QUALITY ASSURANCE IN FLOORING INSTALLATIONS

EXAMPLE OF THE PUBLIC SECTOR COMPANIES' HEAD OFFICE BUILDING IN MEDELLIN - COLOMBIA

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MEDELLÍN - COLOMBIA

1. INTRODUCTION

Our industry is perfectly aware that a customer does not decide what to purchase by thinking of ceramic tiles packaged in boxes, meeting strict quality parameters assured by modern production facilities, but that the decision to use tile is based on images of attractively decorated finished spaces used for daily living, meeting spatial needs and fulfilling general building functions.

It is from this viewpoint that the concept of quality in ceramics as a building finish is to be understood, assured and controlled, which goes quite beyond the product (tile) itself. It should be viewed as quality in a finishing system, as a total covering, which ranges from the surface specification stage and subsequent tile installation to the maintenance and daily cleaning process of the space involved.

Using ceramics is thus an integral decision, which involves knowledge of the prerequisites for installation, the installation itself, and the subsequent processes that assure the success of the ceramic tiling in service, while also providing a wealth of aesthetic possibilities and functional advantages compared to other types of materials.

The decision was taken, based on this integral specification criterion, to install porcelain tile in one of the most representative projects of recent years in the public

building sector in South America, the Public Sector Companies' Head Office Building in Medellín, Colombia (1994-1996). This involved the installation of 70,000 m² (754,000 sq. ft) of porcelain tile flooring for offices, open areas and terraces.

Besides its magnitude as a result of the size of the construction work, the decision was also an innovation in the type of finish, as it involved a relatively new market of ceramic applications in public buildings, a domain traditionally reserved for carpeting and terrazzo tiles, in which porcelain tile had appeared only about a year before. This was moreover a market with a relatively unskilled labour force, accustomed to traditional tile fixing methods, and an empirical quality control method in the finishing operations performed in building, directed at finding installation errors rather than preventing them.

This meant a challenge for the Colombian ceramic market, suppliers and contractors, faced with a project that from the very outset required meeting world class quality standards, not just in materials but also in methods. The company, Empresas Públicas de Medellín, required the contractor to set and comply with a quality system in the installation, based on carefully planned, written procedures, which were to be effective and allow ensuring conformity of the work to plans and specifications, meeting 19 of the 20 functions set out in standard NTC-ISO 9002-94.

As part of the contractor's profile, the client requested ongoing assessment of the quality system from the start of the project, to be conducted by the Instituto Colombiano de Normas Técnicas (ICONTEC), with a contractually stipulated requirement of scoring 90 out of 100 points. This was thus the first company in the Colombian building industry to be asked to implement a total quality assurance system.

We should like to share this experience with the industry, describing the planning, monitoring and control tools, applied to each and every activity involved in the installation. These operations look simple, but from a quality assurance perspective and for any medium or large project they take on such an importance, that on them depends the success of ceramic tiling as an alternative covering material in building construction.

2. DESIGN ELEMENTS THAT AFFECT FLOORING END QUALITY

2.1. PROJECT DESCRIPTION

Head Office Building for the public sector service companies in Medellín Colombia.

Areas tiled with porcelain tile:

Main office:	60.000 m²
Common services:	3.000 m²
Open areas and terraces	5.000 m²
Other areas:	2.000 m²
Total tiled areas:	70.000 m²

2.2. WORK PHILOSOPHY

- Ongoing improvement

- Prevention instead of correction.

- Analytical study and verification of alternatives that ensure optimisation and quality of materials, processes, costs, operating times, and end products.

2.3. DESIGN PARAMETERS

- A module of 0.45 linear metres was adopted horizontally and vertically, to which all the measurements in the building were referred. This was later to facilitate the modulation of the ceramic flooring, entailing great advantages in optimising the ceramic material, yield and ease of installation.
  The architectural modulation facilitated the classification of the work, as will be shown below, allowing an in-line installation system to be implemented from the outset, which was reproducible throughout the building.

- Visual transparency: Each storey of the 6000 m^2 building was conceived under the open office system, creating spaces with angles of vision and floor areas of over 100 m in length.
  This required perfectly level floors. The control parameter was maximum deviations of 3 mm over distances of 3 m in a straight line, carried out with topography instruments when pouring and matching the mortars.
  Moreover, on having long spaces, the lines formed between the tiles had to be perfectly straight. To achieve this, guidelines were set out on the floor using topographic control, at 3.60 m spacings, each with a length of 108 m in one direction, as well as 3.60 m x 72 m in the other, forming a perfect control grid. The installations were carried out in each area on this grid and maximum admissible tolerance was 1 mm.

- Spans of great length. There were spans of up to 38 m in a straight line, which produced deflections that were in no way to be visually transmitted to the immense ceramic flooring areas.

2.4. FINISHES

Besides meeting architectural and decoration design parameters, the specification of the finishes was guided by the following criteria:

- Durability in public service.
- Efficient functioning of the office system.
- Special noise control.
- Ease of maintenance
- Environmental quality.

Three finish flooring options were assessed: carpets, polished cement tiles, and porcelain tile. This last material was chosen owing to its advantages in durability, ease of installation, and maintenance in daily use. The quality parameters used to choose the suppliers of the flooring system (tile, adhesive mortar and grout) are set out below.

