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Airports Commission
Sanctuary Buildings
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SUBMISSION TO AIRPORTS COMMISSION

The issue of additional capacity at Heathrow Airport is complex and will not be solved without some potential downside. In the prevailing circumstances a resolution will require considerable thought and inevitably a degree of compromise on the part of the disparate interests at play.

I respectfully make to enclosed Submission to the Commission within the context that all possibilities should and must be explored, however extreme they might at first appear.

Yours sincerely,

[redacted]

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SUBTERRANEAN AIRPORT RUNWAY

The present invention embodies a novel and innovative subterranean airport runway concept.

BACKGROUND

The International Civil Aviation Organisation defines a runway as "a rectangular area on a land aerodrome prepared for the landing and take-off of aircraft".

The present invention is relevant where runway capacity, or the number of air transport movements (ATM's) is limited or restricted by factors irresolvable by conventional airport runway construction methods. The three principal problems addresses in the invention are; a) availability of land on which to build new runways, b) noise pollution and c) air quality.

The invention applies In particular where there are no viable means by which an increase in runway capacity can be achieved within the legal, physical, environmental and geographical constraints of the airport.

The invention may be employed in the construction of new airports and or as a retro fit into existing airports that require a significant increase in runway capacity in order to meet demand.

A good example of this situation is London Heathrow Airport (LHR) which currently operates at 99% capacity with ever increasing demand for additional air transport movements (ATM's). LHR operates 477,000 ATM's per annum with 68 million passengers being carried. The immediate need is for an increase to 600,000 ATM's by 2020 and as much as 700,000 ATM's by 2030.

Currently flight operations at LHR are from two parallel East – West runways of 3902 and 3658 meters in length and 45 meters wide.

At Heathrow, creating additional runway capacity to meet demand is constrained by geography and location of adjacent conurbations, road networks and infrastructure as well as environmental concerns such as noise levels and air quality.

The example of Heathrow Airport (LHR) does not limit the scope of the invention.

The concept embodied within the invention may apply to commercial airports but there may also be a need to employ this design concept in the construction of military airfields and aircraft carriers.

All major airports are inevitably a balance between the economic needs of a nation and the potential detriment to the environment and local interests.

London Heathrow Airport is estimated to contribute between £5-6 Billion to the national economy annually and is directly or indirectly responsible for generating approximately 200,000 jobs.

Balanced against this is the potential environmental damage, including two key elements – air quality and noise levels – both of which are under strict control through European legislation. An additional factor is the potential detrimental effect on local populations and the negative impact that an ever busy airport can have on their wellbeing.

Any increase in ATM's, in order to meet demand has the potential to cause increased noise levels and reductions in air quality.

Critically, in the case of LHR there is insufficient land available within the existing airport boundary to site a third runway. Consequently, a number of local villages and habitations would have to be destroyed in order to provide sufficient space for a third runway, if this option were to be considered.

A practice known as Mixed Mode Operation has been considered as a temporary stop-gap at LHR. This operational procedure involves the alternate use of one runway between take-offs and landings. This procedure could increase ATM's by 60,000 per annum but is not sufficient to meaningfully deal with the needs of the airport and has been rejected as a viable alternative.

The invention herein is concerned with the construction of safe and efficient runways designed to provide increased ATM's within the existing boundaries of airports, where expansion by additional conventional runway construction is constrained due to physical, environmental and geographical factors and where airport operations cannot be conducted within legislated constraints applied to noise and air pollution.

There are many criteria influencing the design and construction of airports and their runways. These include but not limited to;

- length, width and strength of the runway determined by the requirements of the type of aircraft using the airport,
- materials of construction appropriate to the weight and size of the aircraft,
- direction of orientation of the runways influenced by prevailing wind direction,
- design characteristics and use spectrum determined by environmental considerations such as noise pollution and exhaust pollution,
- general nuisance and disruption of local conurbations,
- available land,
- topography of the local environment,
- capacity requirements for the airport as a whole,
- location in relation to centres of population and or local transport

Under normal operating conditions an airport will utilise two parallel runways simultaneously. One runway for take-off and the other for landing. In this situation take-off and landing are segregated. For an airport operating east-west runways both movements happen in the same direction i.e. the landing aircraft will approach from the east whilst the departing aircraft will take-off towards the west. This ensures separation of the aircraft on the approach path from aircraft departing on the ascent path.

Under 'mixed-mode' operation both landing and take-off happens on the same runway alternating between the arrival and departure of an aircraft.

DESCRIPTION OF THE INVENTION

The invention will be described with reference to the accompanying diagram, Figure 1.

Details of relevant civil engineering will not be described herein as this is well known to anyone familiar with the art.

The accompanying diagram Figure 1, is for illustrative purposes only and does not represent precise dimensions or proportions. The exact detail of design will be determined by those familiar in the art of engineering and architecture.

The invention herein described allows for the construction of a subterranean runway. This runway is designed and constructed in conjunction with a normal surface runway so that the two runways operate in tandem. One above ground 1, see Figure 1 and the other situated below ground 2, see Figure 1.

