3D Release Package **User Friendly Interface** **Design Conforms To IEC Standard**

STATE OF THE ART

In Manufacturing of Electrical Power Switchboard

Built-In features include:

Flawless Quantity Estimation
Artificial Intelligence Design
Brilliant Visual Presentation
Unique Costing System
Lower Drawing & Production Cost
Optimization Techniques Employed
Uniform Documentation & Record (ISO)
Standardization of All Metal Parts (CKD)

WeesCad

WeesCad

EXPERT SYSTEM

To the Ultimate Answer

The WeesCad Expert System was developed by a group of engineers with many years of experience in manufacturing type - tested low voltage switchboards in compliance with IEC 439 Part 1 1991.
Essentially, the System consists of 2 interdependent subsystems, namely:
WeesCad - The heart of its intelligence
WeesMod - A Complete knock down form of its modular parts

The conventional method of manufacturing switchboard consists of 7 processes, viz.

- Manual design with computer aided drafting package
- Cubicle fabrication (welding method)
- Assembly
- Painting
- Busbar fabrication (piece work)
- Electrical wiring
- Testing

The above manufacturing process gives rise to a number of grey areas in term of material usage, manufacturing time, misunderstanding between supplier and clients. A better system of manufacturing is therefore necessary to eliminate these grey areas and shorten the manufacturing process.

Having the above two principles in mind, we have revolutionised the state of art in manufacturing low voltage (<1000 volts) switchboard in compliance with IEC 439. With the help of **WeesCad** and **WeesMod** the manufacturing process is shortened from 7 to 3 stages, and 98% of the grey areas (subject to human errors) can be eliminated.

Applications

WeesCad and **WeesMod** are specially tailored to meet the needs of manufacturers/electrical contractors/consultants and tertiary institutions in the manufacturing of low voltage (< 1000 volts) switchbord.

Special Features

Flawless quantity estimation
WeesCad has built-in intelligence to enable it to record all components and quantities used in a switchboard such as main electrical components, main structures and internal brackets, busbar lengths (including number of bends, cuts, material shrinkages), weight and labour time spent to built a switchboard.

Artificially intelligence design
Based on its built-in rules of manufacturing and the user's specifications such as System Fault Level, Ambient Temperature, Specified Components and Space Constraint, **WeesCad** determines the most economical way the size, general layout & arrangement, busbar sizing and support spacing.

Brilliant visual presentation
The result from **WeesCad** design will be transmitted to AutoCAD rel.12 for a true and accurate 3 Dimensional drawing via and interface which provides user friendly menus automatically. Subsequently these menus are used for the generation of:

- Single Line Drawing
- Busbar Fabrication Drawing (individual busbars)
- General Arrangement which covers:
  - 3D Full Layout
  - 3D Frame Layout
  - 3D cover layout
  - 3D Inner Mounting
  - 3D Busbar and Equipment
  - 3D Busbar only
  - 3D Top Cover
  - 3D Side Cover
  - 2D Layout
  - 2D Front Cover
  - 2D Base Markings
  - 2D Busbar & Equipment
  - 2D Busbar Supports
  - Front View Termination
  - Back View Termination
  - Top View Termination

Unique costing system
With **WeesCad** built-in features, individual switchboard can be truly modelled and therefore costs can be determined accurately.

Low drawing and production cost
As opposed to the convention/manual CAD drafting, **WeesCad** provides an obvious saving since it only requires user input data specifications to produce drawings instantaneously limited only by computing hardware performance.

Optimization techniques employed
Through the years of research and collaborations with universities and with ongoing projects experience an type-tested switchboard, rules and techniques of optimization in design have been perfected. Much consideration has been given to the standard required under ASTA UK (The Association of Short Circuit Testing Authority) in developing **WeesCad.**

Uniform documentation and records (ISO)
Documentation reports produced are:
Bill of Material - Main Components
- Busbar, Cu required
- Time required *(ie. Time taken to assemble all parts, incl. busbar fabrication)*

Switchboard Specifications-reflecting general and specific individual feeder configurations in convenient TEXT/ASCII format for import to any word processor for further enhancement in presentation.
With the **WeesCad/WeesMod** systems the original 7 manufacturing process is reduced to only 3 stages, covering Assembly, Electrical Wiring and Testing. The other 4 stages are now taken care of by **WeesCad and WeesMod**. VIZ.

Manual design with CAD	• **WeesCad**
Cubicle Fabrication	• **WeesMod** *(standard parts)*
Painting	• **WeesMod** *(standard parts)*
Busbar Fabrication	• **WeesCad** *(standard parts)*

All records concerning individual switchboard can be archived in computer storage media for necessary reference.

Users Requirements

The following information below serves as a guide as to what you will require to implement The Panel Trax Expert System.
1 set Authorised **WeesCad** Software
1 set AutoCAD release 12 software
1 set computer system comprising of the following configuration:

- Minimum 486 - DX50 Processor
- Minimum 256K Cache
- DOS 5.0 or later
- VGA or SVGA monitor 0.28 dot pitch
- Minimum 8 Mb RAM
- Minimum 420Mb Harddisk space
- Mouse Z - or equivalent
- Standard features of parallel and serial ports

1 set A3 or A4 printer or plotter compatible for use with AutoCAD.

WEE SYSTEM

WeesCad

Contents

Conventional Procedure
for Switch Board Manufacturer

Conventional Procedures of
Switch Board Manufacturing
Vs
WEESCAD State of the Art
Manufacturing of Electrical
Power Switch Board

Artificial Intelligence Technology

WeesCad

CONVENTIONAL PROCEDURES FOR SWITCHBOARD MANUFACTURING

Stage 1 - Enquiry

Initially when a switchboard manufacturer is approached by the end-user to manufacture a panel, there are serveral practical considerations. The end-user usually provides a general specification covering the following :

a. the standard/code to comply to cover structure and equipment details.
b. the fault level that is required for the system's supply voltage.
c. the ambient temperature and altitude wherever the equipment is used.
d. the form of construction with reference to the code of practice (e.g. IEC439).
e. the index of protection that is necessary for the equipment's location.
f. a set of single line drawing detailing the number of incoming and outgoing feeders and their complimentary reading and protection instruments.

Stage 2 - Quotation

With the above information in hand, the **manual method** would be to :

1. derive a rough physical dimension of the switchboard.
2. estimate the main items e.g. main electrical equipment such as Circuit Breakers, meters, relays, etc.
3. estimate the structure framework covering the internal and external of the switchboard.
4. estimate the quantity and size of busbar (copper) and its accessories required.
5. estimate the time to be utilised for the switchboard's construction.
6. from the above 1-5, derive the estimated prices.
7. present quotation for listing of :
   - type of equipment offer
   - switchboard metalwork specifications
   - price and delivery

Stage 3 - Manufacturing Process

Upon receipt of the order, the manufacturing process begins in the following manner:

1. From Stage 2, Item 1 the production drawing will have to be developed viz,
   - 2D General Layout
   - Redrawn Single Line - showing the scope of supply
   - 2D layout showing Busbar/Busbar Support Spacing for the given fault level
   - 2D Base Plate Interface showing Entry and Exit points
   - 2D Foundation Mountings
   - Wiring Drawings (if any)
   - Detail metal fabricating drawing

2. Metal fabrication begins
   - Each individual cubicle module is tailored to the specifications.
   - Moreover, accommodate special requirements, special brackets are fabricated.

