Compact Secondary Substations, SAHARA

Technical Catalogue

abb

C O N T E N T S

1. General Description

SAHARA is a series of outside-operated compact secondary substations for voltages up to 24kV. They have been designed and manufactured by ABB Electrical Industries Co. Ltd. of Saudi Arabia to withstand all operating needs and special environmental conditions in the Gulf Cooperation Council, Middle East & Africa and other places with same environments.

The SAHARA series prove that compact secondary substations can be really compact while maintaining all required electrical parameters.

Features

- **Outside operated substations**
- **Heat Run Tested to class 10 of IEC 61330**
- **Specially designed sand traps**
- **Contains three compartments which are totally separated by Aluzink sheets**
- **IP43 for the LV & MV compartments**
- **IP23 for transformer compartment**
- **Flexibility in selecting the required LV & MV equipment**
- **Possibility to add one or two doors for the transformer compartment**
- **Double roof with air insulation**
- **Powder paint coated finish**

2. Standards

The design of SAHARA substations and their components is based on the relevant IEC standards and conforms with the Saudi Arabian Standards Organization (SASO) specification no. 3522 regarding Package Substations. The relevant standards are:

SASO 3522	: Requirements for Package Substations.
IEC 61330	: High-Voltage / Low-Voltage Prefabricated Substations.
IEC 60298	: Metal-enclosed Switchgear.
IEC 60265-1	: High-Voltage Switches.
IEC 60420	: High-Voltage alternating current fuse-switch combinations.
IEC 60694	: Common clauses for high-voltage switchgear and controlgear standards.
IEC 60282-1	: HRC fuse links.
IEC 60076	: Power Transformers.
IEC 60947-1	: Low Voltage Switchgear.

3. Design

SAHARA substations are completely self-contained, factory assembled in a totally enclosed metal cladding, weatherproof housing ready for placing into position upon a concrete base pad.

The housing of the kiosk is mainly made of 2mm ALUZINK steel sheets. In the ALUZINK sheets, the steel provides strength while the aluminum and zinc alloy coating provides protection against corrosion. In addition, 3mm galvanized steel sheets are used for stronger support in the base frame. Last finish coat is powder paint of polymer resin base color to RAL 7032 or RAL 7033 (or other colors).

Each substation contains three main equipment: transformer, MV switchgear and LV switchgear, each is contained in a separate compartment. The compartments are completely separated by ALUZINK steel sheets. Labyrinth louvers with sand traps at the bottom form the sidings of the transformer compartment to assure free entry and exhaust of air, as such the inside temperature is kept within limits. The substation is provided with a metallic ceiling as additional provision to diminish heating due to solar radiation (double roof system). Openings located at the lower and upper sides of the slanted roof allow air circulation as part of the ventilation design.

The outer doors of the kiosk are wide and provided with gas spring stoppers. They are provided with heavy-duty hinges to prevent distortion and mis-alignment. Locks are provided with door swing handles. When they are closed, they are firmly locked. The MV doors are provided with a drawing pocket.

Degree of Protection:

HV Compartment	: IP43 (IP54 on request)
Transformer Compartment	: IP23
LV Compartment	: IP43 (IP54 on request)