2.5. STRUCTURAL SYSTEM

- Reinforced, prestressed concrete:
- Distribution of the relieving members and ribs in 11.8 ft x 5.90 ft modules.

and maintain, with a 5-year guarantee of the whole flooring system, led to specifying porcelain tile, replacing traditional materials in our market such as carpeting and polished terrazzo.

The quality criteria used to select the suppliers were as follows:

- Conformity to product standards:
  Porcelain tile: European standards EN 98 to 105, 176 and 202.
  Adhesive mortar: standard ANSI 118.4
  Grout: standard ANSI 118. 6
  Joint sealant: standard ASTM C920

- Quality certification ISO 9001

- Experience verified in similar works (in magnitude, traffic, quality control), which were visited and assessed by the Technical Management of the Consortium.

Furthermore, supplementary services were also required besides the supply, such as:

Participation in planning installation methods.

Training and constant monitoring of the tile fixers.

A resident engineer at the work site throughout the whole tile installation process.

Analysis of the resistance to peeling at the site and in the laboratory, with sporadic samplings.

Five Year Guarantee, including tiling, installation materials and labour costs.

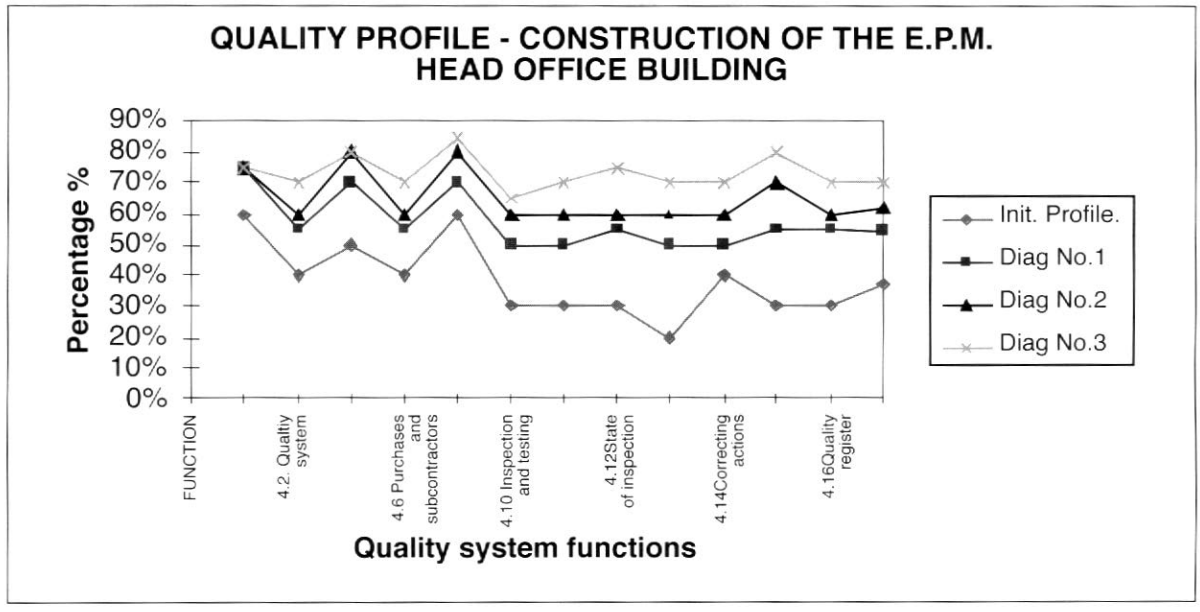
After rating suppliers and materials, Marazzi porcelain tile was chosen, together with the Laticrete fixing system. Both companies are represented in Colombia by the Corona Organisation. The materials chosen were:

- Porcelain tile, size 11.81 x 11.81 in., in different matt and glossy models.
- Adhesive: Ready-mixed mortars with Portland cement and latex, for thin and thick set tile installation.
- Grout: For 5 mm spacings between tiles. Ready-mixed mortar with Portland cement and latex.

3. ELEMENTS OF THE QUALITY SYSTEM APPLIED TO THE FLOOR TILE INSTALLATION

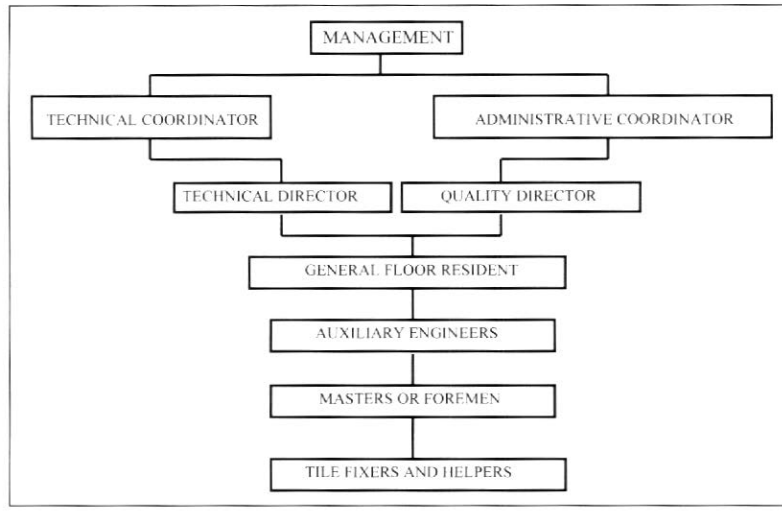
The client wanted the Contractor to establish and maintain a quality system based on written procedures, which was to be efficient and ensure conformity of the work with plans and specifications, fulfilling the functions set out in standard NTC-ISO 9002-94.