3. Spray painting
   . Pre-treating of metal for spray
   . Spraying to the required thickness

4. Assembly work
   . Assemble all metal cubicles including mounting brackets
   . Alignment of cubicles

5. Busbar fabrication
   . Busbar fabrication begins aftert completion of the main equipment mounting
   . Each individual piece is then fabricated

6. Wiring work

7. Testing and commissioning

CONVENTIONAL PROCEDURES OF SWITCHBOARD MANUFACTURING **VS** **WEE SYSTEM STATE-OF-THE -ART MANUFACTURING OF ELECTRICAL POWER SWITCHBOARD**

CONVENTIONAL METHOD	WEE SYSTEM METHOD
Stage 2 - Quotation Design & Estimation Problems	**Solution**
Inconsistent or inaccurate design - depending on designer's ability.	Consistent design by AI - Artificial Intelligence
Speed - slow in production of drawings even with the aid of CAD.	Drawing is immediately available with only limitation by the speed of CPU processing.
Inaccurate costing - without true 3D drawings, there is difficulty in visualisation. Hence, there are many hidden costs such as : cubicle actual size total copper quantity required labour costs etc.	Accurate costing provided via true 3D drawings with the aid of **Weescad** based on users specification Actual switchboard configuration is already determined along with copper quantity and labour costs.
Tedious and time consuming process in the preparation of quotation which is commonly subject to human errors and unnoted grey areas.	**Weescad** provides a clear and concise complete listing of entry data along with required specifications which may be easily imported to any word processor for further enhancement in the quotation.
Difficulty and problematic in accepting last minute amendments due to the fact that the whole quotation process may have to be repeated again which is very time-consuming.	**Weescad** can accept last minute changes because all archived datafiles can be easily retrieved for further amendments.
Stage 3 - Manufacturing Process Design Problems	**Solution**
Drawings (2D) do not provide sufficient visualisation for production.	**Weescad** output drawings are versatile in 3D drawings which may be converted to 2D for production and presentation.
Manufacturing Problems	**Solution**
Material wastage due to human errors which are usually excessive as it is based on piece work.	**Weesmod** consists of standard uniform modular parts in complete knock down form which is readily available for immediate assembly.
Labour wastage due to unproductive time spent on dismantling and reassembling as a result of wrong measurements and inaccurate design. No proper monitoring.	**Weescad** combined with **Weesmod** mininises errors since **Weescad** p predetermines and configures all the standard parts of **Weesmod**. Standard parts are interchangeable. **Weescad** has provisions to allow the user to fine-tune input time spent in each installed entity.

WeesCad

Manufacturing Problems	**Solution**
High dependence on skilled labour as each stage of the manufacturing process is complex, since drawings are lacking in 3D visualisation.	With the **Wee System** the Manufacturer only needs to rely on their Junior staff for **Weescad's** data entry via a user-friendly interface. With more complete drawings and data, there is less need for skilled labour.
Poor space utilisation due to slow production as it is based on too many manual stages viz, Manual design with CAD Cubicle fabrication (welding method) Assembly Painting Busbar fabrication (piece work) Electrical wiring Testing	The **Wee System** couts down the usual manufacturing stages to only : Assembly Wiring Testing E.g. if each stage requires 100 hours, then 7 stages will require 700 hours. In this case, there will be an evident saving od 400 hours as there are only 3 stages.
Poor forecast of Production Limit as this is constrained by factory floor space and lack of knowledge of seitchboard dimensions.	**Weescad** provides foresight in switchboard dimensions and projected time spent to provide for the factory floor space planning for optimum utilisation.
Quality Control Problems	**Solution**
Non uniformity of design creates problems in the preparation of cubicle structure, busbar and location of main electrical equipment.	**Weesmod** has uniform parts, thus inconsistency of sizes of parts are minimised. **Weescad** provides 3D drawings for busbar fabrication and predetermines equipment location.
Unable to fulfil ISO requirements due to lack of proper documentation of each stage in production.	**Weescad** provides complete documentation for every stage in production and its information may be retrieved from its archives for easy reference. Furthermore, each switchboard panel requires a very minimal amount of bytes to store its configuration as opposed to storing the actual drawing itself which may be massive and cumbersome.
Unable to fulfil Type-Tested Requirements as each design do not conform to standard rules governed by the Type Test.	**Wee System** follows the standards set out by the Type Test with regards to . temperature rise . fault level condition
Financial Control Problems	**Solution**
Material/Inventory planning poses a major problem due to bad scheduling as unknowns are many. Main equipment may be required at an early stage long before it can be actually assembled.	**Weescad** predetermines all materials required and also has a library of main popular electrical components in 3D (e.g. ACBs, MCCBs etc.) for utilisation at any time before manufacturing. The **"just-in-time"** strategy can be implemented.

Financial Control Problems	Solution
Large costing differences in Estimated and Actual Production Costs due to . estimator's experience . production manager experience . no preconception of switchboard . prior to manufacturing.	**Weescad** sets a common standard for both the Estimation and Production Departments to comply as it reflects the true situation closely as a 3D-Model. **Weescad's** estimation consists of 3 catergories viz, . Main Equipment (CBs, Meters etc.) . Structure Parts (Weesmod) . Busbar with a summary of: . Total Weight of Switchboard . Total Material Cost of Switchboard . Total Time to Build Switchboard . Total Labour Cost of Switchboard.

The Heart of Wee Expert System - Weescad

General

The WeesCAD Expert System is the direct result of many years of research and testing in the manufacturing of electrical switchboards. The primary goal of the WeesCAD is to reduce costs in the design and manufacturing process. WeesCAD is specially catered for switchboard manufacturers. It has its own intelligence which better or equals a designer in the switchboard manufacturing environment. It utilises the latest technology in switchboard manufacturing with regards to speed, accuracy and uniformity, coupled with a user friendly interface enabling the user to input data relevant to a specific environment.

To operate the system, one only requires the following software :-

1. WeesCAD (version 5.01, 6.02 or 6.03)
2. AutoCAD rel 12

WeesCAD is available in the following packages which may be purchased separately. The packages are as follows:-

1. WeesCAD - Main Distribution Board (version 5.01)
   This package caters for Low Voltage Distribution Switchboard design which complies to IEC439 or BS5486 and ASA1136 for a standard voltage of 380V and 415V. Other voltages are available upon request.

2. WeesCAD - Generator Distribution Board (version 6.02)
   This package caters for Generator Distribution Panel

3. WeesCAD - Motor Control Centres (Fix & Withdrawal) (version 6.03)
   This package caters for all types of Fixed and Withdrawable Motor Control Centres

WeesCad

The Package

Included in the package is a set of five diskettes, one hardware serial lock, warranty and license agreement and one copy of the users manual.

Specifications

Presently the WeesCAD version 5.01 caters for a maximum of two incoming groups and a maximum of 18 outgoings in each incoming group.
Users are allowed to customize that own manufacturing data in their own parameters file. For example, each manufacturer will have their own copper costs, labour hour rate and their own unit electrical equipment costs.
This user parameter file is then used as input for designing the switchboard. Other parameters such as design rules are not available to the user for modification.
However, once the final drawing is generated the user is allowed to save or modify this drawing like any other drawing in AutoCAD.

User Requirements :-

The following information below serves as a guide as to what you will need to implement The WeesCAD Expert System.

1 set Authorised WeesCAD Software
1 set AutoCAD release 12 software
1 set computer system comprising of the following configuration
- o Minimum 486-DX50 Processor
- o Minimum 8 Mb Ram
- o Minimum 256K Cache
- o Dos 5.0 or later
- o VGA or SVGA monitor 0.28 dot pitch
- o Standard Microsoft Mouse or equivalent

The information contained herein relates to version 5.01.

Using the WeesCAD

When you first use the WeesCAD, you will encounter the following screen (Figure 1). Depending on the type of module(s) you have purchased, the WeesCAD will run the specific module.

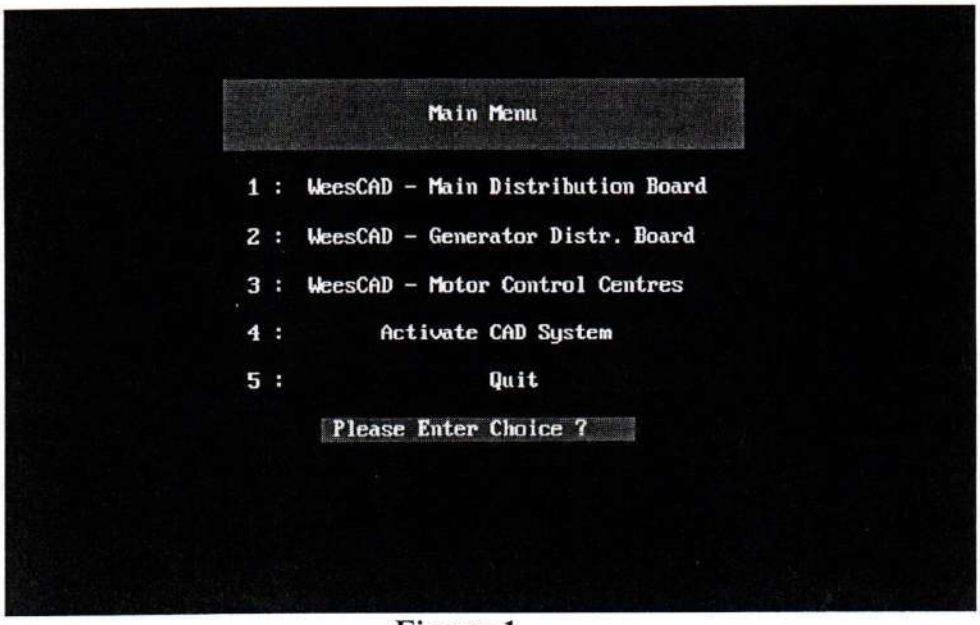


Figure 1

Drawing data is generated from WeesCAD to AutoCAD release 12 for interpretation via its own interface.

