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Airport with a circular runway in India

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ABSTRACT

In India, there are 26 international airport and 18 domestic airports. Indira Gandhi International airport in Delhi is the busiest airport in India with 63.5 million passengers in 2017. It is predicted to cross 80 million in 2018. It is the only airport to enter into the top 20 Asia busiest airport. There are three runways at IGI with flight movement from 76 to 96 per hour. India receives 122 million domestic and 47 million international passengers. Circular runway concept is the concept which had been in considerations for a long time. This concept offers a large quantity of facilities and new airport managing system. There is a runway which is constructed in form of a circle consisting of segments. This concept will be applied on the existing airports in India and feasibility will be determined. This will help in forming a new basis for construction of the airport. It is going to help the country both economically and financially. If feasible it will solve problems which are currently being faced in all over India like bad baggage handling at Chennai airport, flight delay due to the busy runway, the single airport in Delhi (Delhi being the large passenger junction) etc. The circular runway will provide high air traffic movement with more aircraft movement per hour. In this paper, we are going to design two Circular Runway for existing airport and check the feasibility of construction of a new runway in India.

Keywords: *Circular runway, traffic movement, noise, ATM tower.*

1. INTRODUCTION

India being the developing country with large population inbound and with large tourism network. It offers tourist from all around the world through flights. India is expected to welcome 217 million domestic with 76 million international passengers by 2020. There is a need for crowd handling airport facility with the high efficient airport in India. India can emerge as third highest aviation by 2020. There are many abandoned airports in India which are to be rebuilt for smooth movement of traffic throughout the country. The traditional airport can be used at low-cost basis at places where the movement is very less but for hub airports like IGI in Delhi, it requires more runways, which comes at the cost of a lot of areas, facilities, location distance from the city, conveniences? To satisfy the all the requirements we are going to apply the concept of circular runway to the existing airport and check if this concept is to become feasible it is required to be applied properly. The circular runway had never been implemented in India till now. This will give us the foundation for the new type of airport in India. The taxiway will be available outside but along the runway. There is going to be short landing and fast take-off. This runway offers us to counter the wind in any direction. This enables us to use natural wind pattern to our advantage. Further, this will help in saving fuels, aircraft maintenance, and repairs. The capacity will be increased suddenly. This concept will be applied on the airport with a large crowd like IGI and Chhatrapati Shivaji airports. This concept cannot be applied to smaller airports where the need is less. There is going to be

new ATM procedures which are to follow without any discrepancies. This will have low noise impact with possibly more aircraft accommodation. There will less chances of fail landing, if so it occurs by chance there is fast turnaround quickly possible.

A. CONCEPT

- The circular runway will increase the number of aircraft landing and take off at the same time without ramming into each other.
- The high moving wind is used for take-off along its direction i.e. moving in the same direction parallel to aircraft, thus will save fuel.
- Aircraft can land quickly by landing in opposite direction to high wind.
- Cross winds will not affect the procedure at a high level as it can be reduced.

B. OBJECTIVE

- Apply the circular runway concept to existing major hub airport in India and to compare it.
- To find the feasibility of the concept in India.

2. METHODOLOGY

To implement the concept let's take in consideration two existing major airports in India which are as follows:

- Indira Gandhi International Airport (Delhi)
- Chhatrapati Shivaji International Airport (Mumbai)

These Airport are selected due to their unique feature and being the hub of movement of passengers and recording the highest in-flight movement throughout India.

The information regarding the two above mentioned Airport in collected. The information should cover the total cost of construction, area coverage, facilities available, baggage system, noise impact in the nearby vicinity, ATC management system, runway length. The Data is collected through Airport Authority of India.

I. Indira Gandhi International Airport (IGI)

- The total cost of Project construction is equal to 12718 crore rupees.
- The Airport is spread over an area of 5106 acres.
- There are 3 runways of length 2813m, 3810m, 4430m with an asphalt surface.
- The width of runways is 45m, 46m, 60m.
- It has 6 Terminals and one Cargo terminal.
- It has 7.84 mw solar plant.
- The capacity of 80 million passengers.
- Located 10 km from the city.
- 15 Hangers available.
- Baggage system-12,800 baggage /hr with tilt tray sorter.
- 12 km of aviation fuel hydrant system.
- Noise pollution in nearby area Vasant kunj and bijwasan.
- 55 Immigration counters.
- No provision for control and monitoring for efficient energy management.
- 1339 air traffic movement.
- The 3 runways cannot operate simultaneously.
- Approach lights are of CAT-1 and CAT-B type.
- ATC tower is 101.9m in ht.

