Budget would be extracted, used as basis to meet the construction and the business performance. Also, the business commercial launching would only occur with the legal permits approval, which has not happened yet. In this study, the design process stands in transition between the Basic Design and the Construction Documents step.

## 5.4 Project team interface management

The team groups were built according to the real estate developer established commercial and contractual relations (Figure 5).

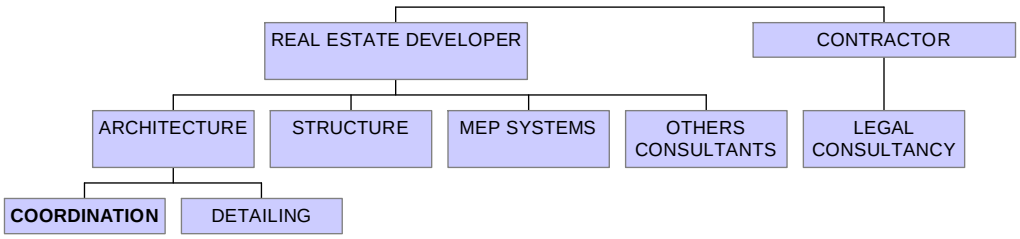


Figure 5: Studied process team groups

The architecture design office, responsible for the design coordination, hired one specific office for the coordination work and another for the design detailing. Facing the client, which was the real estate company, these three players were, in fact, just one, but at least three people should attend meetings to represent this one player. The other design specialties offices had their work scope defined by the client.

A design process facilitation was expected due to the fact that the design coordination was the architecture design office responsibility, since the architecture incorporates the other design specialties main concepts. Nevertheless, the real estate developer had to work in the coordination process as the design contract manager, “splitting” the design specialties offices attention about

design management issues. The real estate developer evident prevailing of the design specialties concepts emphasized this aspect.

Another important point refers to the number of the parties involved during the coordination meetings. In the real estate company team, there were at least three members from the D&C department, one from the CD department and one from the FM department. From the other parties, there was at least one member of the contractor and one or two of each design specialty office. Since the conclusion meetings stand the technical solutions validation for all design subjects, it was possible to observe that the number of 20 or more people was easily achieved during those meetings.

# 6. Critical analysis

## 6.1 Process analysis

The observed process flow phases in the case study allow making a parallel (Figure 6) with the phases mentioned in the literature review (Figure 1). Both consider a Product Conception as an initial phase, in which the briefing is defined; and the following phases are very similar. In this sense, the case study Preliminary Design phase can be considered as the model Product Development; the Schematic Design phase, as the Solutions for Technical Interfaces; the Basic Design and Construction Documents phases, as the Detailed Design; and the Construction Budget as the Post-Design Delivery.

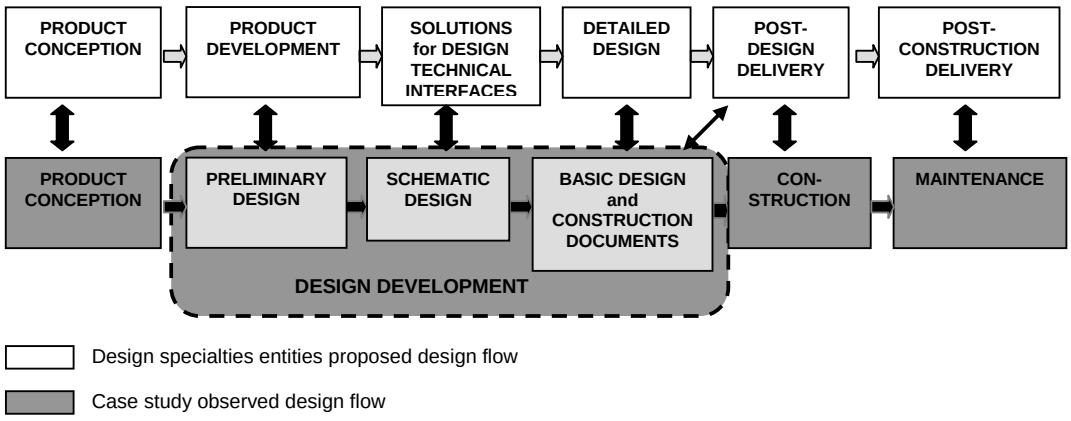


Figure 6: Design flows parallel

Despite the fact that the design phases are essentially in sequence (Figures 3 and 4), it was possible to observe that the real estate developer has intuitively practiced some concepts based on the concurrent design approach, when its process previews all the players attendance to the coordination meetings (contractor, subcontractor, maintenance and operation representatives), even though the number of participants seemed excessive at a first.