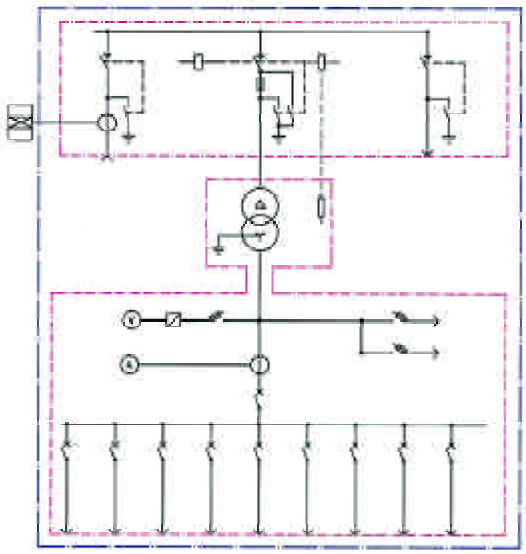


Fig. 1

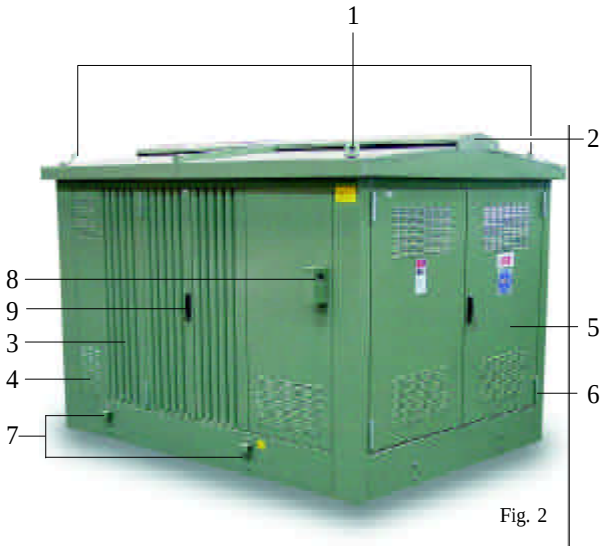


Fig. 2

1. Four roof mounted lifting eyes (for SAHARA 500-1600)
2. Top external slanted roof with ventilation openings
3. Sand traps in both sides of transformer compartment
4. Ventilation louvers for LV panel in both sides.
5. MV compartment door
6. Heavy-duty door hinges
7. Supporting points for transportation purposes
8. Optional earth fault indicator
9. Optional door for transformer compartment

4. MV Compartment

MV compartment can be equipped with wide varieties of MV switchgears. For voltages up to 24kV, standard SF_6 insulated ring main units (RMU), like ABB SafeRing, can be provided. ABB SafeRing is a family of non-extensible, type tested, RMU's with different standard configurations. The basic configuration is called SafeRing CCF which consists of a single, sealed tank containing two load break switches and one switch fuse combination for transformer protection. Other combinations of switches, switch-fuses and circuit breakers are also available within the same family of RMU's. Refer to SafeRing RMU catalogue. (see Fig. 3)

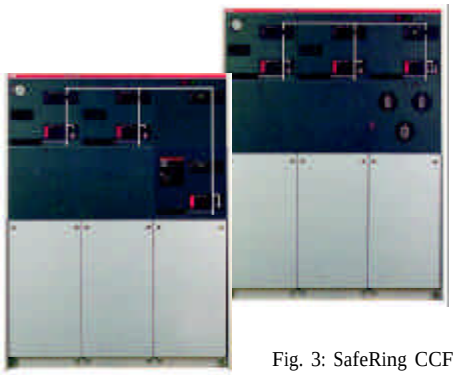


Fig. 3: SafeRing CCF & CCV RMUs.

Whenever extensible compact switchgear is required, ABB SafePlus SF_6 insulated switchgears can be provided for voltages up to 24kV. SafePlus modules range covers all required applications such as switches, fuse-switches, circuit breakers, sectionalizers and metering panels. These modules can be combined together in the factory to form units, each contains up to 5 modules in order to satisfy different customer needs and requirements. Optionally, SafePlus can be provided fully modular for increased flexibility. (see Fig.4)

Fig. 4: SafePlus CCV+F, extensible switchgear (RMU)

An internationally approved ABB air-insulated switches; type NAL switch disconnectors and NALF fused switch disconnectors (see Fig. 5) are available for voltages up to 36kV. These switches can be motorized, remotely operated and used in different configurations and arrangements in order to provide the required protection, metering and switching needs in the MV side of the secondary substations. Each switch/fuse-switch can be equipped with a mechanically interlocked earthing switch with making capacity.

Alternatively, ABB air-insulated modular MV switchgear type UniSwitch 36kV (see Fig. 6) or other SF6-insulated switchgear can be provided to protect the distribution transformer. Load break switches and circuit breakers modules can be combined together in different arrangements as per the customer needs.