II. Chhatrapati Shivaji International Airport (CSI)

- The total cost of project construction is equal to 12380 crore rupees.
- The airport is spread over an area of 1500 acres.
- Thera is 2 runway of length 3660m and 2990 m.
- The width of the runway is 60m and 45m.
- Cargo apron can hold five bodied aircraft.
- There is 6 terminal with 3 as old terminals.
- It has seating capacity for 900 passengers and movement of 50 million passengers.
- The runway has gone under maintenance continuously with a cost above 400 crore rupees.
- 969 air traffic movements.
- Approach light of CAT 1(Both Direction).
- ATC tower is 85m in ht.

III. Circular Runway

The circular runway will be used against traditional runway as it provides far greater benefit. Circular runway offers movement of 2 or more aircraft simultaneously. The circular runway has outer taxiway along the outer edge of the runway. The outer edge in elevated at 30% for a smooth landing of aircraft against cross wind and to counter centrifugal force acting on the aircraft. Outer edge can be expanded d at higher width for construction of facilities or accommodation inside the runway. The ATM TOWER is located in the center for continuous monitoring of aircraft. The runway is divided into segments which are allocated to particular aircraft during take-off and landing. Lights are provided along the runway to help the pilot land. It provides more area which can be used to make more check points and baggage system. The inner edge of the runway has no elevation. There is quicker exit taxiway throughout the outer edge of the runway. For defining the runway against traditional runway we are going to consider new approach method. The assumptions are as follows:

- The length of the circular runway will be no of aircraft movement multiplied by the longest existing runway.
- The width of the runway will be 2.5 times width of the existing width of the longest runway.
- The ATC tower situated in the centre of the runway along with the airport building.
- Airport building can be situated outside runway at a considerable distance with the underground movement.
- Noise Impact is reduced and movement can be increased for the busy airport by constructing larger runway to allow more aircraft at the same time.
- Temporary strips of the segment can be used instead of a delay in take-off.
- The route can be changed with the change in direction.
- Cost of expenditure is 1.1-1.6 times traditional runway as per ERAC.

3. RESULT

I. Designing of the new runway:

A. IGI AIRPORT

Taking length existing of runway = 4430m

For movement of 3 aircraft at same time length of circular runway =3x4430m

=13290m

Radius of runway (outer)R

=2116.24m

Width of runway =2.5x60m

=150m

Radius of runway (internal)r =1966.24m

Providing 4 taxiways along the strip and facilities inside the runway

Lights are provided at both outer and inner edge of the runway at 15m intervals with alternate red and white light for next 300m and 600m.

Total area covered =3.14xRxR sqm

=3474.89 acres

Minimum Distance between two aircraft is

=120m

The centralized terminal is provided underground with finger piers and 80 gates. High-intensity runway lights are installed on the runway for different purposes like taxiway, centreline etc.

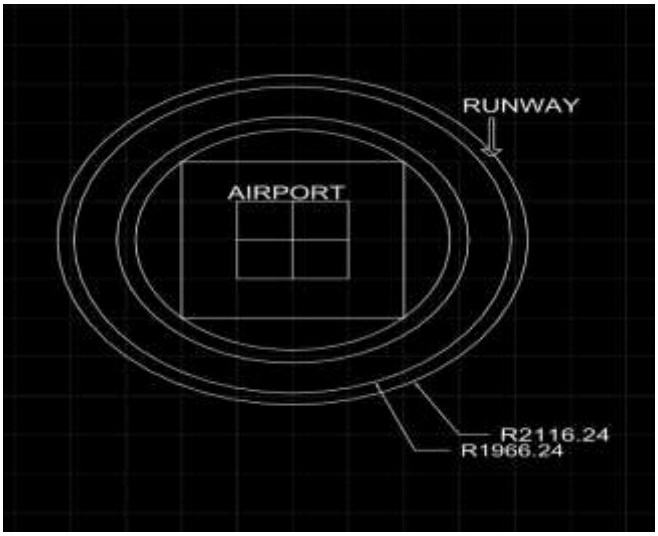

Chart-1: CAD Diagram of IGI Airport

B. CSI AIRPORT

Taking length existing of runway y= 4430m

For movement of 2 aircraft at same time length of circular runway =2x3660m

=7320m

Radius of runway (outer)R =1165m (approx.)