Initially, the user has to decide whether the job is a new or existing one. If it is a new job then he selects the "No. Incoming & Outgoing" option. Otherwise, he selects the "Use Previously Entered Data" option which uses a previously created Datafile.

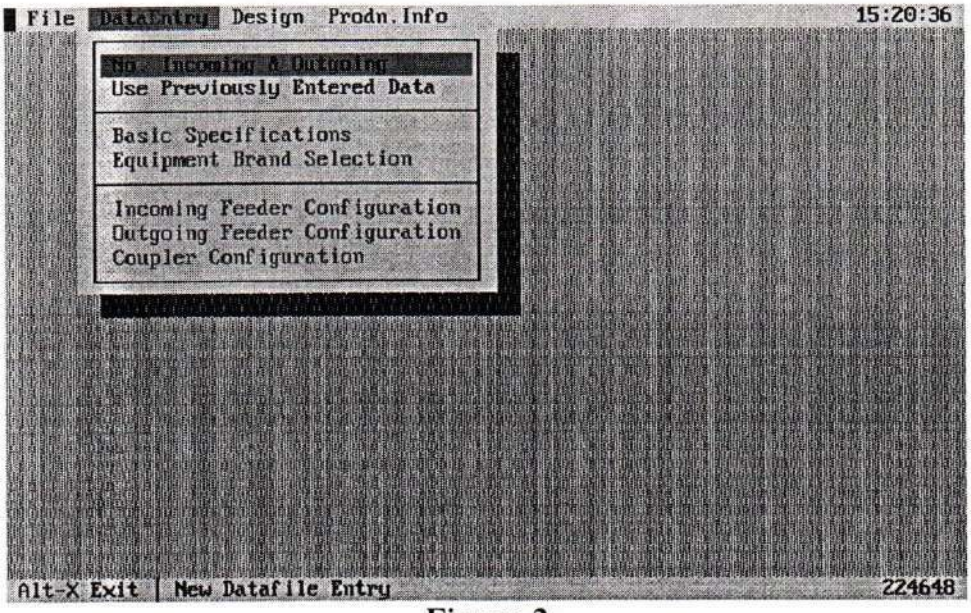


Figure 2

WeesCad

The option of using an existing Datafile allows the user to search through the directories (if he cannot remember the existing File Name) and pick from a friendly File Menu which is shown below :-

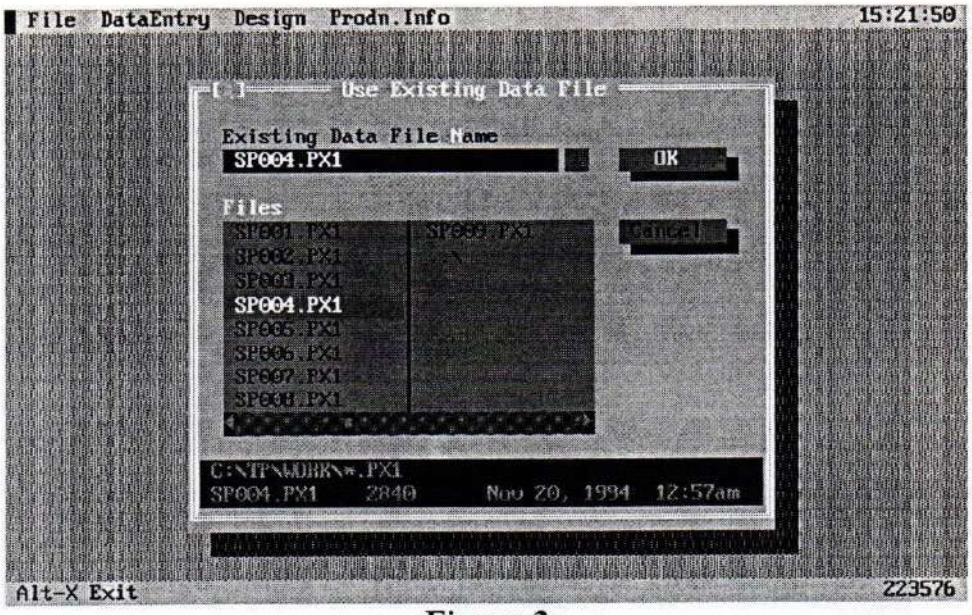


Figure 3

The above format is also used when the Datafile is Archived for future reference. Storage in bytes is at a minimum since all data is stored for interpretation and conversion into AutoCAD drawings when required.

Menu - DataEntry/Basic Specifications

Basic Specifications is required during the switchboard design (as shown below) to enable WeesCAD to determine the switchboard's environment such as Ambient Temperature, Fault Level, Form of Construction according to IEC 439, BS 5486 and ASA 1136 etc.

This data which is extracted is also for WeesCAD's Automatic Single Line Drawing construction and other analysis such as Material checks etc.

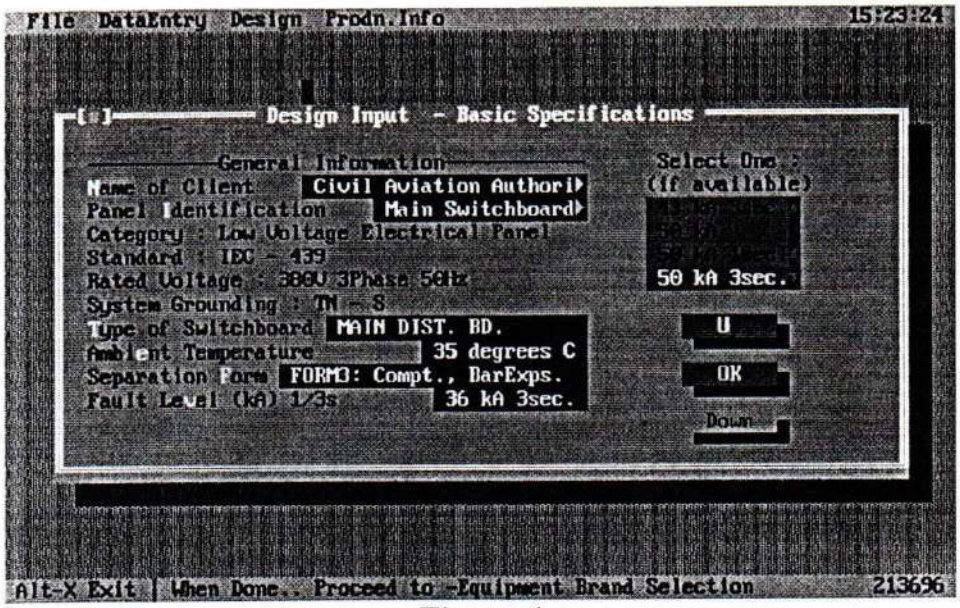


Figure 4

Menu - DataEntry/Equipment Brand Selection

Normally price would be the criteria for selection of Main Equipment if there are no preferences. Otherwise, it could be that the user may have his own set of Brand preferences for say the main equipment, in which case he would select his preferred brand as shown below :-