All options can be provided with distribution automation facilities.

Fig.5: ABB NALF

Fig. 6: UniSwitch 36

5. Transformer Compartment

The compartment is specially designed to provide the transformer with sufficient air volume and flow for cooling through adequately sized and professionally designed ventilation openings. These ventilation opening, located on both sides of the compartment, are uniquely designed to trap the sand from entering the compartment. Hence, they are called sand traps.

Transformer compartments can be equipped with either oil-immersed or dry type (as an option) transformers. In case of oil-immersed transformers, normally, three phase hermetically sealed (with corrugated sheet) steel tank transformers are used. All standard and optional accessories can be offered with the used transformers. (see Fig. 7)

Fig. 7: Transformer Compartment

6. LV Compartment

This compartment contains the Low Voltage Distribution Boards (LVDB-see Fig. 8), connected to the secondary side of the transformer. The LVDB can be designed in different arrangements and configurations in order to suit a specific application with certain required equipment such as:

Air Circuit Breakers (ACB)
Moulded Case Circuit Breakers (MCCB)
LV Fuse Switches / Fuse ways
Instrumentation & Metering
Automatic Transfer Schemes (ATS)
Street Lighting Systems

Fig.8: LV Compartment

7. Connection between Equipment

Equipment safety is our concern. Accordingly and in order to have full safety of equipment inside SAHARA CSS, especially the transformer bushings, the connection between the transformer and the RMU is made with XLPE insulated cables.

The customer has the option to choose either plug-in or heat-shrink type termination as connection to the transformer and the RMU sides.

The connection between the transformer and LVDB is made with flexible busbar. The flexible part is installed to absorb vibrations caused during transportation.

Fig.9: Connection between equipments

8. Grounding

Each SAHARA substation forms a complete metallic structure bolted together. In addition, the LV and MV compartments are provided with grounding busbars. Bonding and interconnection of the grounding buses are made of 70mm^2 bare stranded copper conductors.

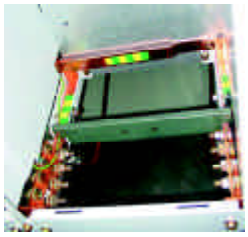


Fig.10: Grounding connection between equipments

9. Double Roof

One of the remarkable advantages of the design of SAHARA Substations Series is the double roof system. Each substation is equipped with a top slanted roof under which an additional internal ceiling is fixed. The external roof and the internal ceiling are separated by a volume of air. This air plays a remarkable role in insulating the internal equipment of the substation from the external heating sources (mainly due to sun radiation). In addition, both roof and ceiling are specially designed with ventilation openings to facilitate the air circulation and hence to support the complete cooling system of the substation. (see Fig. 11)