Width of runway =2.5x60m

=150m

Radius of runway (internal)r

=1015m

Minimum Distance between two aircraft is

=120m

Providing 4 taxiways along the strip and facilities inside the runway

Lights are provided at both outer and inner edge of the runway at 15m intervals with alternate red and white light for next 300m and 600m.

Total area covered =3.14xRxR sqm

=1053.086 acres

The centralised terminal is provided underground with finger piers and 60 gates. Medium intensity runway lights are installed on the runway for different purposes like taxiway, centreline etc.

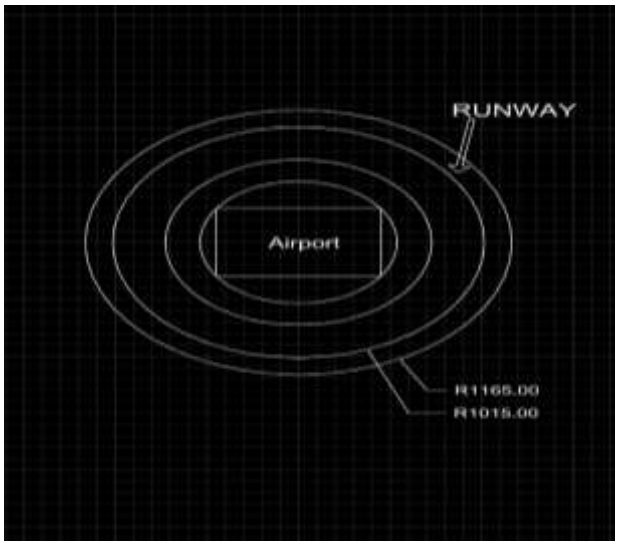

Chart-2: CAD Diagram of CSI Airport

II. FEASIBILITY IN INDIA

The project feasibility Depend on two major points

- The master plan of runway design
- Capital expenditure

Our project is to find the circular runway design feasibility in the place of the existing runway and can it be implemented in our country. For this, we are required to have data which can give a clear view. That is why we have redesigned circular runway for two major hub airport in India. When comparing traditional runway design to the circular runway design for IGI and CSI Airport we get the following data:

- Taking average cost of construction equal to 1.35 times cost of the traditional runway.

Table -1: Design Parameters

Parameters	**Traditional Runway**	**Traditional Runway**	**Circular Runway**	**Circular Runway**
	IGI AIRPORT	CSI AIRPORT	IGI AIRPORT	CSI AIRPORT
RUNWAY LENGTH AVAILABLE	2813m 3810m 4430m	2990m 3660m	13290 m 2116.24m (outer radius)	7320m 1165m (outer radius)
WIDTH	45m 46m 60m	45m 60m	150m 2-3 segment	150m 2-3 segment
AIRCRAFT MOVEMENT AT SAME TIME	1	1	3	2
COST OF CONSTRUCTION (Crore Rupees)	12718	12380	17169.3	16713
AREA (in Acres)	5106	1500	3474.89	1053.086

4. CONCLUSION

Through our project analysis, we now know that the circular runway is not feasible in India right now. The design itself can be constructed. This concept has not been implemented till now in India due to its non-executed trials and high requirements. The implementation requirement as follows:

- The area covered at IGI is 5100 acres and at CSI is 1500 acres.
- Area required by Circular Runway at IGI is 3474.89 acres and at CSI is 1053.086 acres.
- Area profit at IGI is 1631.11 and at CSI is 446.914 acres.
- The Aircraft movement at Terminal 3 (IGI) is 1150 aircraft per day (approx...) and at CSI is 780 aircraft per day.
- The circular runway can provide 2300 at IGI and 1500 at CSI aircraft movement per day.
- Time delay at IGI (terminal 3) and CSI (terminal 2) is around 6 min. at min traffic on other hand time delay on the Circular runway is very rare.
- Require high capital investment.
- The circular runway cannot be extended if demand grows.
- The maintenance and repair could disrupt the whole runway movement.
- For new airport construction, existing cannot be scraped.
- It can only be applied to smaller airports but the cost will not be recovered by operating at maximum efficiency.

Concluding, keeping in consideration all the design parameters for the circular runway.

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