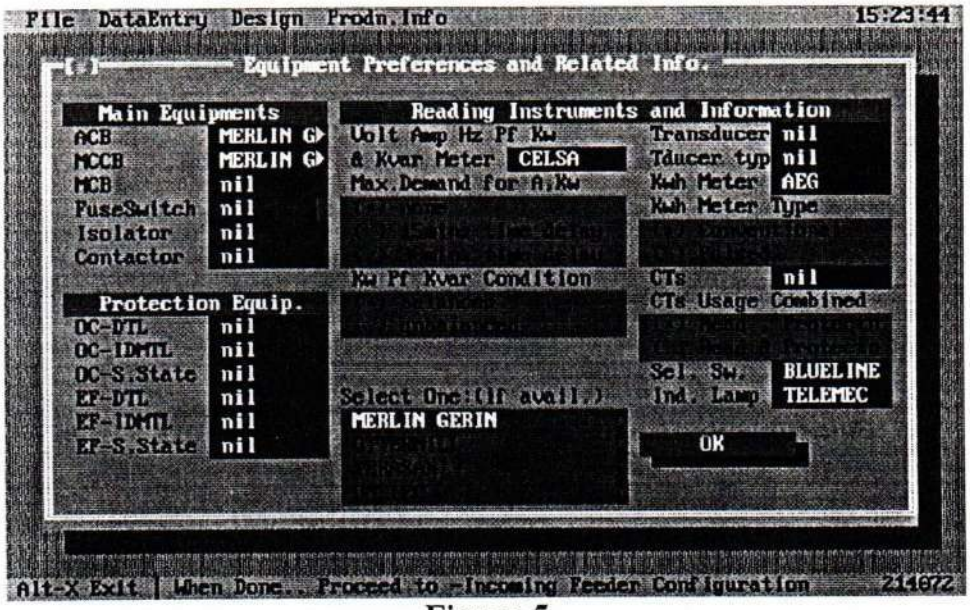


Figure 5

WeesCAD has its own database of popular equipment denoting prices and equipment installation time of which the user may modify to suit his own situation from time to time.

Menu - DataEntry/Incoming Feeder Configuration

Every Incoming has its own unique configuration. Figure 5. shows a typical Incoming Feeder covering Main Equipment, Reading and Protection Equipment and other specifications which would be reflected in the Single Line Drawing and Material List. All along WeesCAD has Automatic Lists presented for easy selection to limit human errors to a minimum.

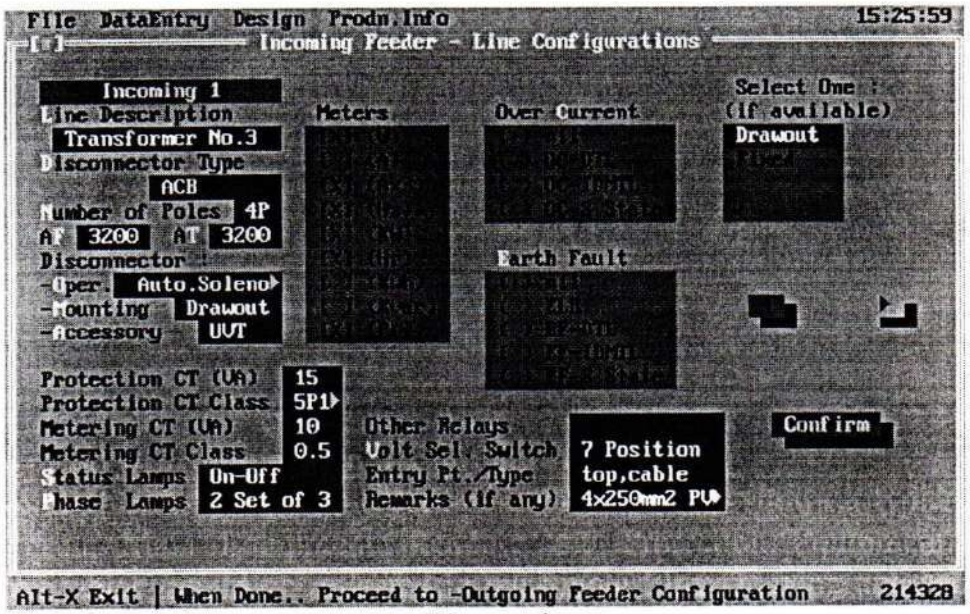


Figure 6

Menu - DataEntry/Outgoing Feeder Configuration

Every Outgoing Feeder also has its own unique configuration. Figure 6. shows a typical Outgoing Feeder covering Main Equipment, Reading and Protection Equipment and other specifications which would be reflected in the Single Line Drawing and Material List. Again, WeesCAD has automatic Lists presented for easy selection to limit human errors to a minimum.

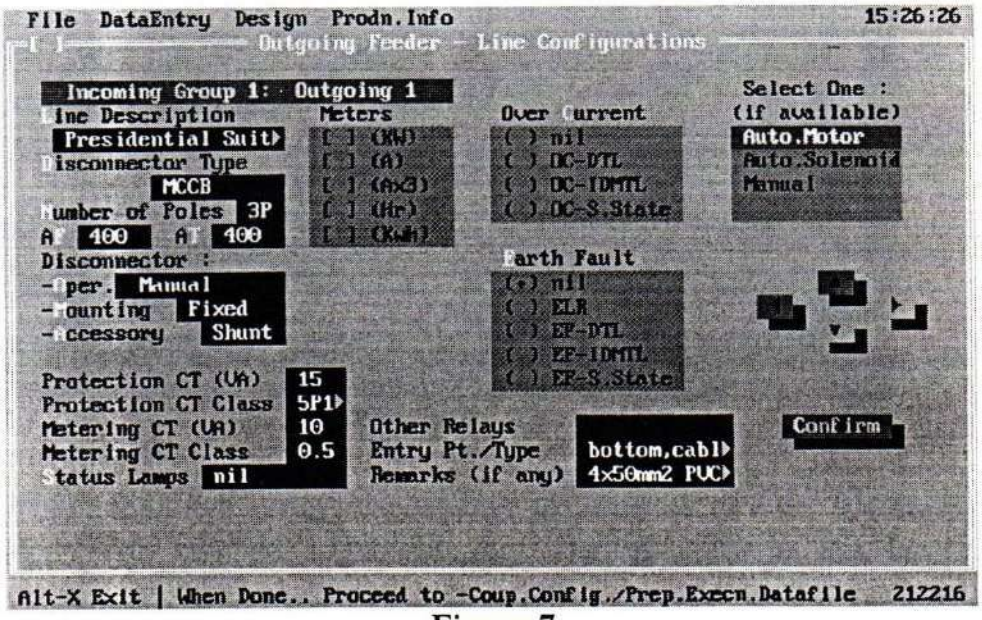


Figure 7

Menu Design/Prepare Execution Datafile
Design/Verify Execution Datafile
Design/Select Main Equipment
Design/Execute Design
Design/Archive Execution Datafile

The users may amend his data entry repeatedly under the DataEntry section until he is satisfied with all his input information. Thereafter, he proceeds to prepare the Execution Datafile which is required for WeesCAD complete analysis and presentation. This data is Verified and on successful verification the user is allowed Main Equipment Selection. Finally, he Executes this design based on his successful database Main Equipment retrieval.

At any stage the user can decide whether or not to Archive this successful/unsuccessful Data.

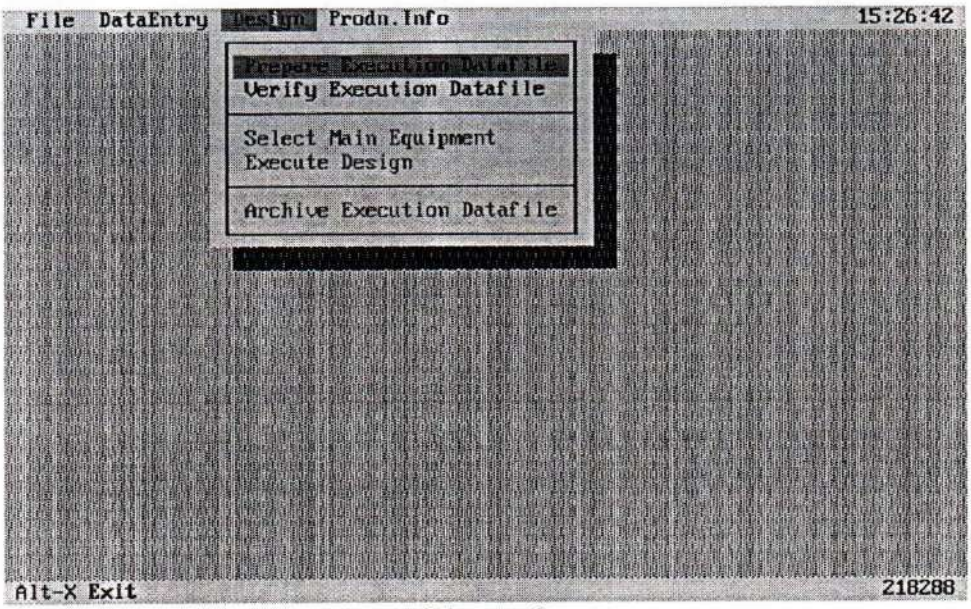


Figure 8

Menu Prod. Info/User Specifications
Prod. Info/Lists of Equipment's
Prod. Info/Master List of Materials
Prod. Info/Busbar Manufacturing Data
Prod. Info/Panel Cut-Out

WeesCAD automatically generated a reflection of the **User Specifications**. Since this data is required for quotation or presentation, it is easily exported to any word processor for further enhancement.