During the construction, the quality system of the Consortium (CONVEL-CONINSA) was assessed on 4 occasions by the Instituto Colombiano de Normas Técnicas, with a contractual requirement of scoring 90 points out of 100, obtaining very positive results. This was the first company in the Colombian building industry, which was asked to implement a quality assurance system.



3.1. MANAGEMENT RESPONSIBILITY

The project was conducted within the framework of the policies and quality objectives of the building company, which forms part of the company's Quality Manual. Therefore, the administrative structure of the project was designed so as to assure conformity to the quality assurance requirements set by Management.



3.2. IDENTIFICATION AND TRACEABILITY

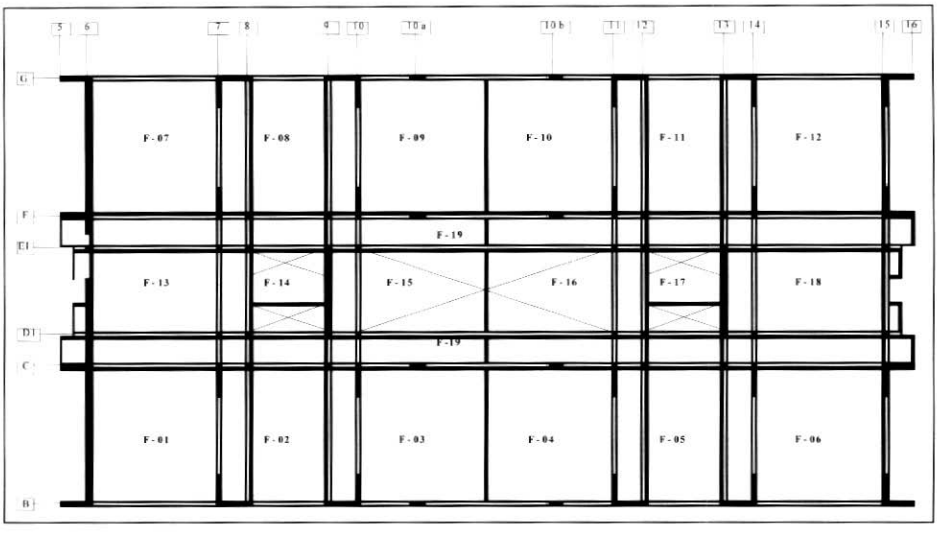
3.2.1. IDENTIFICATION

Using a harmonised language, this element of the system allowed identifying all the parts of the project. To attend to the installation of 70,000 m^2 of porcelain tile, it was necessary to have a simple, ordered, logical schematisation that could be systematically used throughout all the storeys to be tiled.

A standard plan of the building (5.500 m^2) was used for this purpose, which was subdivided into approximately equal areas, so that installations could take place

simultaneously in different areas, leaving a central corridor for traffic movement and allow closing the installation in an organised way, preventing traffic across already tiled areas, until 48 hours had passed after grouting the joints.

This led to 18 work fronts, each dealing with about 324 m².

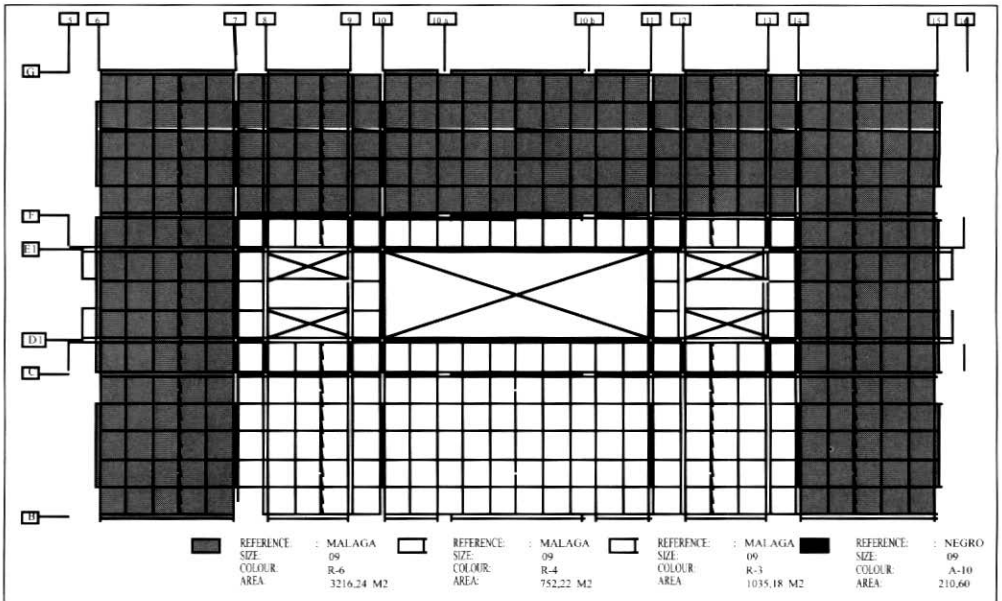


3.2.2. TRACEABILITY

This allowed identifying and locating with certainty the variables involved in a project such as: materials, methods used, labour, etc.

