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CONCEPTUAL MODELLING OF BUILDINGS

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"Information handling in the Swedish MCAD system"

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KEYWORDS

CAD, relational database, code table, classification, quantity take off

ABSTRACT

The MCAD project stands for "Material take off CAD". Four companies are participating in the project. ABV, SIAB and SKANSKA represent more than half of the Swedish contractors turn over, and ARCONA is a new Construction Management Company with a business idea of using a total computer support through the whole building process.
The project is partly financed by the Swedish Council for Building Research (BFR) and SBUF.

The aim of the project is to structure the information in the CAD drawings and connect it to alpha numerical data in a generic relational data base outside the CAD system.

The structure is based on the code table for building parts which the contractors have agreed upon a couple of years ago. Without such a common structure (accepted and used by everyone) it would have been impossible to get a flow of information through all phases of the building process.

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Introduction

In 1985 the MCAD group got 0.3 million $ from BFR and SBUF.
The four companies in the group (ABV, ARCONA, SIAB and SKANSKA) had to finance the remaining 0.7 million $ themselves.

The project aims, with help of the CAD-technique, to create such a structure in drawings and data bases that the later on extracted information from the CAD drawings in different phases can be used as a powerful tool in the building process. (Figure 1)

General

The CAD technique opens up new possibilities to extract information from drawings. This means that more participants in the building process can use the information if it is presented and structured in the right way. As the new technique gives you unknown possibilities it is necessary to have a very open dialogue with our construction companies to fullfil their demands.

The building industry has many participants. From early bidding phases to maintenance there are drawings that the participants use in different ways. This means that the drawings are important information carriers in the building process. In the future more and more drawings will be created in CAD systems. Therefore it is very important that we can test and develop how a CAD drawing must be structured.

The importance of a structured drawing is that you connect information outside in data bases to the objects in the drawing. This information is often alpha numerical, but can also be graphical. (Figure 2)
To be able to do this you need a useful code and classification system. In Sweden we have the building part table based upon the BSAB code. (Figure 3)

The increased use of terminals in offices and construction sites give you more possibilities to use the extracted information for planning and controlling the construction phase.

A big and important part of the extracted data consists of quantities, that today often are prepared by special quantity surveyors. In the future the main part of the quantities will be extracted from structured CAD drawings.

Levels

We have chosen four levels of material take off in this project.

Level 1 : Rough quantities in early phases
Level 2 : Main building part quantities
Level 3 : Building part quantities
Level 4 : Detailed quantities for specific building parts

Out of these four number 1, 2 and 3 give the quantities on building part level, that makes it possible to send them to other systems in the format of "telephone delivered quantities". The fourth level is for more detailed planning of purchase and production.

Quantity take off

When doing the quantity take off, graphical data is taken from the drawing and alphanumerical is taken from the database. It is important not to store object data twice, as serious effects can occure if for example the graphics are updated without corresponding changes in database. (Figure 4)

Building part structure

We have gone through all building parts according to the table and have defined the information to be fetched from graphics and database. There are few "elementary types" of building parts. In the MCAD project we use "wall type", "slab type", "piece type" and "section type". (Figure 5)
For all these building parts there are to be program support for the operator (designer) to guide him/her to place definition lines, objects, attributes etc right in the structure of the drawing. (Figure 6)

Example of quantity take off

The quantity take off can be done detailed regarding both the object attributes and the location. In the CAD drawing the information about geometry and location is stored with millimeter tolerances.
For companies with CAD projects of their own and computer supported cost estimation this makes it possible to fetch more and better data into the cost estimate system of their own. (Figure 7)

For companies without CAD design all quantity information must be keyed in manually or bought from outside in digital form.
The standard format today is "telephone delivered quantities" format. (Figure 7)

Room description

As the design work is done in a structured way in MCAD it is possible to automatically put definition lines along building parts of specific type, for example inner wall, facade wall, staircase wall etc.
The program controls that the graphics have the right type and places the definition line of the room. Information belonging to the room is automatically placed in the database. (Figure 8)

After this information about the different surfaces in the room can be put into the database. All facts about the walls behind the surface are fetched from the database. (Figure 9)

The situation today

The project is today finished. The report will be published during the winter. In the MCAD companies the system is implemented step by step since spring. Connections to company specific systems will be the next thing to do when all building parts are supported by MCAD.