WeesCAD generates two types of Material Listings. This **List of Equipments** is principally meant for External reference since it does not contain pricing. However, it contains all prime information, such as detailed electrical components specification, suitable for External utilization. The **Master List of Materials** is for Internal utilization (see Figure 8). This list details all materials (e.g. Panel Armor Structures, Busbar, Electrical Components, and a summary of its analysis of time taken to construct, total weight, total labour and total switchboard cost) required for the successful manufacturing

of the said switchboard. The Busbar Manufacturing Data shows the total list of busbars required for manufacturing the specified panel. With this feature the user may minimise wastage in his utilization of copper busbars

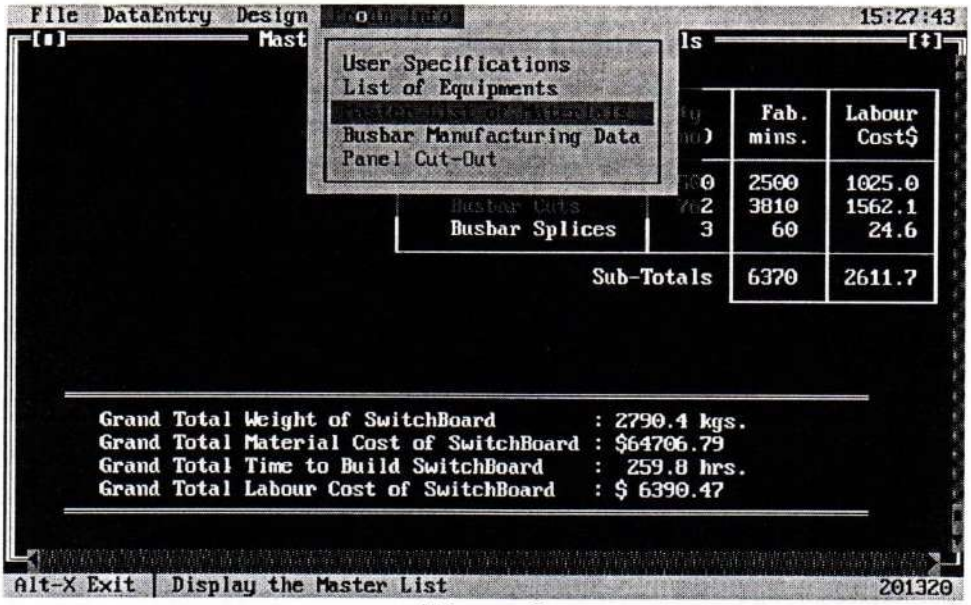
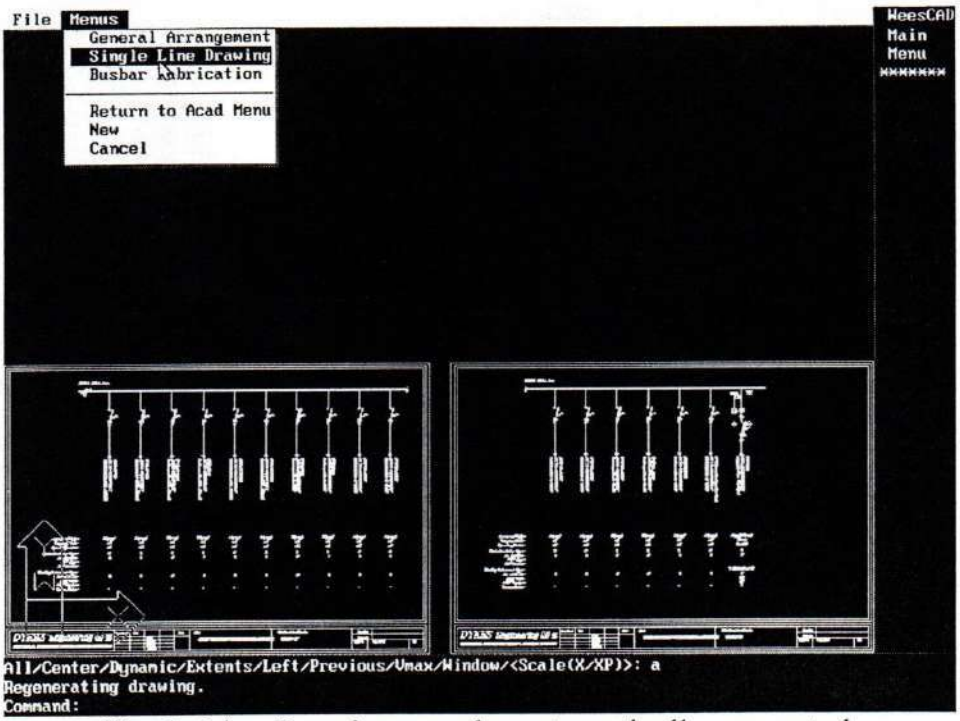


Figure 9

WEESCAD Data is Exported to AutoCAD re. 12

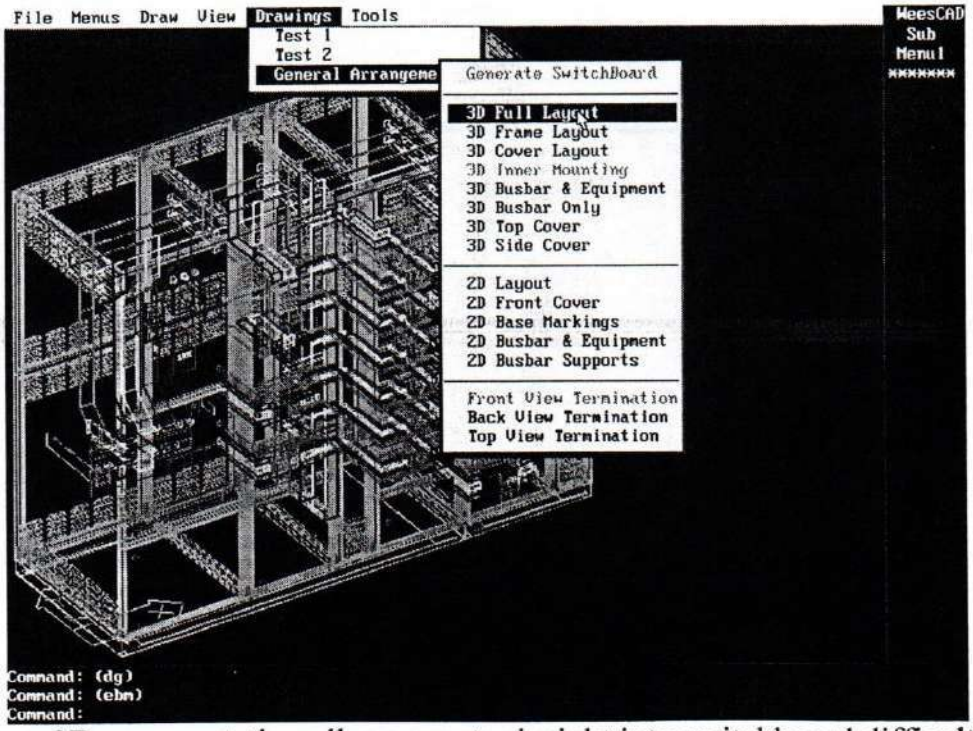
The Data generated from WeesCAD is exported to AutoCAD for interpretation via an interface. Several types of Drawings can be obtained :-

A. Single Line Drawing



Single Line Drawings can be automatically generated.