For example, in the project it was possible to establish where each batch number of adhesive mortar was used, references and shades of the porcelain tile, which worker installed each square metre, and so on.

As an example, the following graphic shows the traceability of porcelain tile.



DISTRIBUTION OF COLOURS AND SIZES PER STOREY

3.3. PROCESS CONTROL

Six months before the installation, work was started on planning the variables (93 in all) which would be involved and needed to be controlled.

As part of the planning, all the installation procedures and all related activities were documented, such as:

- Reception of raw materials (ceramic tile, adhesive, and joints)
- Despatching materials to each work front
- Horizontal and vertical transport
- Cutting tiles
- Preparation of the adhesive and grouting material
- Tile installation
- Grouting

Various examples are presented in the following of how some of the most important variables were controlled.

3.3.1. CUTTING TILE

Given the floor design, the location of the expansion joints and dimensions of the format to be used (30 cm x 30 cm), it was necessary to cut 18,000 m^2, i. e. about 200,000 tiles. It was therefore indispensable to design and ensure a procedure that would facilitate and optimise the process.

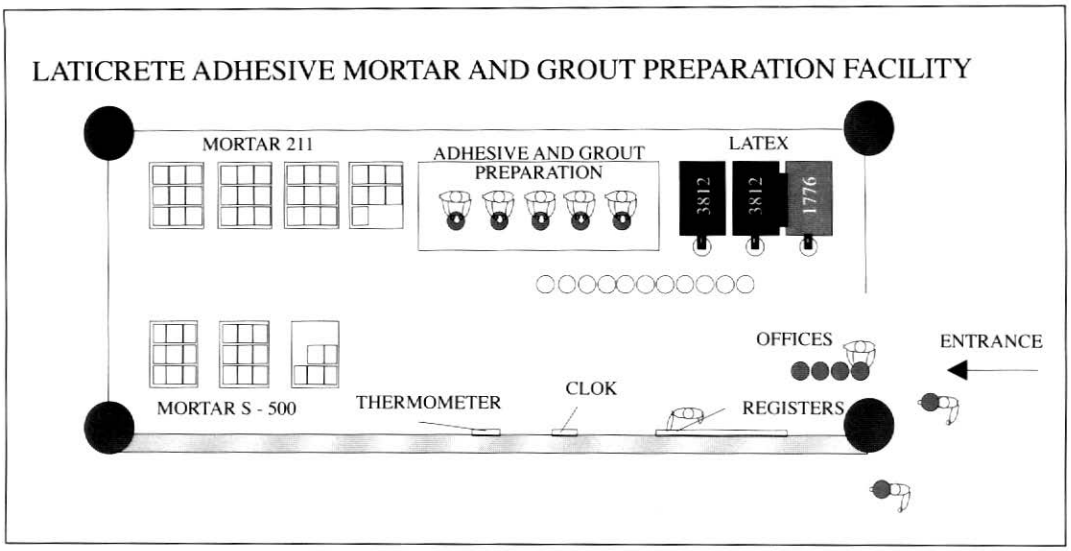
This was done by setting up a machining station on the first floor of the building, whose task it was to supply all the cut tiles, packed and coded, so that they were delivered exactly at the work front where they were to be installed. This also allowed classifying the cuts, raised productivity, reduced scrap, and yielded cleanliness and order as a result of not producing dust at the work front.

It was decided to do the cutting with hand cutters, as a result of the better finish and greater yield. Thus, 6 manual cutters of the Rubi TS-60 type were placed and work was started 3 months before commencing with the installation.

3.3.2. ADHESIVE AND GROUTING MATERIALS

One of the greatest challenges was to ensure the preparation of the adhesive mortars and grouting materials, so that in the more than 800 tons of mixture used in the project, proportioning conditions, mixing time and consistency would remain unchanged.

To do this, an in-line production process was designed, set up as mixing facility on all the storeys of the building. Control formats were implemented such as: Date and production time, mixing time, proportions, r.p.m of the mixers, consistency, at which work front the product was used, etc. It should be noted that this register was kept for each and every 5-gallon batch charge that was prepared.