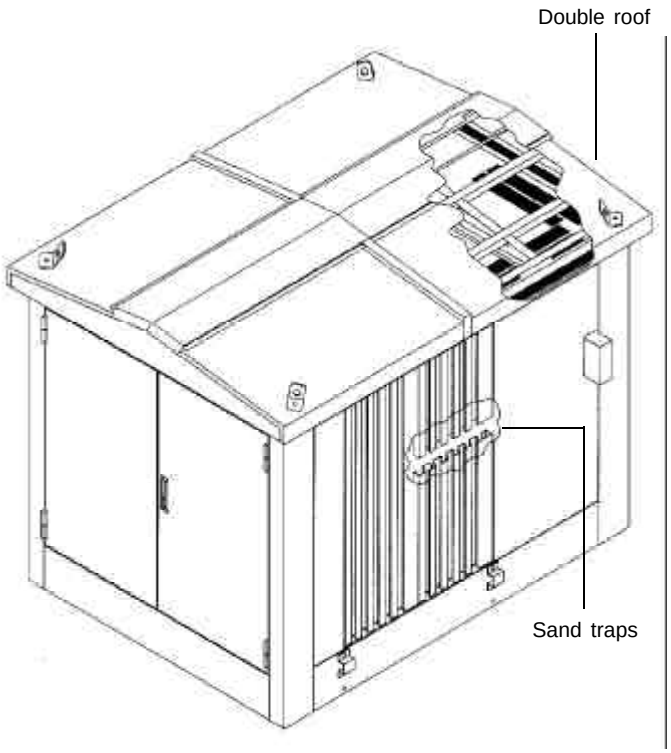


Fig. 11: Double roof & Sand traps

10. Ventilation and Sand Traps

Another remarkable feature of SAHARA substations design is the sand traps located at both sides of the transformer compartment. These sand traps are specially designed for harsh and sandy environments. While trapping the sand, these sand traps will allow the smooth circulation of the incoming and outgoing ventilation air. The natural flow of this ventilation air is due to the thermosiphon effect. Cool air enters from lower inlets. As it absorbs heat, it becomes lighter (less dense), so it rises upwards and then slowly expelled out of the substation from the outlets located on top. As a result, the temperature rise of the internal compartments of the substation can be kept within limits. (see Fig. 12)