Today MCAD is only dealing with building parts. We have already started to use the same ideas on "installation parts" and the systems that keep them together.

We think that it is rather unique that four competitors work together, but we find it a good deal for us all, as we understand that a single company can't do anything like the MCAD project if you want it to be used by a large part of the industry.

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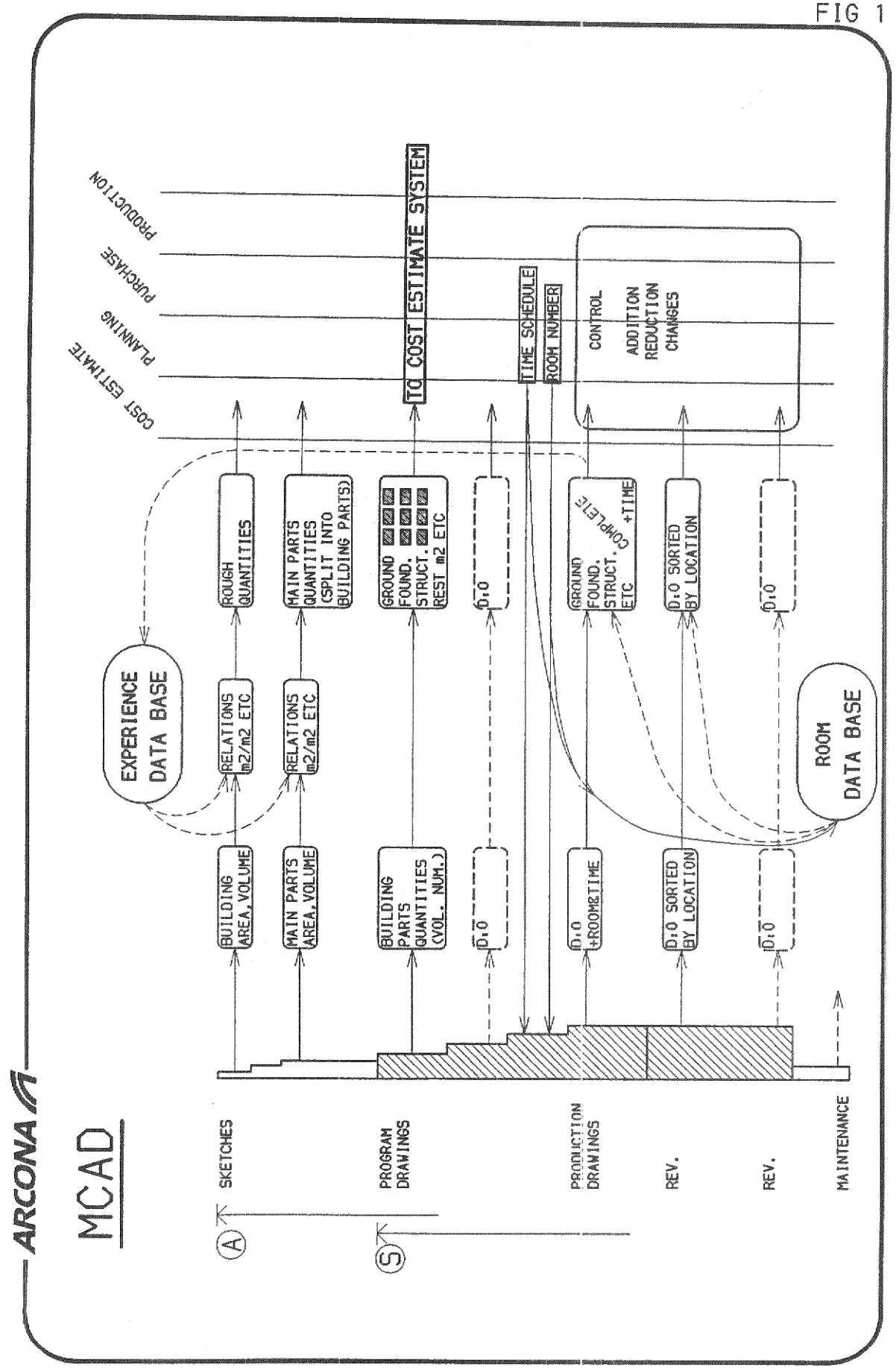
FIG 1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MCAD
COST ESTIMATE
PLANNING
PURCHASE
PRODUCTION
TQ COST ESTIMATE SYSTEM
TIME SCHEDULE
ROOM NUMBER
CONTROL
ADDITION
REDUCTION
CHANGES
EXPERIENCE DATA BASE
ROOM DATA BASE
RELATIONS m2/m2 ETC
RELATIONS m2/m2 ETC
ROUGH QUANTITIES
MAIN PARTS QUANTITIES (SPLIT INTO BUILDING PARTS)
GROUND FOUND. STRUCT. REST m2 ETC
D.O
GROUND FOUND. STRUCT. ETC
COMPLETE +TIME
D.O SORTED BY LOCATION
D.O
BUILDING AREA, VOLUME
MAIN PARTS AREA, VOLUME
BUILDING PARTS QUANTITIES (VOL. NUM.)
D.O
D.O +ROOM&TIME
D.O SORTED BY LOCATION
D.O
SKETCHES
PROGRAM DRAWINGS
PRODUCTION DRAWINGS
REV.
REV.
MAINTENANCE
A
S