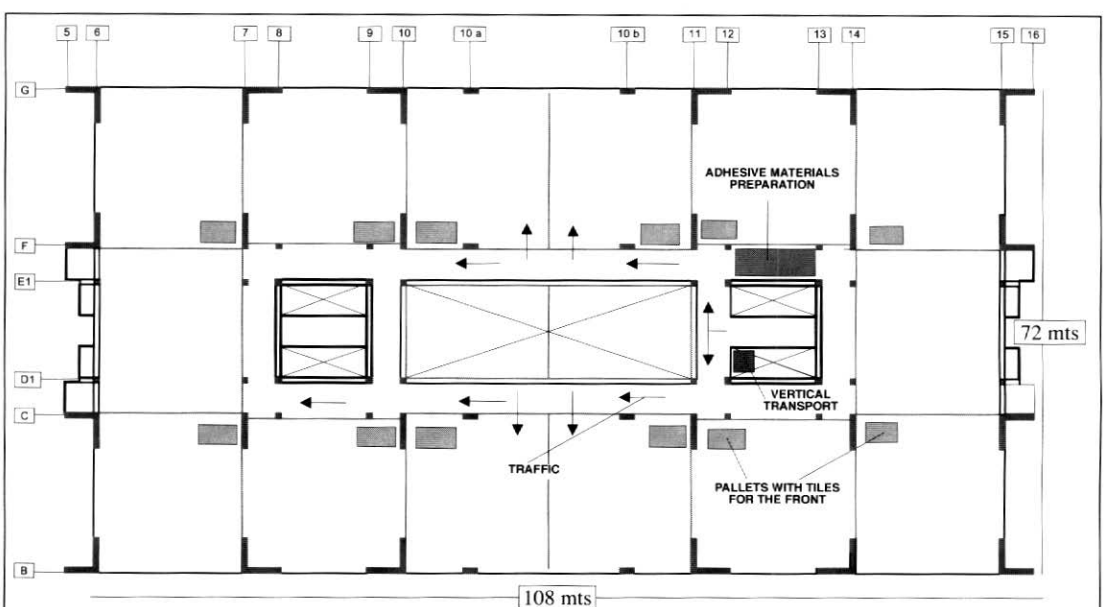


3.3.3. PREOPERATIONAL ACTIVITY

Before starting the tile installation on each storey, the floor surface was prepared as follows:

Topographical marking
Provisional closing of fronts
Vertical and horizontal transport of tile to each front according to the modulation.
Assembly of the mortar and grout preparation facility
Cleaning the fronts
Tracing lines.

This was all done 2-3 weeks before commencement. After concluding the preoperational activities on the floor involved, the installation was started according to the route set out for this purpose.



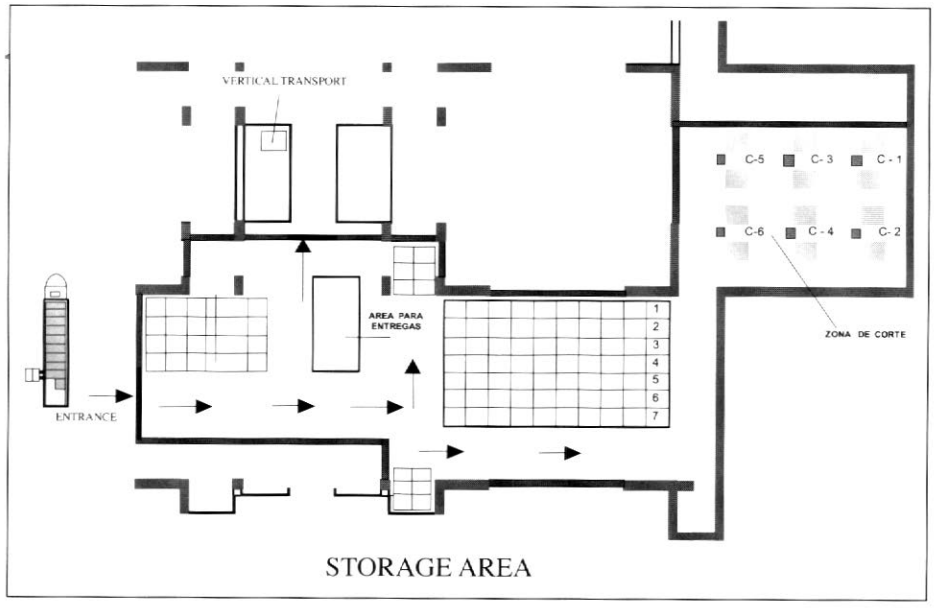
FLOOR ORGANISATION BEFORE INSTALLATION

3.4. STORAGE AND TRANSPORT OF MATERIALS

As all the flooring materials were imported from Italy and the US, it was necessary to ensure satisfactory supply. It was decided to keep 45,000 m^2 tile stored prior to installation start. Similarly, a permanent stock of adhesives was held for 6000 m^2.

In view of these large quantities, the processes involved in loading and unloading, storage and internal transport of materials were also included in the quality assurance process, documenting the following procedures:

- Storage location and distribution.
- Storage method.
- Horizontal and vertical transport system requirements.
- Reception, transport and delivery to the floors.
- Stockpiling systems, transport and movement routes on the floors.
- Kardex system.



STORAGE AREA

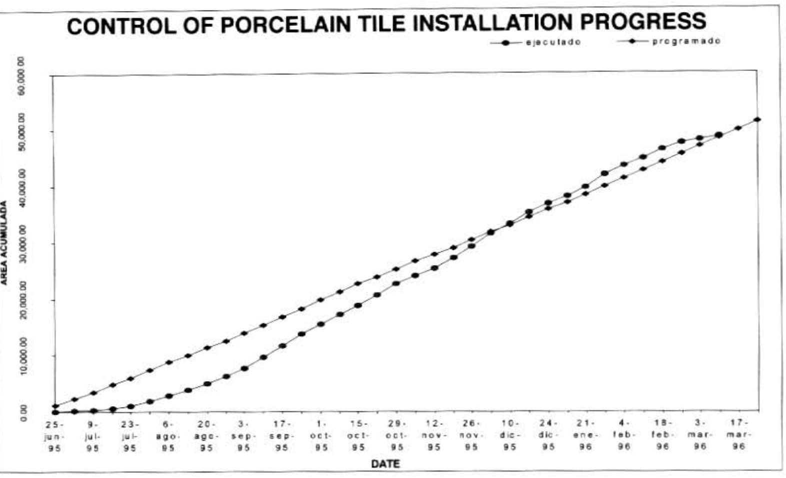
3. 5. QUALITY REGISTERS

These registers and controls were the basis of any decision of a technical or administrative nature. In most cases they were of a preventive nature, since the information system allowed trends to be identified, such as: behaviour of the materials used, labour (quality, yield, etc.), effect of the behaviour of the structure on the floor system, and in general all the variables that intervened in the installation process.