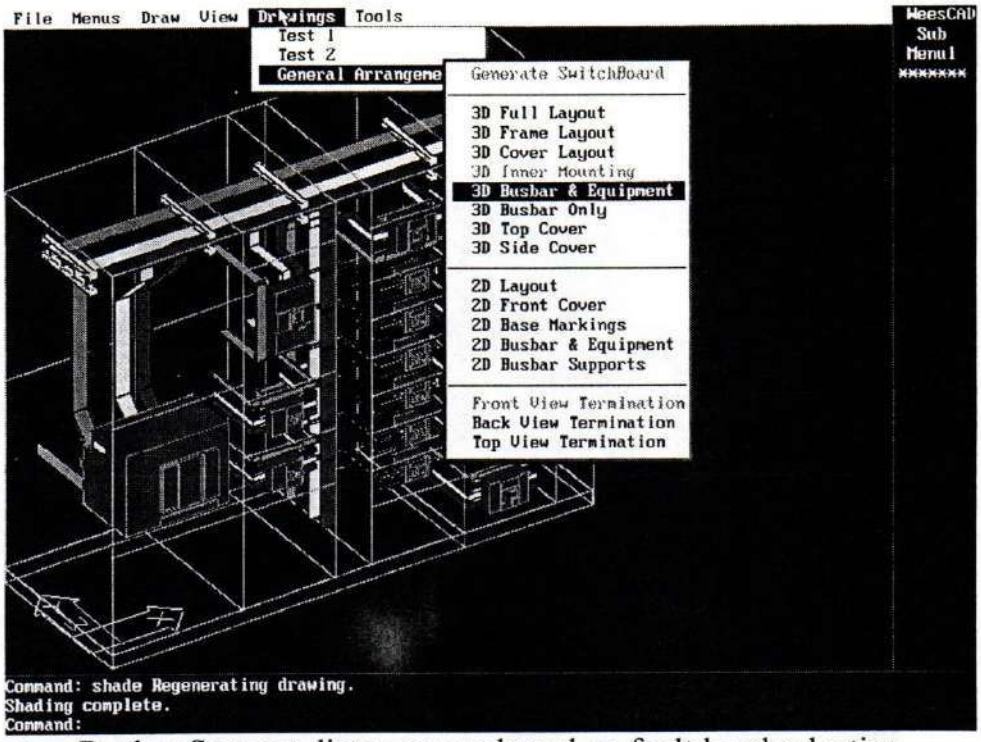
B. 3D Full Layout



A true 3D representation allows greater insight into switchboard difficulties.

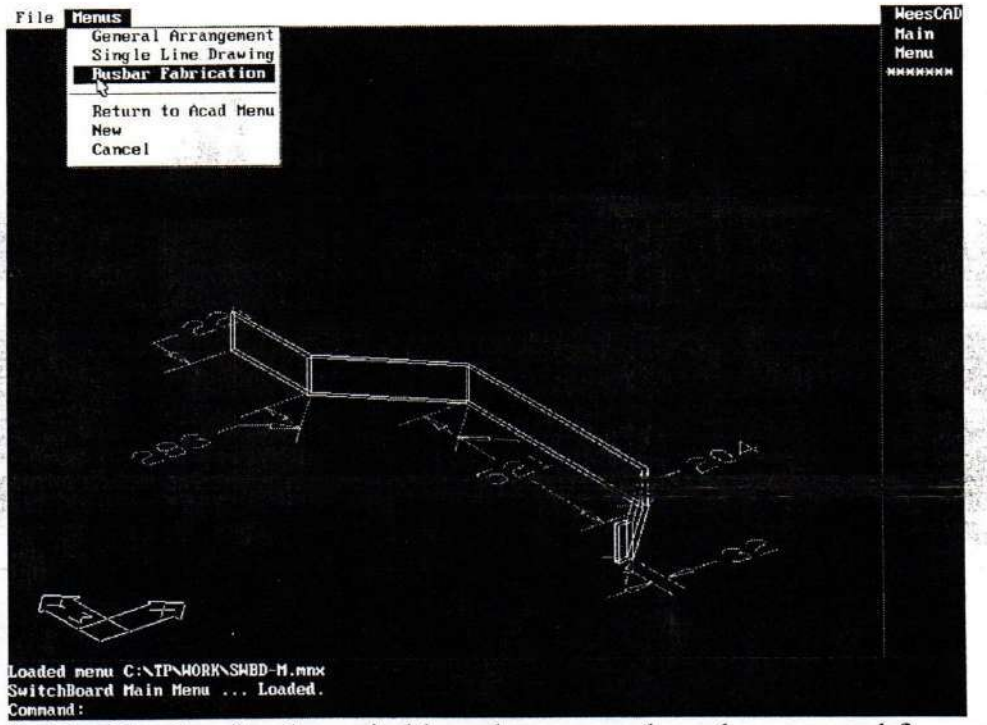
WeesCad

C. 3D Busbar and Equipment



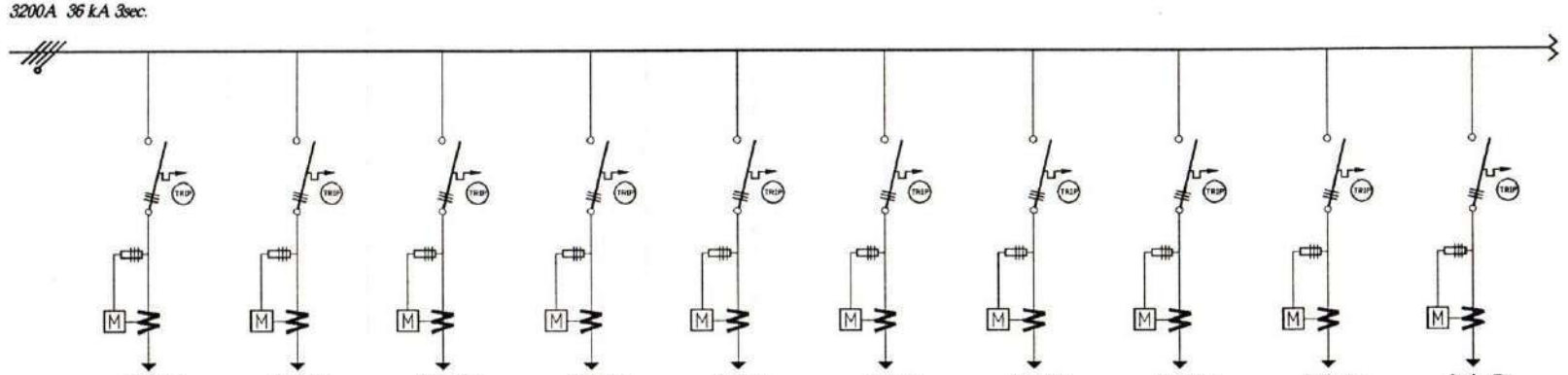
Busbar Support distances are based on fault level selection

D. Busbar Fabrication Drawing



Every individual busbar for the switchboard concerned can be accessed for record and manufacturing.

