Implementation Study of Safety's Plan in building

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Abstract

The scope of this research had in consideration the need to analyse the Implementation of Safety's Plans and Health in construction of buildings. It was chosen a building of great dimension, included in the construction of a shopping centre. The fundamental objective of the present research addresses the analysis of the Implementation of Construction Safety Plan and Health in the referred shopping centre. The goal is to verify the anomalies, the duration and, at large, identify the most common mistakes, the related prevention measures and the risks involved in the respective tasks.

Supported by the help of I.D.I.C.T., of I.G.T., of EARTH TECH (responsible for the supervision) and co-ordination of safety and health and of the construction company ECOP it was possible to analyse the Implementation of Safety's Plan and Health. To obtain important information about the inspection of registry plans and prevention of the anomalies, these documents were analysed. It was also observed and identified in situ the safety plan anomalies. From these tasks some preventive measures were proposed taking into account the related risks involved in the execution of the associated tasks.

1. Introduction

This research makes the analysis of the implementation of the construction safety and health plan, of the inspection records and of the prevention of the irregularities during the construction of a shopping centre. The data was obtained from several sources like statistics from official organizations, like building construction companies, like professional associations and like related publications. This analysis intends to verify which are the more common

irregularities and the respective duration leading to the proposal of measures that create an attempt of trying to minimize the probability of the respective occurrence.
The final objective is to know if the implementation of the construction safety plans is applied with the proper criteria and to determine which are the most common mistakes committed during the execution and the respective corrective measures. The irregularities were listed and divided in three groups being the first composed by those already corrected, the second by those in the process of being rectified and the third by those detected waiting for the corrective measure. For a better understanding of the distribution of these types of irregularities it was created a bar chart where each of the errors detected was represented by a bar indicating the date when it was identified and, when applicable, the date it was rectified. The observation started in December 2001, different colour schemes were defined for each different type of error and also for the various types of the degree of seriousness of the irregularity.

2. Procedures, inspection records and prevention

The execution of a building comprises a set of activities where each one has different levels of risk that have to be quantified and to be minimized [1]. To analyse the existent risks in the execution of each one of the tasks in a clear and brief mode it was necessary to use a complete set of inspection records and of the adopted corrective measures. The records are classified in three types like inspection procedures, inspection records and corrective actions [1]. In table 1 it is presented an example of a type of inspection procedure and prevention accompanied by the respective detailed description of the related construction task.

Table 1: Type of inspection procedure and prevention [1]

Inspection procedures and prevention				N.º	P.
Owner of the work		Representative			
Work					
Designer		Coord. Safety (design)			
Engineer		Coord. Safety (execution)			
Construction task / Element construction code					
Checking/tasks	Risks	Reference documents	Prevention Actions	Inspection frequency	

After the use of the inspection records to control the analysis of the scheduled construction tasks a record is produced in an adequate model and an example is presented in table 2. With the production of these records the goal is to draw the attention of the contractor to the responsibility of the implementation of the respective corrective measures [1].

Table 2: Model of a record of Inspection and Prevention [1]

RECORD OF INSPECTION AND PREVENTION		N.º	P.
Owner	Representative		
Work			
Contractor			
Construction task / Element of construction code			

Place/Activity							
Verification / Activity		I control					
		Contractor: Date: Signed:	Contractor: Date: Signed:				
		Supervision: Date: Signed:	Supervision: Date: Signed:				

2.1 Record of irregularities and of corrective measures

The errors appear whenever, for certain tasks, the risk of an accident exists. This record is made as a record of irregularity instead of inspection record and prevention. When this situation occurs, according to the contract made between the owner and the contractor, there is a withholding of 0,5% of the monthly invoice per each of the non-rectified irregularity [2]. This withholding is maintained until the contractor corrects the error.
The record of irregularities aims at improving the construction safety level and, therefore, deserves a thorough analysis allowing an insight of the effects of the errors recording and of the respective corrective measures. Another important benefit is the identification of errors that were not identified in the original construction safety plan. An example of this type of recording is in table 3.