Examples of some of the registers kept in the installations are:

Despatch of materials, Piece production order, Adhesive mortar and grout production, Yield in tile installation, Cumulative tile installation areas, Correcting and preventive actions. Colour, size and quantity of tile installed per storey.

WEEK			CUMULATIVE INSTALLED TILE	PROGRAMMED CUMULATIVE
19-jun-95	a	25-jun-95	24.00	1,147.00
26-jun-95	a	2-jul-95	127.04	2,294.00
3-jul-95	a	9-jul-95	289.12	3,441.00
10-jul-95	a	16-jul-95	590.98	4,874.75
17-jul-95	a	23-jul-95	1,013.80	6,021.75
24-jul-95	a	30-jul-95	1,801.72	7,455.50
31-jul-95	a	6-ago-95	2,796.67	8,889.25
7-ago-95	a	13-ago-95	3,915.26	10,036.25
14-ago-95	a	20-ago-95	5,006.69	11,470.00
21-ago-95	a	27-ago-95	6,290.81	12,617.00
28-ago-95	a	3-sep-95	7,740.89	14,050.75
4-sep-95	a	10-sep-95	9,707.84	15,484.50
11-sep-95	a	17-sep-95	11,732.09	16,918.25
18-sep-95	a	24-sep-95	13,846.28	18,352.00
25-sep-95	a	1-oct-95	15,526.40	19,785.75
2-oct-95	a	8-oct-95	17,347.52	21,219.50
9-oct-95	a	15-oct-95	18,922.53	22,653.25
16-oct-95	a	22-oct-95	20,669.16	23,800.25
23-oct-95	a	29-oct-95	22,774.98	25,234.00
30-oct-95	a	5-nov-95	24,128.76	26,667.75
6-nov-95	a	12-nov-95	25,481.19	27,814.75
13-nov-95	a	19-nov-95	27,304.31	28,961.75
20-nov-95	a	26-nov-95	29,234.57	30,395.50
27-nov-95	a	3-dic-95	31,598.78	31,829.25
4-dic-95	a	10-dic-95	33,320.12	32,976.25
11-dic-95	a	17-dic-95	35,219.27	34,410.00
18-dic-95	a	24-dic-95	36,853.49	35,843.75
8-ene-96	a	14-ene-96	38,165.24	36,990.75
15-ene-96	a	21-ene-96	39,760.85	38,424.50
22-ene-96	a	28-ene-96	42,056.30	39,858.25
29-ene-96	a	4-feb-96	43,559.48	41,292.00
5-feb-96	a	11-feb-96	44,841.27	42,725.75
12-feb-96	a	18-feb-96	46,477.38	44,159.50
19-feb-96	a	25-feb-96	47,609.46	45,593.25
26-feb-96	a	3-mar-96	48,201.57	47,027.00
4-mar-96	a	10-mar-96	48,751.11	48,460.75
11-mar-96	a	17-mar-96		49,894.50
18-mar-96	a	24-mar-96		51,328.25
25-mar-96	a	31-mar-96		52,188.50



AVERAGE INSTALLATION	
PROGRAMMED	182.48
INSTALLED	183.97

INSTALLATION PROGRESS

Control of adhesive mortar. Control of installation yields.

Fronts no: 1, 6, 7 and 12 MODULATION
MODULE no: 15
AREA MODULE: 12.96 M2

3	2	2	2	2	2	2	2	2	2	2	3
2	1	1	1	1	1	1	1	1	1	1	2
2	1	1	1	1	1	1	1	1	1	1	2
2	1	1	1	1	1	1	1	1	1	1	2
2	1	1	1	1	1	1	1	1	1	1	2
2	1	1	1	1	1	1	1	1	1	1	2
2	1	1	1	1	1	1	1	1	1	1	2
2	1	1	1	1	1	1	1	1	1	1	2
2	1	1	1	1	1	1	1	1	1	1	2
2	1	1	1	1	1	1	1	1	1	1	2
2	1	1	1	1	1	1	1	1	1	1	2
3	2	2	2	2	2	2	2	2	2	2	3

PIECE No.	SIZE	QUANTITY	REFERENCE
1	29.9 x 29.9	100	MALAGA
2	29.9 x 26.8	40	MALAGA
3	26.8 x 26.8	4	MALAGA
		144	

Concrete colour washed granite
Joint CTC Joint 9.5 mm.
Joint CTC Edge
Slab edge
Trim
Construction joint 6 mm.

