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MOBILE RAIN GAUGES

ABSTRACT:

Stationary Rain gauges have many problems in siting, maintaining and placing only one rainguage for large area. Mobile rain gauges are moving rain gauges which are used to measure rainfall by moving from one place to another. The problems or disadvantages of stationary rain gauges can overcome with these rain gauges by making some assumptions. Use of these rain gauges is economical at some places like hilly areas.

INRTODUCTION

RAINGAUGES

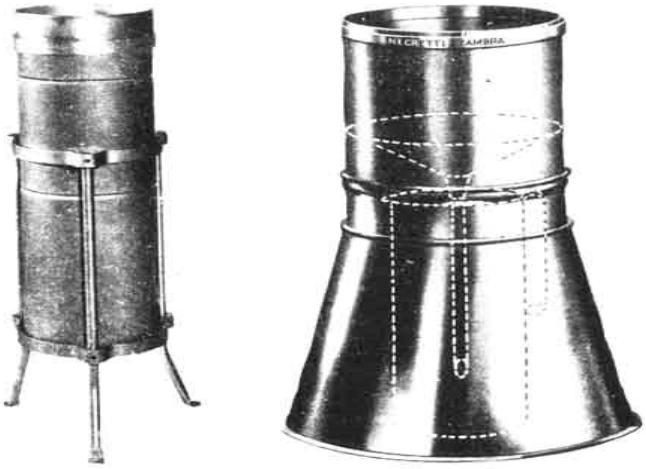
Rain gauges have a cylindrical form. The leakproof collector rim is placed above a funnel which leads to a receiver. The receiver should have a narrow neck into which the funnel fits to reduce evaporation loss.

The collector should have a receiving area of 200 to 500 cm^2. The rim of the collector should have a sharp edge which falls away vertically inside. The collector is designed so that rain cannot splash out; the walls should therefore be sufficiently deep and the slope of the funnel sufficiently steep (more than 45°).

Rain gauges are made of non-corrosive metal, fibreglass or plastic. Since type, diameter of the collector, height and way the gauge is exposed vary considerably from country to country, it is important that the type selected and method of installation should be like any other rain gauge in the area to obtain comparable data. Normal height of exposure is usually 30 cm above ground level. At greater height wind affects the accuracy of measurement. Where the rain gauge placement and particularly the siting are very different from local practice, a side by side comparison between the two rain gauges may be needed. The graduation of the gauging device (jar or rod) must, however, always be consistent with the size of the collecting area of the rain gauge. A number of rain gauge types are shown below.

SITING

The site must be level and the surrounding ground should be uniform. The ground should preferably be grassed or loose earth. No object such as another instrument, building or trees should be closer than four times their height. Very exposed sites, such as on the top of a hill, should be avoided. For very exposed sites without any natural shelter rain gauge shields are sometimes used. The rain gauge should be firmly mounted on a concrete base. The rim of the rain gauge must always be horizontal.



MAINTENANCE

Rain gauges should be checked for leakage; dust and leaves should be removed from the collector. The inside should be cleaned but should not be polished. The measuring cylinder should be clean, and should not be dented. A spare measuring cylinder should be available. Plant growth around and above the rain gauge should be kept out.

Rain gauges have their limitations. Attempting to collect rain data in a hurricane can be nearly impossible and unreliable (even if the equipment survives) due to wind extremes. Also, rain gauges only indicate rainfall in a localized area. For virtually any gauge, drops will stick to the sides or funnel of the collecting device, such that amounts are very slightly underestimated, and those of .01 inches or .25 mm may be recorded as a trace.

Another problem encountered is when the temperature is close to or below freezing. Rain may fall on the funnel and ice or snow may collect in the gauge, blocking subsequent rain.

Rain gauges should be placed in an open area where there are no obstacles, such as buildings or trees, to block the rain. This is also to prevent the water collected on the roofs of buildings or the leaves of trees from dripping into the rain gauge after a rain, resulting in inaccurate readings.

The total amount of rainfall over a given period is expressed as the depth of water which would cover a horizontal area if there is no runoff, infiltration and evaporation. This depth is generally expressed in millimetres.

Accuracy of rainfall measurement is mainly affected by wind, by the height of the gauge and exposure. Wind and exposure errors can be very large, even more than 50 percent. The catch of rainfall is a function of the height of the gauge; the more open the location the greater will be the difference in catch with height

WMO recommendations on rain gauge density

Flat regions of temperate, Mediterranean and tropical zones

- Ideal – 1 station for 600-900 sq.km.
- Acceptable – 1 station for 900-3000 sq.km.

