5.5 GROUND SUPPORT EQUIPMENT AND STANDARD MOUNTINGS:

5.5.1 Ground support Equipment:

a. Hangar:
A large surface area is necessary for building a shed for the fabrication and erection of an airship. It is also necessary to protect the airship from harsh weather when it is not flying either between operations or for servicing. If the weather conditions are permissible then it is preferred to keep the airship outside the shed in order to avoid any mishaps during the entry and exit of the airship from the shed and also for proper ventilation in the case of fire. Alternatively the airship can be protected from winds by erecting two walls in the direction of the strongest winds.

b. Docking system:
The docking process of an airship can be classified into mobile and fixed docking systems. The mobile docking system is equipped with devices for automatically catching the airship as it flies over them. The airship has latch at the bottom and is required that the airship flies precisely over the mooring vehicle at a very low forward speed. This system involves complexities and is suited for small airships only.

In the fixed docking systems the airship is recovered by flying on to a turntable or mooring ring. The craft is lined up by the engagement of a docking probe and secured by mooring latch. The docking assembly can rotate freely as per the wind conditions. This system can also be used to handle large numbers of airships at the same time by combining with a rail transport system.

c. Ground stations:
Ground stations (also remote units, RUs) measure the time of arrival (TOA) of the same transponder message at one or more locations. Aircraft horizontal position is determined by processing three or more TOA measurements at a central location. Only a single message needs to be received in an update interval for accurate position determination, because signal variability (noise) is sufficiently small that it is not necessary to average multiple measurements. Aircraft identify (Mode A code and Mode S code when available) and barometric altitudes (Mode C code) are determined from information in transponder messages [70].
d. **Central processing site:**
A central processing site (CPS) is the one where data provided by the RUs are processed to derive aircraft positions. The CPS also displays aircraft positions and monitors the status of the system.

e. **ITACS (Integrated Tracking and Control System):**
   It consists of three subsystems, the Meteorological, Especially Wind Observation and Prediction System (MEWS), the Flight and Operation Simulator (FLOPS), and the Telemetry, Tracking and Command System (TTRAC).
   The MEWS measures and forecasts weather for operation safety using its own weather measuring equipment comprised of a weather Doppler radar, a wind profiler, and a Doppler sonar, based on its own meteorological model, and by referring to the weather data supplied by the Meteorological Agency. The FLOPS consists of PCs and a workstation interconnected via LAN and remote command terminals with a side stick type controller for pilot command inputs, and LCD displays for visual information and multi function displays (MFD) [71].

f. **Blower:**
Inflation can be assisted by using a ground based inflation blower. The blower, while helpful, is not strictly necessary. In any case, once inflation is complete, the blower is turned off and the structure is statically self-supporting [72]

g. **Ground Station linked to the Platform and Transmitting Alarm:**
The ground stations automatically disseminate alarm signals through speakers as soon as they receive specific warning commands from a platform. All the stations are independently powered by the individual solar array clusters with secondary batteries day and night.

h. **Monitors:**
Ground system consists of monitors, where the real images broadcasted by the onboard video-cameras are integrated with synthetic scenarios

i. **AMM:**
The ground-based automation system, AMM, typically located at the airport that would provide appropriate sequencing information to the arriving aircraft. The AMM provides an arrival sequence and broadcasts the total number of arriving aircraft in the SCA. It does not, however, provide separation, altitude assignments, or sequence departures.
j. ADS-B:
Automatic dependent surveillance-broadcast (ADS-B) is a cooperative surveillance technique for air traffic control and related applications. An ADS-B-equipped aircraft determines its own position using a global navigation satellite system and periodically broadcasts this position and other relevant information to potential ground stations and other aircraft with ADS-B-in equipment.

ADS-B provides accurate information and frequent updates to airspace users and controllers, and hence supports improved use of airspace, reduced ceiling/visibility restrictions, improved surface surveillance, and enhanced safety, for example through conflict management.

Under ADS-B, a vehicle periodically broadcasts its own state vector and other information without knowing what other vehicles or entities might be receiving it, and without expectation of an acknowledgment or reply. ADS-B is automatic in the sense that no pilot or controller action is required for the information to be issued [73].

k. Ground control system:
A ground control station (GCS) is a land- or sea-based control center that provides the facilities for human control of unmanned vehicles in the air or in space.

The UAV Ground Control Station (GCS) is a commercially available trailer. The trailer incorporates an integral uninterrupted power supply (UPS), environmental control system (cooling only), pilot and payload operator (PPO) workstations, data exploitation, - mission planning, - communication (DEMPC) terminals, and synthetic aperture radar (SAR) workstations. All mission imagery recording is located in the GCS since the Predator has no onboard recording capability. Power is supplied either by commercially supplied power or by dual external 35 kW generators [74]

To control the airship on the ground efficiently, GCS is designed to have two major modules, Mission Module and Payload module. GCS is designed to have 3 racks to install Mission Module, communication equipments and Payload Module. For the optimal operation of unmanned airship in GCS, S/W modules such as mission planning, networking and real time control, etc. are required. Mission Module has the function of mission planning, airship control and system status displaying. Before flight, in the map of Mission Module, flight mission planning will be carried out. Airship flight information and status of communication system are
displayed on the screen. Various control commands can be imposed through touch panel, knobs and switches at the module.