Joint	15	Total
CTC Joint	7.20	7.20
CTC Edge	0.00	0.00
•		7.20

MODULATION FOR 3.60 x 3.60 m MODULE

Fronts no: 2, 5, 8 and 11 MODULATION
MODULE no: 8, 13 and 18
AREA MODULE: 10.30M2

8	2	2	2	2	2	2	2	2	8
5	1	1	1	1	1	1	1	1	5
5	1	1	1	1	1	1	1	1	5
5	1	1	1	1	1	1	1	1	5
5	1	1	1	1	1	1	1	1	5
5	1	1	1	1	1	1	1	1	5
5	1	1	1	1	1	1	1	1	5
5	1	1	1	1	1	1	1	1	5
5	1	1	1	1	1	1	1	1	5
5	1	1	1	1	1	1	1	1	5
5	1	1	1	1	1	1	1	1	5
8	2	2	2	2	2	2	2	2	8

PIECE No.	SIZE	QUANTITY	REFERENCE
1	29.9 x 29.9	80	MALAGA
2	29.9 x 26.8	16	MALAGA
5	29.9 x 27.3	20	MALAGA
8	27.3 x 26.8	4	MALAGA
		120	

Concrete colour washed granite
Joint CTC Joint 9.5 mm.
Joint CTC Edge
Slab edge
pa Trim
Construction joint 6 mm.

Joint	8	13	18	Total
CTC Joint	3.00	3.00	0.00	6.00
CTC Edge	0.00	0.00	0.00	0.00
				6.00

MODULATION FOR 3.60 x 3.60 m MODULE

ADHESIVE MORTAR AND GROUT PRODUCTION CONTROL

F - 11 TIME (DD/MM/AA) **02 / 09 / 95**

No.	TIME	No. Measures MORTAR	No. Measures LATEX	REMARKS
1	7:25	16	5.33	Ceramic adhesive
2	7:30	16	5.33	Ceramic adhesive
3	7:40	16	5.33	Ceramic adhesive
4	7:50	16	5.33	Ceramic adhesive
5	8:35	16	5.33	Ceramic adhesive
6	8:45	16	5.33	Ceramic adhesive
7	8:50	16	5.33	Ceramic adhesive
8	8:55	16	5.33	Ceramic adhesive
9	9:10	16	5.33	Ceramic adhesive
10	9:35	16	5.33	Ceramic adhesive
11	9:40	16	5.33	Ceramic adhesive
12	10:25	16	5.33	Ceramic adhesive
13	11:05	16	5.33	Ceramic adhesive
14	12:00	16	5.33	Ceramic adhesive
15	12:05	16	5.33	Ceramic adhesive
16	12:15	16	5.33	Ceramic adhesive
17				
18				
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34				

CONSORCIO CONVEL - CONINSA

PORCELAIN TILE INSTALLATION YIELD CONTROL

DATE	STOREY	FRONT No.	INSTALLED AREA	ADHESIVE MORTAR CONSUMPTION	FRONT	GROUTING AREA	GROUT CONSUMPTION
20-nov-95	**53.10**	1	73.44	15.18	4	53.37	0.73
		2	0.54	19.36	9	89.64	0.65
		3	25.74	18.41	10	124.2	0.73
		5	48.42	14.39	12	129.24	0.61
		7	17.46	17.56			
		8	20.7	16.15			
		11	2.7	16.13			
		18	66.78	14.84			
21-nov-95	**53.10**	1	102.24	16.36	7	50.76	0.64
		2	76.86	13.05	9	106.92	0.73
		3	25.92	15.06	10	62.1	0.85
		5	53.91	13.95	11	49.68	0.66
		7	30.24	14.75	12	62.46	0.42
		11	5.4	15.49			
		13	114.03	14.91			
		18	61.2	14.11			
22-nov-95	**53.10**	1	99.18	14.77	4	76.32	0.86
		2	57.15	14.63	9	63.72	0.83
		3	25.92	15.06	11	112.5	0.7
		5	60.21	14.35			
		7	27.9	15.55			
		11	10.62	15.74			
		13	78.93	16.95			
		17	31.23	15.17			
		18	43.83	16.53			
23-nov-95	**53.1**	1	43.92	10.39	4	60.75	0.86
		2	15.84	19.36	7	128.34	0.58
		3	33.3	15.07	8	99.18	0.59
		5	62.91	13.73	11	76.59	0.86
		7	14.94	14.11			
		11	7.92	21.12			
		13	76.77	13.79			
		14	63.99	17.15			
		18	10.44	15.5			
		19	21.6	11.61			

CONSORCIO CONVEL - CONINSA
EPM HEAD OFFICE BUILDING
FINISHES

CONTROL OF PORCELAIN TILE INSTALLED AREAS

DATE DAY	DATE MONT	STOREY	INSTALLED AREA M2	CUMULATIVE AREA M2	WEEKLY AREA M2
8	NOV	**53.10**	202.50	202.50	
9			387.63	590.13	
10			284.40	874.53	
11			165.24	1039.77	1039.77
14	NOV	**53.10**	282.33	1322.10	
15			452.79	1774.89	
16			416.70	2191.59	
17			345.15	2536.74	
18			140.40	2677.14	1637.37
20	NOV	**53.10**	254.70	2931.84	
21			469.80	3401.64	
22			434.97	3836.61	
23			258.57	4095.18	
24			128.97	4224.15	
25			34.11	4258.26	1581.12
27	NOV	**53.10**	105.48	4363.74	
28			57.33	4421.07	
29			21.60	4442.67	
30			43.92	4486.59	
1	DIC		41.31	4527.90	
2			7.74	4535.64	277.38