Table 3: Record of irregularity and of preventive action [1]

Record of Irregularity and of Preventive Action		N.º	P.
Owner	Representative		
Work			
Contractor:			
Construction task / Element of construction code			
D Description of the irregularity			
Location:			
Documents of Reference:			
Contractor: ____ / _____ / _____	Supervision: ____ / _____ / _____		
Description of the Preventive Actions:			
To correct until: ____ / _____ / _____			
Contractor: ____ / _____ / _____	Supervision: ____ / _____ / _____		
Verification of the Preventive Measures:			
Contractor: ____ / _____ / ____	Supervision: ____ / _____ / _____		
Coordinator of safety and health: ___/___/____	Manager: ____ / _____ / _____		

3 Most frequent anomalies

The analysis of the anomalies in the construction safety implementation since the beginning of the research in 6 December 2001 allowed predicting the probability of occurrence of each one based on the records and on the frequency of similar construction works. The compilation of these anomalies is presented and resumed in table 4.

Table 4: Most frequent anomalies

Description	N.º of Times
Incomplete work platforms	16
Access stairways without conditions of safety	15
Lack of body rails	15
Lifting loads with the crane with the inadequate devices to the type of loads	8
Workers without using the equipment of individual protection	7
Inadequate auxiliary means of lifting	5
Movement of suspended loads in incorrect form	5
Lack of signals on site	5
Lack of sound signals behind in the shipyard equipments	7
Steel bars without cap protection	4
Incorrect storage of materials	4
Access to the crane without conditions of safety	4
Threads and electric cables risking cuts and crush	4
Cabin of distribution of electrical energy unprotected	4
Incomplete scaffolds	3
Incorrect use of the equipment of removal of loads	3
Lack of inspection procedures and prevention of the constructive methods	3
Bedrooms without hygienic conditions	2
Disarranged shipyard	2
Workers' passage in areas where there is the danger of land slides	2
Lack of first aid nurse nomination and delivery of related documents	2

4 Correction of anomalies

Analysing the anomalies of longer duration, some conclusions can be reached like the length of time needed for the application of the preventive measures or like the rate of occurrence of the following anomalies. Figure 1 shows that the anomalies of longer duration that have larger meaning are the access stairways without safety conditions with a rate of 30%, the inadequate work platforms with 21%, followed by the inadequate displacement of materials with an occurrence of 14%.

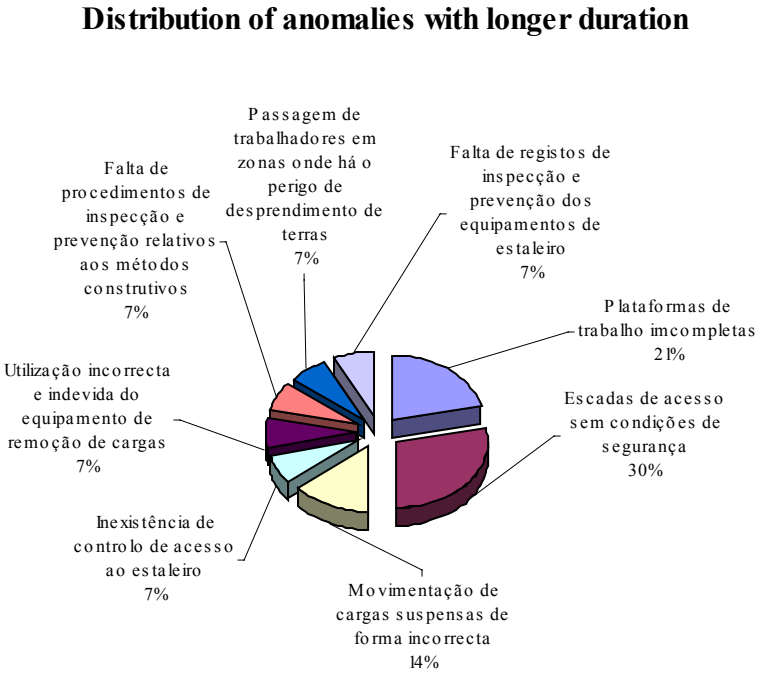

Figure 1: Percentage of anomalies detected

The analysis of figure 2 indicates that the duration of inadequate access stairs, of improper work platforms, of lack of inspection records and of lack of records

of site equipments is about three hundred days. Other anomalies, like improper transportation of materials, lack of control of site access and risk of landslides, are within an interval of fifty to seventy days.