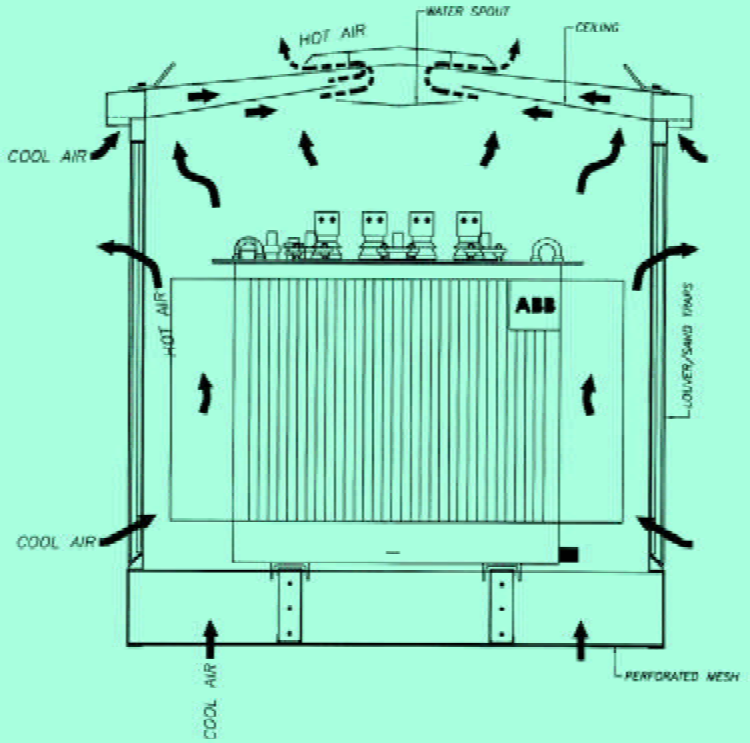


Fig.12: Natural air ventilation

11. SAHARA Range

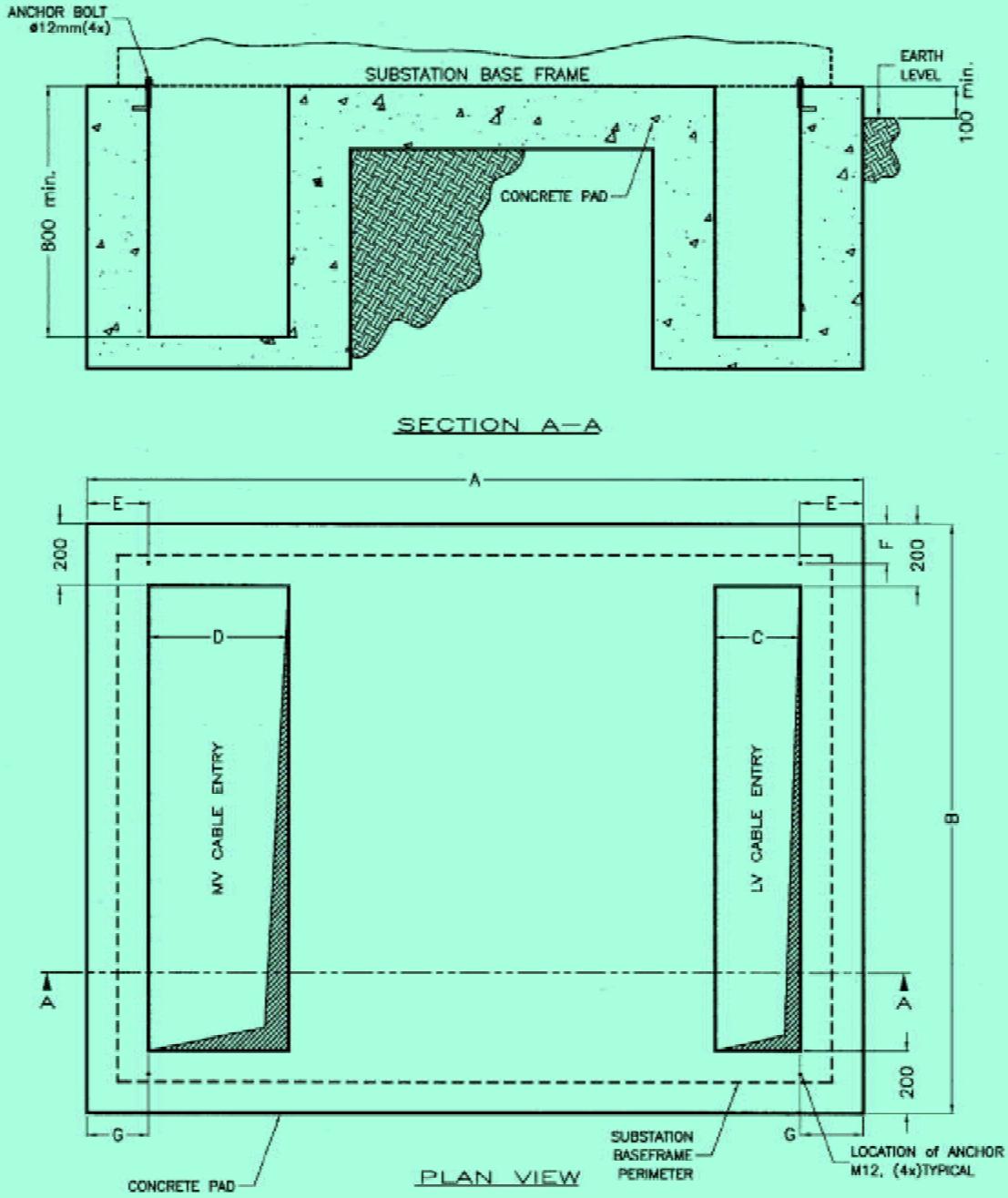
Maximum voltage rating (kV)	Substation Type	Transformer rating (kVA)	MV Switchgear		Outer dimensions (LxWxH)	Arrangement	Comments
			SF6 insulated	Air insulated		W H L	
24	SAHARA 500	Up to 500(Oil Type)	3-way	one switch/ fuse-switch	2450x1850x1875	MV TRAFO LV	As an option, one or two doors for transformer compartment can be provided
24	SAHARA 1000	Up to 1000(Oil Type)	3-way, 4-way	one switch/ fuse-switch	3050x2200x2200	MV TRAFO LV	As an option, one or two doors for transformer compartment can be provided
24	SAHARA 1600	Up to 1600(Oil Type) Up to 1000(Dry Type)	3-way, 4-way	up to 3 switches/ fuse-switches	3150x2350x2350	MV TRAFO LV	As an option, one or two doors for transformer compartment can be provided
24	SAHARA 2000	1600-2000(Oil Type) 500-1600(Dry Type)	3-way, 4-way	up to 3 switches/ fuse-switches	3750x2550x2600	MV TRAFO LV	
24	SAHARA 3000	2500-3000(Oil Type) 2000-2500(Dry Type)	3-way, 4-way	---	4150x3150x2633	MV TRAFO LV	
36	SAHARA MAX-1	Up to 500	up to 3-way	one switch/ fuse-switch	3350x2550x3250	* TRAFO LV	*MV Fuse-switch Please see the note below
36	SAHARA MAX-2	500-1600	up to 4-way	up to 3 switches/ fuse-switches	5000x2950x3040	* LV TRAFO ** ***	* MV Switch-1 ** MV Switch-2 *** MV Fuse-switch Please see the note below