CONSORCIO CONVEL - CONINSA

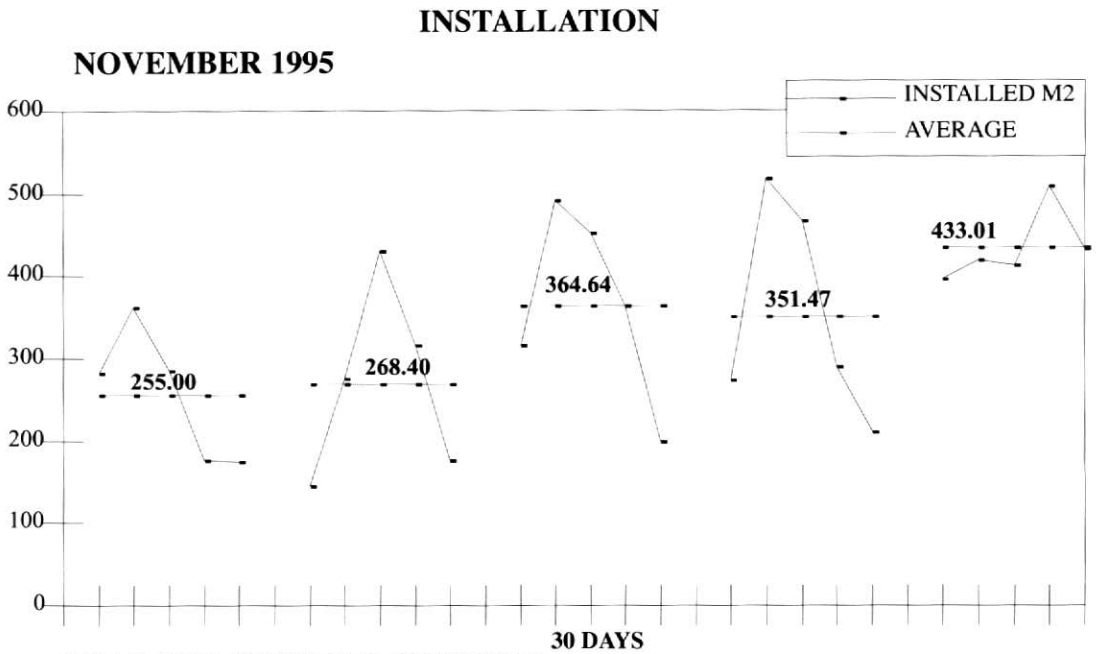
PRODUCTION ORDER FOR PORCELAIN TILE PIECES

DATE: 14/08/96

REFERENCE:MALAGA
SIZE: 09
COLOUR: R-6

STOREY	FRONT No.	MODULE No.	PIECE No.	QUANTITY	SPACING	CUTTING
35.1	1	1,2,3,4,5,6,7	1	2580	2580	
		8,9,10,11,12	2	970	970	970
		13,14,15,16,	3	88	88	89
		17,18,19,20	11	18	18	18
		21,22,23,24	12	1	1	1
		y 25	13	2	2	2
	2	1,2,3,4,5,6,7	1	2001	2001	
		8,9,10,11,12	2	396	396	400
		13,14,15,16,	5	284	284	284
		17,18,19,20	8	56	56	56
		21,22,23,24	9	148	148	148
		y 25	10	24	24	24
			11	84	84	84
			14	4	4	4
			15	12	12	12

MASTER CUTTER



EXAMPLE OF YIELD CONTROL

3.6. WORKER TRAINING

As no qualified tile fixers were available for installing porcelain tile flooring, training was undertaken together with our suppliers, involving both professionals and labourers.

Training was conducted at the tile supplier's facilities, where an exact reproduction was built of work site conditions, fully simulating the complexity that the tile fixers would be facing.This allowed developing personal skills and correcting all the errors under identical conditions to those that would be encountered in reality.

Design conditions and flooring structure were exactly reproduced:

- Surface mortars with identical absorption, texture, strength, etc.
- Expansion joints, treatment and sealing.
- Tile fixing according to the design, spacing, cutting, and grouting.

In training times, movements, yields, wear of equipment, scrap, aesthetic quality, bonding etc., were measured.

Several joint actions were also undertaken with the supplier, seeking a greater understanding of porcelain tile, installation systems, joint treatment, installation machinery, etc. The client-supplier team carried out an in-depth study on all the existing regulations concerning installation processes, standards, and methods EN, UNI, ANSI, TCA.

All the foregoing investigation and training started 6 months prior to installing the first square metre, thus ensuring a successful start without setbacks. In this way, the risk of error was minimised in the installation.

4. FINAL CONSIDERATIONS

- The project showed that in our context, applying quality assurance criteria was feasible in building operations, achieving great improvements in technical and aesthetic results besides raising productivity, lowering scrap, and minimising the risk of post-installation problems.

- It was shown that the subject of quality assurance was accessible for processes that have traditionally been craft trades, of an empirical nature, carried out by relatively unskilled workers. This experience marked the starting point in the direction of a "Quality Culture", especially with regard to activities relating to "finishes" in building construction

- The high quality parameters required by the client in the project obliged suppliers to introduce modern installation systems, materials, machinery and procedures, creating progress in the ceramic and building sectors.

- The success in this large-scale project was definitive for the introduction of porcelain tile in Colombia. Thanks to quality assurance, the work was performed with enviable results, in spite of the initial lack of knowledge regarding the product and its installation.

- "Industrialisation" in ceramic tile installation opens up the institutional market to its use in large-scale projects, previously reserved for traditional materials, already dominated by the medium as far as their installation process is concerned.