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FIG 2

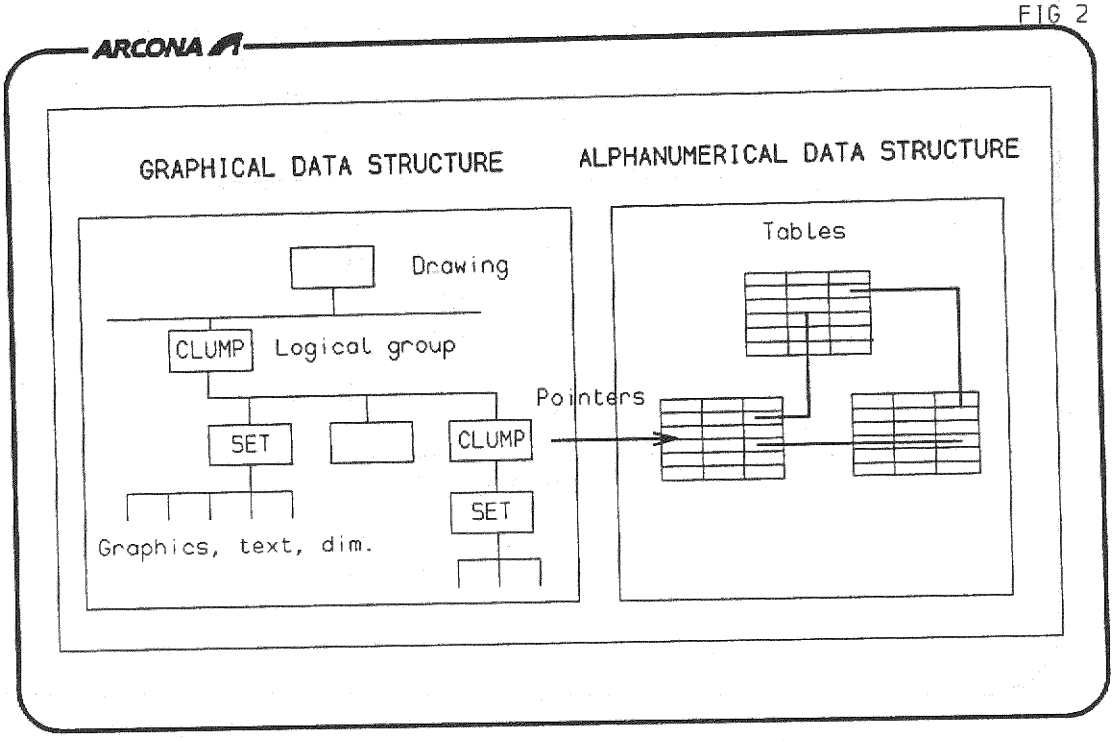

FIG 3

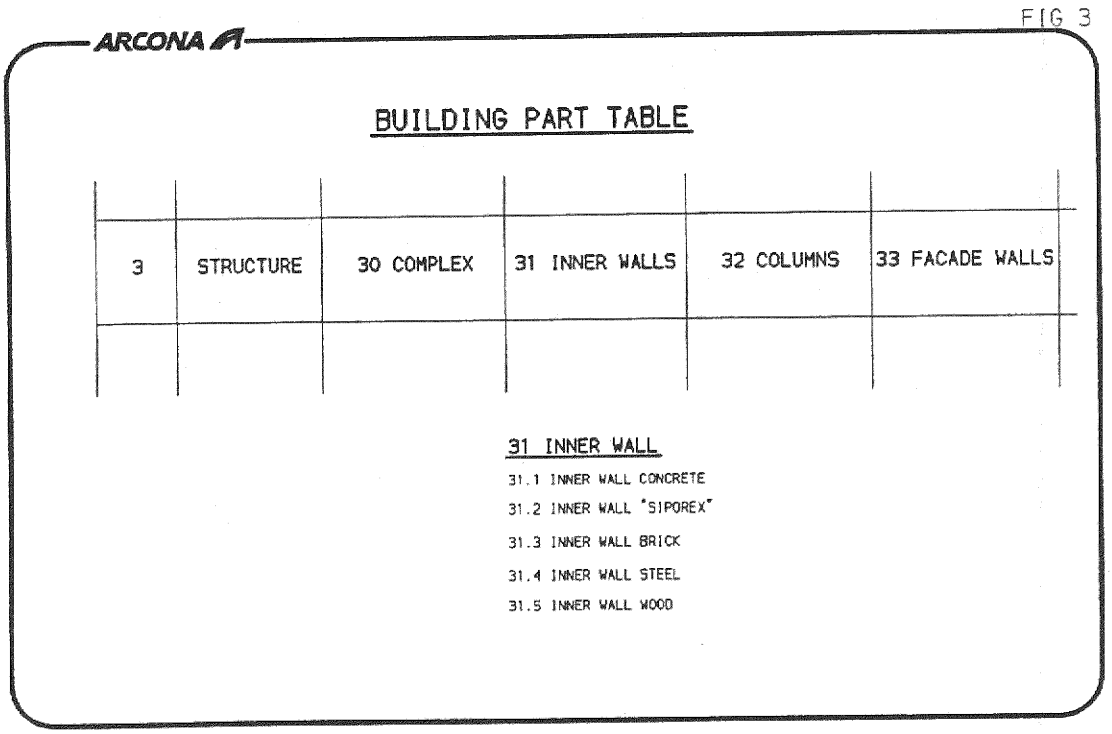

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FIG 4

QUANTITY TAKE OFF

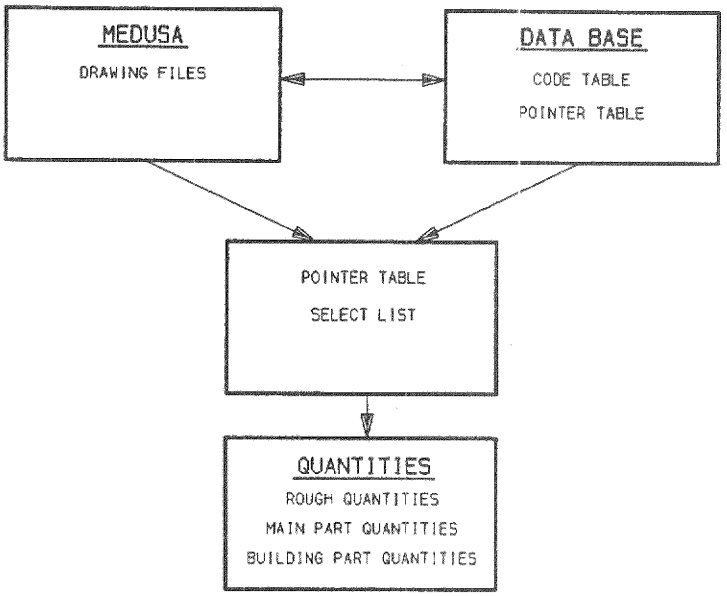

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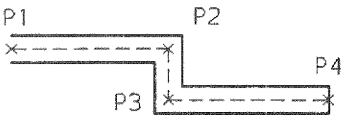
FIG 5

EXAMPLE ELEMENTARY TYPE : "WALL"

GRAPHICS



P1 X Y Z -OPEN
P2 X Y Z -CONTIN
P3 X Y Z -CONTIN
P4 X Y Z -CLOSED

ALPHANUMERICAL DATA

ATTRIBUTE 1 : EXCENTRICITY