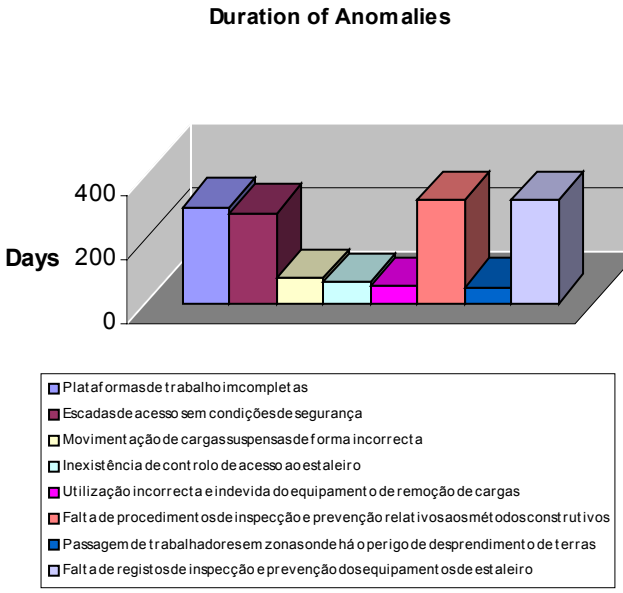

Figure 2: Number of days of anomalies

A third analysis made was the relative distribution of anomalies with longer duration. Inadequate access stairways presented a rate of 19%, followed by the lack of proper documentation about subcontractors with 18% and the others presented an average of 9%.

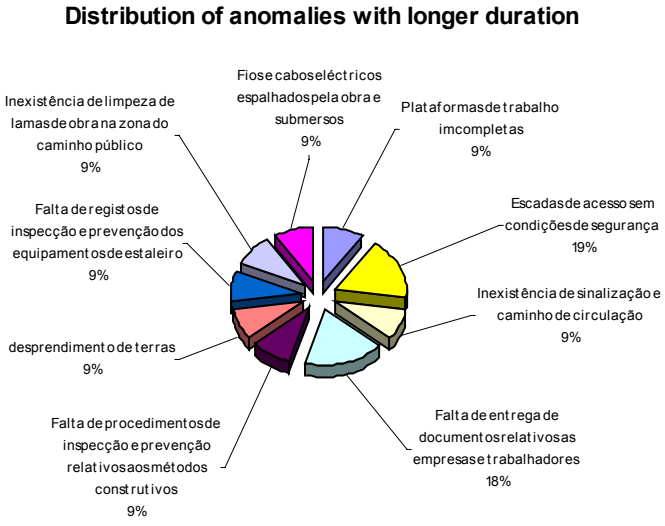

Figure 3: Relative percentage of anomalies with longer duration

In figure 4 the anomalies that were detected were corrected after a considerable period that varies between nine and eleven months. The longer are the lack of inspection procedures for the tasks and for the equipments, lack of documents

from subcontractors, incomplete work platforms, stairways without safety conditions and inexistence of road and circulation signals.

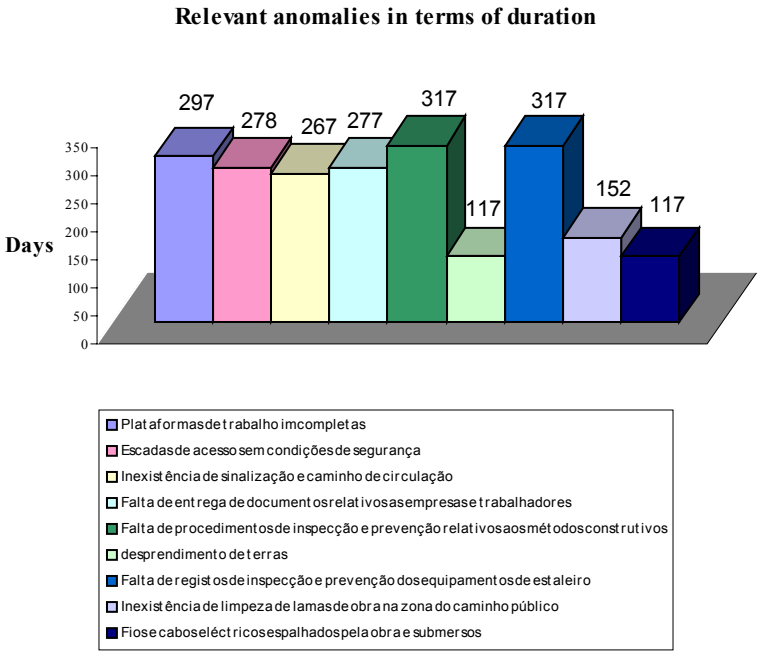

Figure 4: Number of days of uncorrected anomalies

5 Difficulties in the implementation of safety plan

Since the publication of the construction safety legislation in 1995 [3] other related legislation was produced. The main obstacle in implementing the construction safety plans is that the contractor and owner, in general, perceive safety as a cost and not as a benefit. It is shown through research works [4], that safety in construction reduces the overall costs as shown in table 5.