Mountainous regions of temperate, Mediterranean and tropical zones

- Ideal – 1 station for 100-250 sq.km.
- Acceptable – 1 station for 250-1000 sq.km.

Arid and polar zones

- Ideal – 1 station for 1500-10000 sq.km. Depending on the feasibility.

10% of rain gauge stations should be equipped with self-recording rain gauges

BIS recommendations on rain gauge density

- In plains – 1 station for every 520sq.km.
- In regions with average elevation 1000m – 1 station per 260-390 sq.km.

- In hilly areas with heavy rainfall – 1 station for every 130 sq.km.

DRONES

A drone, in a technological context, is an unmanned aircraft. Drones are more formally known as unmanned aerial vehicles (UAVs) or unmanned aircraft systems (UASes). Essentially, a drone is a flying robot. The aircrafts may be remotely controlled or can fly autonomously through software-controlled flight plans in their embedded systems working in conjunction with onboard sensors and GPS.

In the recent past, UAVs were most often associated with the military, where they were used initially for anti-aircraft target practice, intelligence gathering and then, more controversially, as weapons platforms. Drones are now also used in a wide range of civilian roles ranging from search and rescue, surveillance, traffic monitoring, weather monitoring and firefighting to personal drones and business drone-based photography, as well as videography, agriculture and even delivery services.

There are long range radio systems available that can be used to extend the range to 15-20 kilometres.

DJI Matrice 600

- Operating Range: 5000 meters (16404 feet)
- Weight: 9600 grams (21.2 pounds)
- Battery: 22.2V 4500mAh Li-Po 6S
- Flight Time: 16 minutes
- Payload Capacity: 6000 grams (13.2 pounds)

- Maximum Speed: 18 m/s (40 mph)
- Maximum Flying Altitude: 2500 meters (8202 feet)

Average height of buildings in India in 4.7 floors

Highest height of building in India 268 metres in Kolkata

Under construction height in Mumbai is 442 metres

Planned to rise to 718 metres.

Highest hill range in India is 2695 metres.

- At places where there are obstacles it can be raised to a height such that the height raised becomes a plane of no obstacles.

Rainguage attached to a drone is shown below.

According to BIS,

In plains 1 station per 520 sq.km. which is placed statically at a place.

A drone can be controlled up to 5 km of range

Area of 25 sq.km can be covered with a single drone.

- The advantage of using the mobile rain gauge is it can cover 25 sq.km area and move from one place to other for measurement of rainfall at any place.
- As we assume that rainfall is uniform throughout at a place near to the rain gauge we don't get accurate value of rainfall.
- By using these mobile rain gauges, we can measure accurate rainfall.

In hilly areas, we provide 1 station for every 130 sq.km

Area of 25 sq. km can be covered with a single drone.

From this we can say that approximately 1 rain gauge station can be replaced with 4 drones which is attached with a rain gauge.

Assumption is to be made in these rain gauges that the rainfall at a certain is equal to rainfall at ground level for hilly areas (assuming there are no hills).

CONCLUSION:

Rain gauges at a place cannot measure the rainfall which is very near to it. this is the main disadvantage of using stationary rain gauges. Fixing the rain gauges permanently may causes damage. Regular checking should be done by going to the place where it is situated.

Drones are used in weather forecasting. By using rain gauges attached to drones we can know the rainfall measurement by moving it from place to place by using GPS. It is also used in hilly regions by raising to a certain height. To know the rainfall at high rise building areas such as highly developed areas by knowing the rainfall we can estimate the precipitations and cause of floods. By making an arrangement of direct transfer of data of rainfall from mobile rainguage directly to station. By using sensors which detect the occurrence of rainfall can alert the drone by sending the location to it. It is economical. As the technology is developing the drones of more range can be invented which can be also used in measuring rainfall.

This is only an idea of using moving rain gauges instead of using so many number of rain gauges at places where there is no rainfall.

As the technology is developing the capacity of Drones can be increased and the range they can be operated may be increased upto 100 km range in future so that it can cover an area of 10000 sq.km .

It becomes more economical by replacing more number of rain gauges which are stationary.

REFERENCES

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- https://theconstructor.org/water-resources/design-of-raingauge-networks/4477/