Note:
1. Standard SAHARA MAX-1 & SAHARA MAX-2 are equipped with air insulated MV switches/fuse-switch as shown in the above table. However and as an optional alternative, an SF_6 insulated MV switchgear can be provided.
2. For other arrangements and ratings, please consult ABB.

Fig. 13: SAHARA 3000

Fig. 14: SAHARA MAX-2

12. Recommended Foundations



TYPE	A	B	C	D	E	F	G
SAHARA 500	2500	1900	275	450	200	125	200
SAHARA 1000	3100	2250	425	450	200	125	200
SAHARA 1600	3200	2400	425	450	200	125	200
SAHARA 2000	3700	2500	525	725	135	135	200
SAHARA 3000	4100	3100	625	825	140	135	200

Fig. 15: SAHARA 500-3000 proposed foundation plan

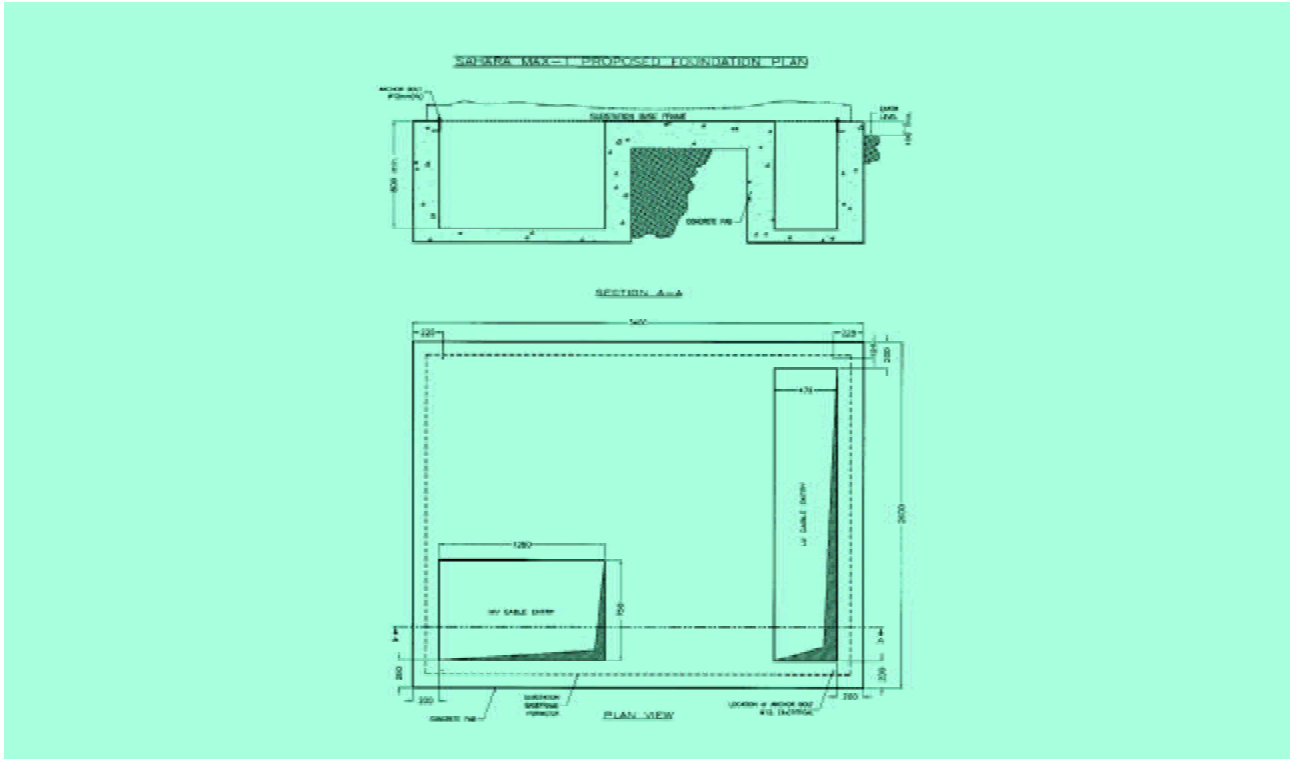


Fig. 16: SAHARA MAX-1 proposed foundation plan

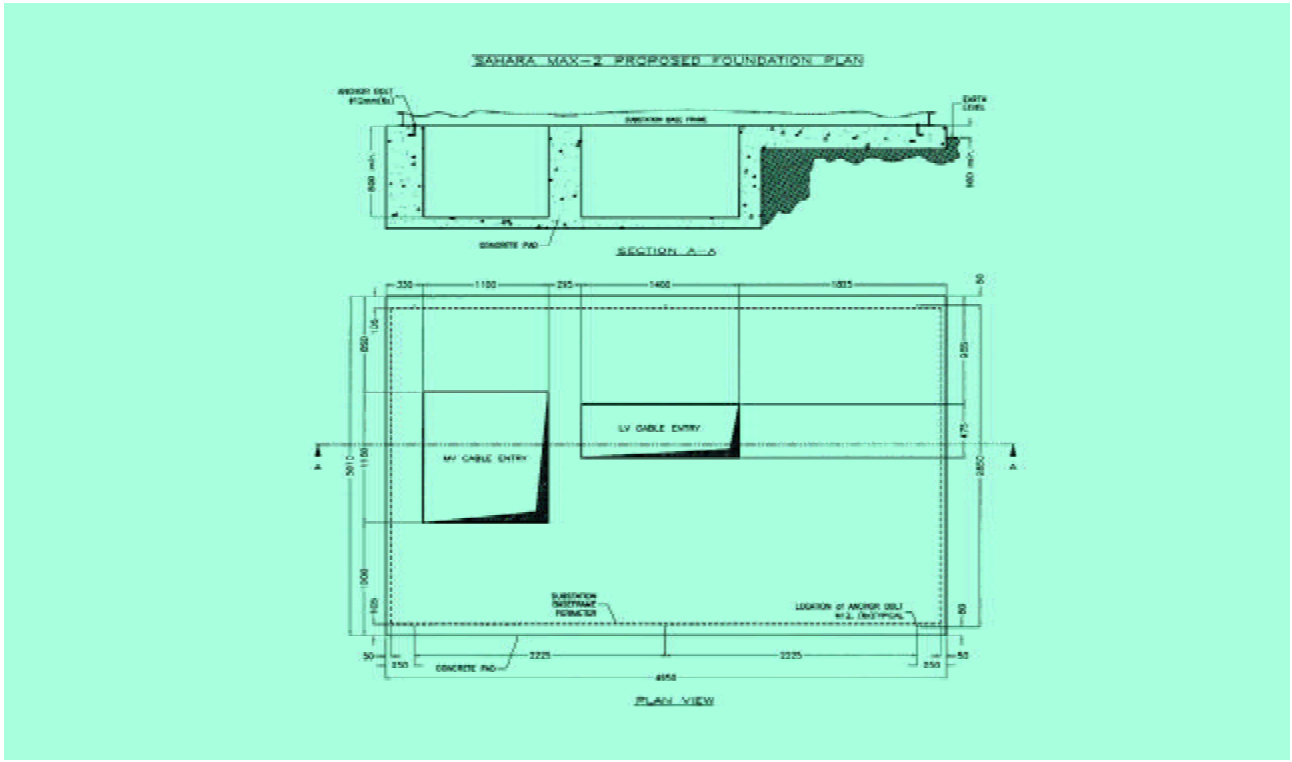


Fig. 16: SAHARA MAX-2 proposed foundation plan

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