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Table 5: Relationship of expected values of costs of construction accidents [4]

Point of view	Economical Advantages
Construction company	3
Insurance company	21
Social	5

Analysing the costs of expected accidents presented in table 5 one concludes that the construction company would save about three times what it would spend in the implementation of the safety plan if an accident of average seriousness occurs. The insurance is saving more than twenty one times the insurance premium if no accident occurs and in social terms the savings is about five times. It is worth investing in effective prevention when looking at costs that are easily accountable since these values do not consider other collateral damages that can not be quantified in economic terms.

Other obstacles to effective safety implementation are the lack of strategy towards safety in construction companies, absence of adequate worker training, lack of proper culture of safety and inclusion of safety as a traditional item in the budget.

6 General conclusions

After having analysed the anomalies one of the conclusions is that it takes time to correct the anomalies even with the withholding of the respective fines. Another aspect is that the correction of some anomalies depends of the rectification of others. A third main conclusion is that the prediction of anomalies through the analysis of previous records is an efficient tool to draw the attention to the greater risks of possible accidents. National statistics of the construction sector show that a large number of fatal accidents result from falls [5, 6]. These values are represented in figure 5 and presents values for erection of scaffolding, roof work, floor gap, floor opening, stairs, scaffolds/platforms and others.

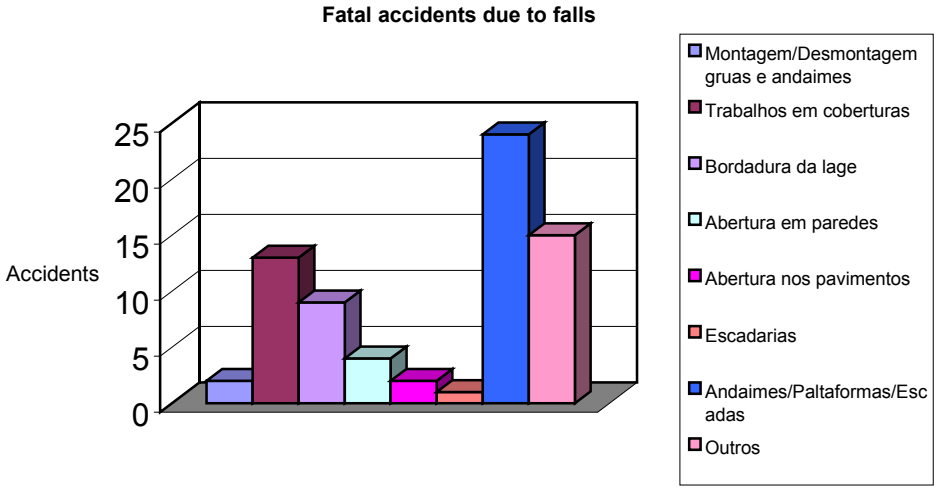

Figure 5: Fatal accidents due to falls in 2000 [3]

In the two hundred and twenty anomalies other common errors were the lack of individual equipment and of acoustic signals in moving equipment. Also some repetition of anomalies were found especially in the most frequent ones. More research on other construction works is needed to validate some of the conclusions found in this work.

8 References

[1] Alves Dias, L.M e Santos Fonseca, M. - *Construção Civil, Plano de Segurança e de Saúde na Construção*, I.D.I.C.T., I.S.T., Lisbon, November 1996.
[2] Earth Tech - *Plano de Segurança e Saúde da obra do centro comercial Douro Center*, Porto, 2000.
[3] MESS – Ministério do Emprego e da Segurança e de saúde - *DECRETO LEI n.º 155/95*, DR - I Série A, 1 July 1995.
[4] Dos Reis, Cristina - *Análise Económica da Segurança na construção – Estudo de Alguns Casos,* dissertation of Master of Construção de Edifícios, Faculdade de Engenharia da Universidade do Porto, Porto, January 1999.
[5] I.G.T. – *Relatório Anual de Actividades de 2000*, Lisbon, 2000.
[6] Dos Reis, Cristina Madureira; Soeiro Alfredo, *Analysis of Accidents scenario in construction due to safety framework change*, International Conference on Costs and

Benefits to Quality and Safety and Health in Construction, Barcelona, Spain, October 2001.