ATTRIBUTE 2 : THICKNESS
ATTRIBUTE 3 : HEIGHT
ATTRIBUTE 4 : ELEVATION
ATTRIBUTE 5 : LOCATION
ATTRIBUTE 6 : TYPE
ATTRIBUTE X : OTHER ATTR.
ATTRIBUTE X :

NEUTRAL OBJECT DESCRIPTION

ID:	12345
ELEMENTARY TYPE:	WALL
EXCENTRICITY:	50
THICKNESS:	200
HEIGHT:	3200
ELEVATION:	10.000
LOCATION:	HOUSE3, FLOOR1, PART A
TYPE:	W1
POINT X:	X Y Z OPEN
ATTRIBUTE X:	FIRE CLASS

FIG 6

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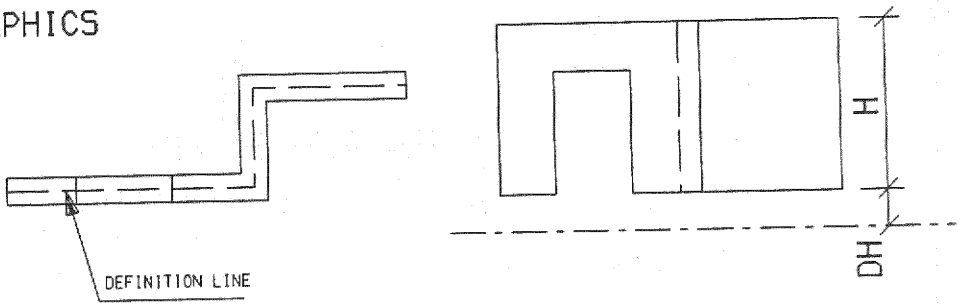
31. INNER WALL

ASKED ATTRIBUTES: BDTK OR TYPE
THICKNESS
HEIGHT
DH (ELEVATION)

GRAPHICS



CALCULATED ATTRIBUTES: NUMBER OF SEGMENTS
LENGTH
HORISONTAL AREA (GROSS/NET)
VERTICAL AREA (GROSS/NET)
VOLUME (GROSS/NET)
LOCATION

CHARACTERISTICS: FREE ENDS
CONNECTED ENDS

CORNERS
OPENINGS

FIG 7

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RESULT FILES

STANDARD

63.711	INNER WALL GYPSUM 1 + 1	AMA CODE	TYPE: W1
		THICKNESS	95
		HEIGHT	2500
		NUMBER	12
		LENGTH	60.3
		VERT. AREA	150.5/130.1
		LOCATION	HOUSE3, FLOOR,1, PART A
	FREE ENDS	LENGTH	7500
	CONNECTED	LENGTH	17500
	CORNERS	LENGTH	10000