Image Module has the function of controlling mission payload and displaying acquired data and status of the payload. Real time image will be transmitted with the map information of the image [75].

I. GPS Receiver:

GPSR contains GPS antennae, LNA (Low Noise preamplifier) s, and GPSR processing unit. The GPSR processing unit consists of CPU’s, DSP, and SIOP (serial input/output processor). Signals received by a GPS antenna are amplified by LNA. In this process, only GPS signals are extracted through RF filters for the removal of out-of-band RF interference, and are supplied to a GPSR processing unit. The GPSR processing unit has interfaces with the electric power sub system and with housekeeping data subsystems, in addition to GCC data interface.

Communication between the ground station and the airship occurs over two radio links. One of them operates in analog mode to transmit video imagery from the airship to the ground station. The other operates in digital mode to transmit sensor and command data between the ground and onboard stations. An error detection scheme utilizing checksum insures digital data integrity.

Mounted at reference ground locations, there is a third GPS antenna and receiver used as a base reference for differential GPS measurements of the two airborne units.

m. Human-Machine Interface:

The human-machine interface (HMI) of ground station provides the communication and visualization mechanism between the operator and the airship. The operator uses this interface to receive and visualize flight data acquired onboard, and to define the control parameters and flight profile. This interface is enveloped using Visual C++ 6.0 object-oriented programming environment, and its main functionalities are detailed in the following.

1) Flight data display and storage: The flight data from onboard system is displayed in corresponding textbox and stored in a file appointed by user at the same time. The stored data provide the first-hand information for further flight investigation and analysis.

2) Ground command editor: It is provided to edit ground command, calculate the checksum and transmit to onboard system. It’s necessary for user to define flight profiles and change control
parameters. During mission execution, if any unforeseen event occurs which cannot be automatically solved by the robotic airship, the ground operator intervene through this editor.

3) Flight path visualization: The vehicle flight path and geographic information can be shown in a longitude-by-latitude window. It is capable of zooming, panning, and freezing so that users can examine in detail the flight data.

4) Airship attitude visualization: The airship attitude is shown in two ways simultaneously. One way is to use avionics panel to present a representation of compass data, i.e. angles of heading, pith and roll of the airship. The other way is to model 3D geometrical body using OpenGL libraries to of the airship [76]

   n. User terminals:

   Fixed ground terminals can be a self-contained PC office configuration with modem, or as an integrated part of an advanced LAN or WAN, laptop, fixed telephone set in office or public and mobile or cellular phone equipment.
   At this point mobile ground terminals can be PC portable or laptop configurations interfaced to the transceiver with adequate antennas or self-contained mobile or portable/in vehicle transceiver units with mobile auto tracking antenna and personal handheld terminals with built-in antenna [77].

   o. Transmitter location equipment:

   The ground monitoring and transmitter location of illegal electromagnetic waves or mobile access users represent applications that could benefit from the strong visibility of the HAPS. Conventionally, the transmitter location is conducted using sensor antennas on the ground. When the antenna is elevated to the altitude of the stratosphere, the influence of multipath and shielding can be reduced; therefore, it is expected that high-accuracy and wide-area transmitter location of electromagnetic waves may be realized. To demonstrate this fundamental concept [78]

In the event that there is no direct mechanical linkage provided between primary controls of the pilot in the ground station and control surfaces a method for the pilot in the ground station to easily and rapidly transition from the primary means of controlling those surfaces to the emergency (control) system such that no unsafe flight characteristics are encountered and the probability of complete loss of control and landing capability is unlikely.
5.5.2 Standard mountings:
Fins, nose cone, battens, air valves, and helium valves are attached while the envelope is still near the ground. After these parts are attached, the envelope is allowed to raise high enough to permit rolling the gondola underneath it. After the gondola is attached, the net is removed and the airship is rigged for flight [79]

a. Ballonets:
Ballonets are air-filled bags that are located inside the envelope. The blimp has two ballonets, one at the front and another at the rear. The ballonets are similar to the ballast tanks of a submarine. Because air is heavier than helium, the ballonets are deflated or inflated with air to make the blimp ascend or descend, respectively. They are also used to control the trim, or levelness, of the blimp.

The ballonets are typically inflated by ram air from the propeller wash entering the air duct mounted directly aft of the propeller. The air is routed by the duct to two damper valves which can be opened to allow the air to enter either or both of the ballonets, as directed by the pilot. If the air flow from the prop wash is not sufficient to keep the ballonets inflated, or in the event of an engine failure, electric blowers mounted in the air duct can be used to keep the ballonets inflated [80].

b. Gondola:
The gondola holds the passengers and crew. It is enclosed, and holds two pilots and up to 12 crew, depending upon the type of blimp (Goodyear's Eagle and Stars & Stripes each hold two pilots and six passengers). Some gondolas have specialized equipment, such as a camera, attached to them [81].

Fig 5.21: Gondola Exterior and Interiors