WeesCad



Operating Mode -	Manual	Manual	Manual	Manual	Manual	Manual	Manual	Manual	Manual	Manual
Tripping Mode -	Shunt	Shunt	Shunt	Shunt	Shunt	Shunt	Shunt	Shunt	Shunt	Shunt
Operating Status -	nil	nil	nil	nil	nil	nil	nil	nil	nil	nil
Protection Relay Type -	0	0	0	0	0	0	0	0	0	0
No. of PCTs -	0	0	0	0	0	0	0	0	0	0
PCT Class -	5P10	5P10	5P10	5P10	5P10	5P10	5P10	5P10	5P10	5P10
PCT Burden -	15	15	15	15	15	15	15	15	15	15
Reading Instrument Type -	A3	A3	A3	A3	A3	A3	A3	A3	A3	A3
No. of MCTs -	3	3	3	3	3	3	3	3	3	3
MCT Class -	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
MCT Burden -	10	10	10	10	10	10	10	10	10	10
Source Status -	-	-	-	-	-	-	-	-	-	-

DYKES Engineering (S) PTE LTD

ELECTRICAL INSTRUMENTATION & PROCESS CONTROLS

Amendment	Date			Scale
		Drawn		
		Designed		
		Checked		
		Approved		

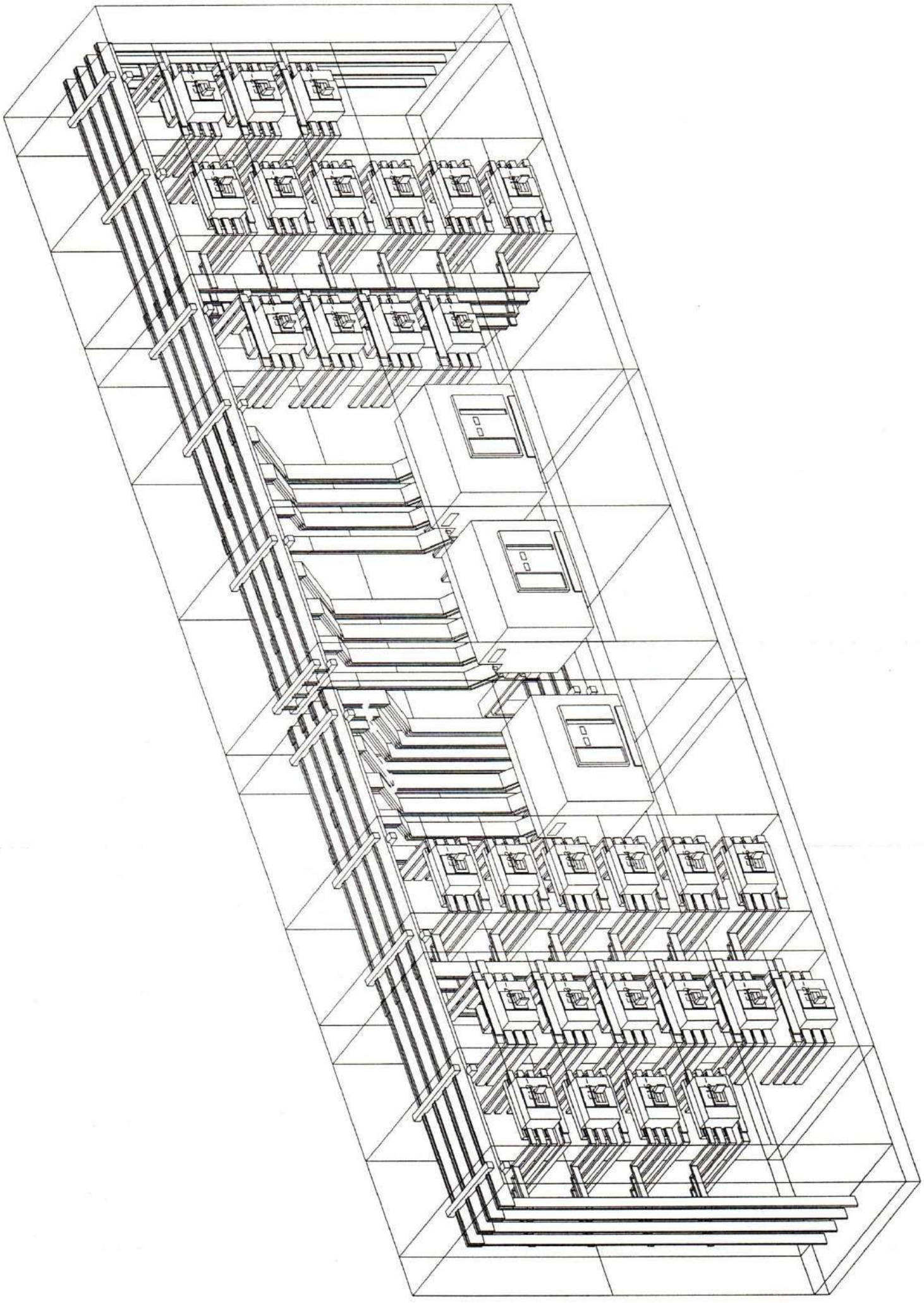
Client: Singapore Technologies Pte Ltd

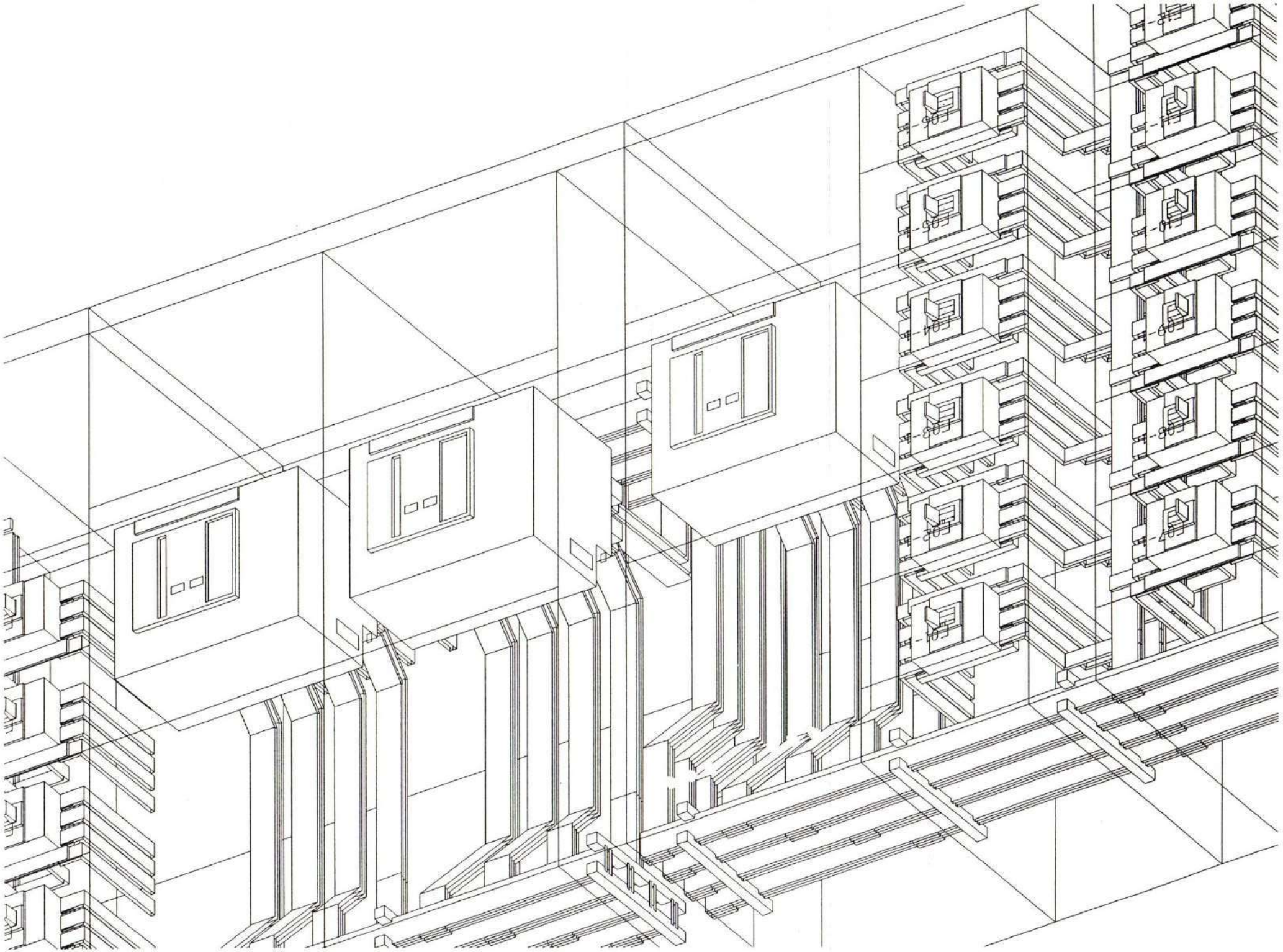
Title / Description of Drawing: Main Switchboard No.3