## 6.2 Interface analysis

The number of participants attending the coordination meetings has shown to be necessary, so that every player could contribute in the design process. It is possible to say that the way the interface of this process was structured (Figure 5) has limited the coordination autonomy and has contributed to some undesirable effects, such as: a) the real estate developer has had to deal with three different spokespersons to solve coordination and architecture issues, resulting in process efficiency loss; b) there has been a significant design schedule delay as compared to the first established deadlines (three-month delay), in part, due to the coordination office unawareness of the real estate company managing process; c) the coordination office has not effectively performed its expected function, reducing its scope to operational issues (convening meetings, taking meeting notes, drawing schedules).

In order to achieve an effective design management and coordination in the case study, the design coordinator should be closer to the player who happens to dominate the entire process and the specialties design technical information, in this case, the real estate developer. If, in another hypothetic case, the architecture office dominated the design multi-specialties technical issues, the design coordinator could keep being there.

# 7. Conclusion

In the case study, it has been observed that one part of the technical guidelines appears indirectly in the Product Conception briefing and the rest is defined during the following phases. This design process has been typified by the frequent comparison, at the end of each phase and step, of the Product Conception estimated value. This allows two reflections: a) these periodic verifications are important control tools to the process; b) the Product Conception is the phase, before the Architect draws the first sketches, in which the main design technical guidelines have to be already defined, since the economic feasibility established in this phase guides the whole following process.

In effect, those considerations suggest that an office building design guidelines can be split into two main categories: mass plan guidelines and guidelines for the design following process. The first category defines the building contours, its life span and use flexibility. The second category defines how the building will operate and what kind of contingencies it will have to be prepared for (i.e. lack of water or energy, flood, emergency situation). In order to identify the first category guidelines, the following interaction detailing between the Briefing and the Mass Plan steps (Figure 7) is proposed:

1- The site area, zoning regulations and the commercial product (office building standard, renting or selling purposes, using flexibility level) define the building contours and its maximum size;

2- The BOMA[2] area is estimated, which is a reference to the building performance and the base to define the building main areas;

3- The following concepts are defined: core configuration, leasing depth, structural system, HVAC system, raised floor preview or not. These concepts determine the floor-to-floor height, which, in addition to the maximum building area, define its number of stories;

4- Part of the building operation is conceived, in order to estimate the number of elevators and their distribution (low-rise and high-rise, parking shuttle elevators);

5- The typical floor is conceived, with main vertical circulation spaces preview, such as: escape routes, stairs, elevators and HVAC shafts;

6- The need of the previous steps verification is checked (i.e. if the BOMA area keeps profitable, if the mechanical areas are excessive, if there are too many elevators, if the core is disproportional to the typical floor);

7- The building envelope is conceived (which is directly related to the HVAC system definition) and the materials finishing standards;

8- The mass plan is concluded.

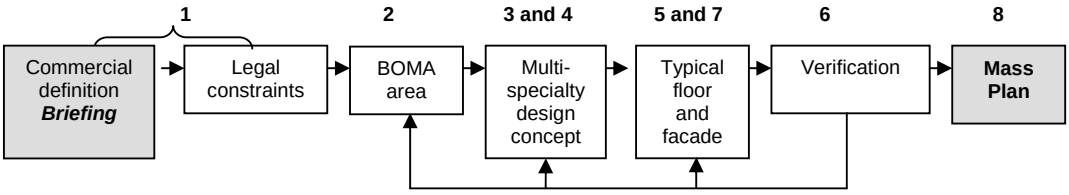


Figure 7: Interaction detailing between Briefing and Mass Plan steps

From this flow, it is possible to infer that it is necessary to dominate the technical concepts of several design specialties beyond architecture (such as: structure, HVAC system, life safety, vertical transportation and facilities management) in the early stages of the office building design phase, which is essentially commercial. In the case of a hypothetical real estate developer, which is looking for process improvements, the implementation of these guidelines can be suggested in the Product Concept phase of Figure 1 proposed model.

[2] Method of floor area calculation used by owners to determine the rentable area in an office building. The method is described in the American norm ANSI/ BOMA Z65.1 (1996).

The implementation of a Product Concept flow similar to the case study is expected, in addition to the initial phase proposed detailing, to facilitate the design process of the office building design and to avoid significant divergences in the entire project process.

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