TELEPHONE DELIVERED QUANTITY

M001 63 +0000130.1 m
T INNER WALL GYPSUM 1 + 1
T TYPE W1
T THICKNESS 95
T HEIGHT 2500

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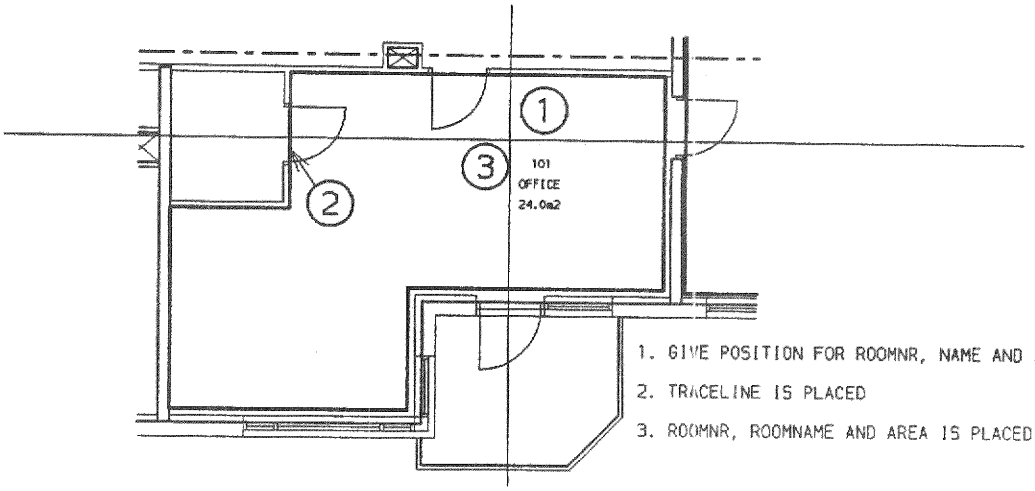
FIG 8

DEFINE NEW ROOM



1. GIVE POSITION FOR ROOMNR, NAME AND AREA
2. TRACELINE IS PLACED
3. ROOMNR, ROOMNAME AND AREA IS PLACED

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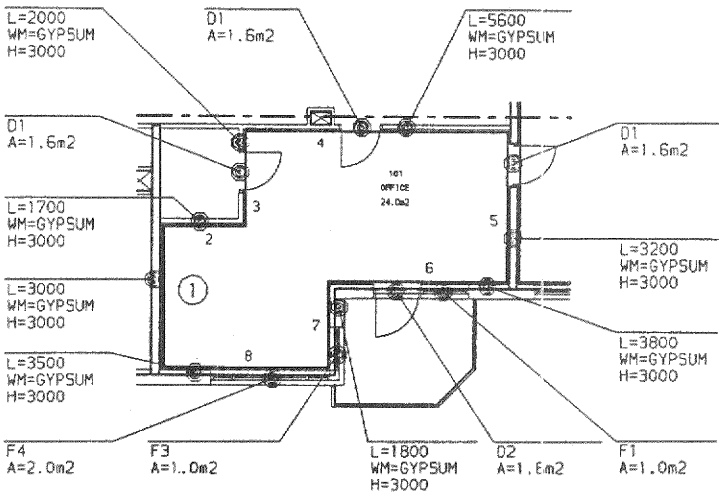
FIG 9

NEW SURFACE ON WALL



WALLS

	WALL MATERIAL	SURFACE	COLOUR	AREA	
AREA 1	CONCRETE	PAINT	NCS0500	9.0	(1)
MAIN AREA	GYPSUM	PAINT	NCS0010-8906	5.1	2
	GYPSUM	PAINT	NCS0010-8906	4.4	3
	GYPSUM	PAINT	NCS0010-8906	15.2	4
	GYPSUM	PAINT	NCS0010-8906	8.0	5
	GYPSUM	PAINT	NCS0010-8906	8.8	6
	GYPSUM	PAINT	NCS0010-8906	4.4	7
	GYPSUM	PAINT	NCS0010-8906	8.5	8
				54.4	