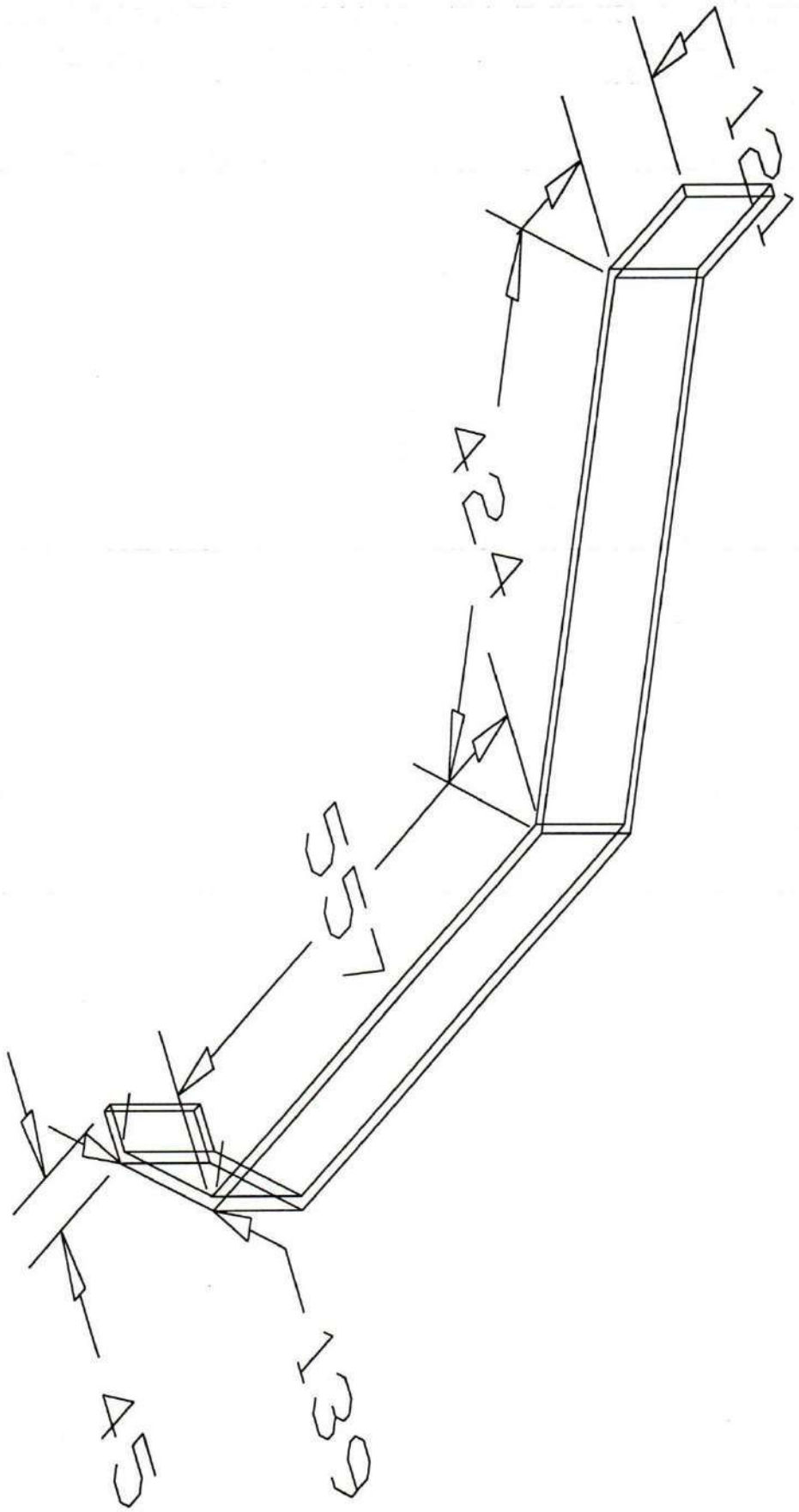
Consultant:

Contractor:

Sheet No. | Drawing No. | Rev.



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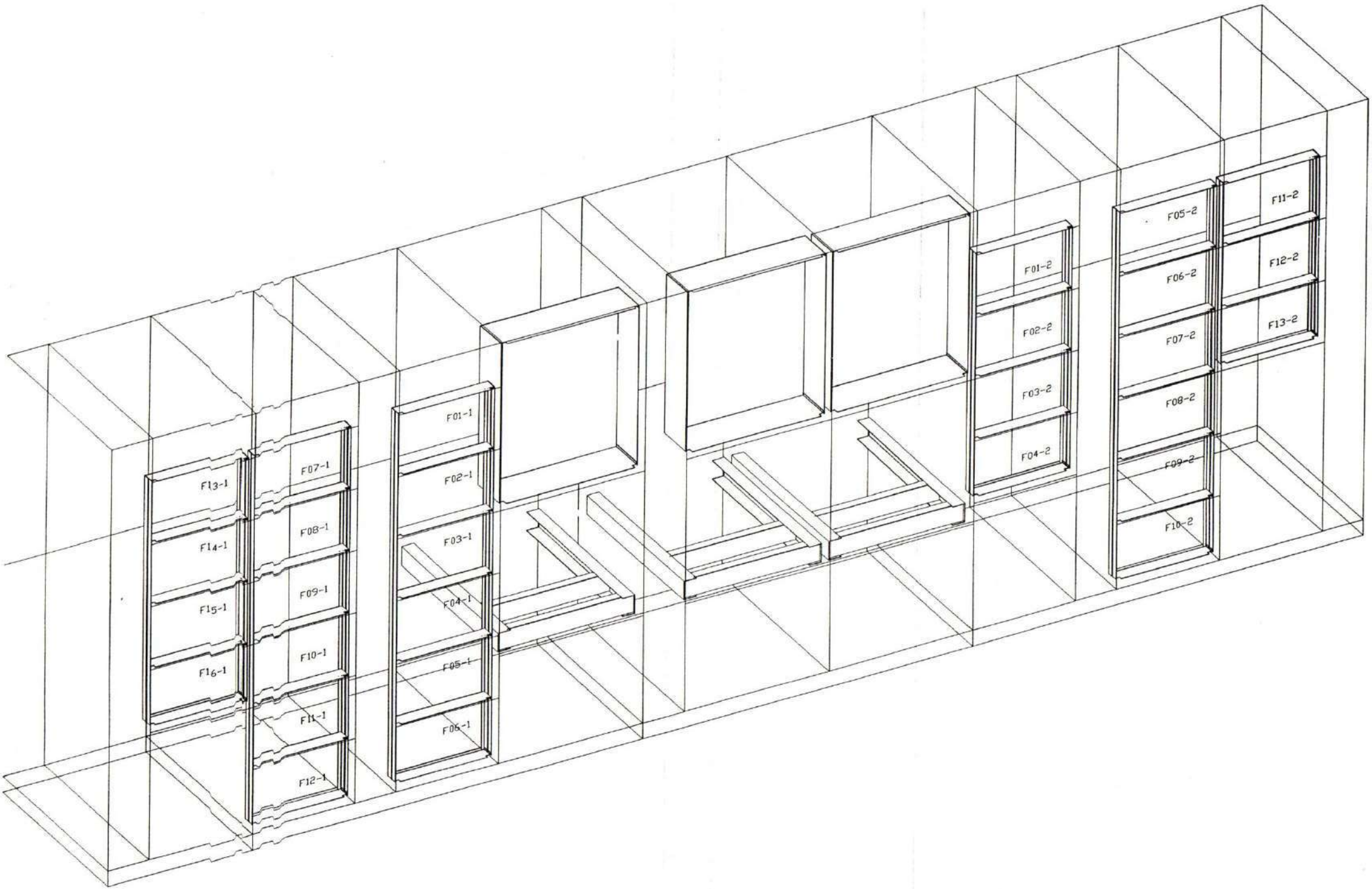
42
55
5
13


F01-1
F02-1
F03-1
F04-1
F05-1
F06-1
F07-1
F08-1
F09-1
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F12-1
F13-1
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F16-1
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F03-2
F04-2
F05-2
F06-2
F07-2
F08-2
F09-2
F10-2
F11-2
F12-2
F13-2