In this configuration the conventional surface runway is designated for landing aircraft and the subterranean runway is for take-off only. However, the surface runway may also be utilised for take-off movements if circumstances require.

The two runways may be constructed one on top of the other or the subterranean runway may be sited to one side or other of the surface runway. The two runways may be constructed in parallel to each other or off-set so that both runways have a different directional orientation, Figure 1.

The purpose of the invention is to increase the number of ATM's (airport capacity) without the need for additional ground space or land. In effect, to allow an airport to expand operations without expanding the boundaries of the airport itself.

Vitally, the increase in ATM's is achieved without an increase in noise and air pollution. In some circumstances it may be possible to reduce the existing levels of noise and air pollution at a given airport.

An airport operating such a runway system will effectively double the runway capacity by virtue of the fact that take-off and landing can occur simultaneously and there is no need for a time separation between take-off and landing as per conventional single runway use. Subject to safety requirements.

The invention may be applied to a single runway or to multiple runways. At existing airports and or within airports under construction. By means of an example, at Heathrow Airport either one of the existing runways could be duelled with a subterranean runway or if required both existing runways could be duelled.

The invention does not seek to limit the final configuration of the two runways as a number of options may determine the final design within the unique circumstances of each airport.

In the majority of situations where the invention is employed the take-off runway will be subterranean within a tunnel. However, if geography and or geology determine otherwise it is possible for the take-off runway to be on the ground surface with the landing runway being built above ground in a manner similar to some double-decker bridges and motorways.

Airports vary as to the length of the runways but an average international airport will have runways from between 3,500 meters and 5,500 meters in length and 80 meters wide. These dimensions will accommodate the largest commercial jets. Some military runways may be longer.

The subterranean runway herein is designed and built to dimensions considered safe and efficient for the effective movement within a tunnel of jet aircraft of all types likely to utilise an international airport. The precise dimensions will not be discussed herein as they are known to anyone familiar in the art of engineering.

Within the invention herein described the designated landing runway will be utilised as per a conventional surface airport runway. Operating with the aircraft landing and then departing by taxiway in the normal manner.

Within the invention herein described the subterranean take-off runway for departing aircraft will employ a number of specific operational procedures unique to this system.

In an ideal configuration the subterranean take-off runway tunnel has an exit opening at each end in order that the runway may be utilised in both directions according to wind direction and airport operational requirements 3, see Figure 1.

The subterranean runway tunnel may also have an exit point at only one end if circumstances dictate.

As described in the invention herein the subterranean take-off runway is ideally longer than the landing runway according to Figure 1. This allows for the exit points at each end of the subterranean take-off runway tunnel to be situated beyond either end of the landing runway.

Under certain circumstances the ideal arrangement may be impractical and the two runways may be the same length or alternatively the take-off runway may be shorter than the landing runway. In this specification the runways will either be off-set but parallel or alternatively they may be orientated at an angle to each other.

The ideal arrangement is for the runways to be off-set in order to increase the separation between landing aircraft and take-off aircraft. This orientation provides additional levels of safety especially in emergency situations where a landing aircraft may be compelled to abort a landing on approach and execute a flyby.

This arrangement also confers the benefit of a physical separation between the point at which aircraft land on the surface runway and where the tunnel begins and ends allowing an increased level of safety.

Departing aircraft commence take-off from a suitable position within the subterranean take-off tunnel in order that the precise point where the aircraft leaves the ground coincides with the opening at the end of the runway in the *take-off zone* 4, see Figure 1.

In order to achieve this position departing aircraft enter the subterranean runway tunnel through side entry taxiway tunnels, which deliver the aircraft to the appropriate position along the length of the runway in order to achieve the required position at which the aircraft will leave the ground.

Departing aircraft utilise the necessary length of take-off runway in order to achieve take-off velocity at the appropriate position in the *take-off zone* 4, see Figure 1.

The *take-off zone* may still be below the effective ground level or alternatively the take-off runway may be sloped upwards over the final distance to bring the runway closer to actual ground level.

Directional guidance and permitted take-off position of the aircraft within the tunnel may be facilitated by various electronic and visual aids. These systems will not be described in detail herein as they are known to anyone familiar with the art.

It is probable that take-off will be fully automated through computerisation and directional electronics built into the tunnel. These systems will not be described in full as they are well known to anyone familiar with the art. However, these guidance technologies may include lights, radar and laser systems which will guide the aircraft and maintain the correct directional orientation of the aircraft during take-off. These systems may also be utilised to determine the exact location of the ideal and safe take-off position. All such guidance systems may be computerised in order that the take-off of aircraft may be fully automated.

The subterranean runway tunnel is designed and constructed utilising various sound reducing materials and construction methods. These to include the use of specialised sound absorbing materials and design of the tunnel walls in order to maximise the suppression of sound.

Through the employment of efficient sound reduction processes it is possible to significantly reduce the overall noise profile of the airport as a whole thus allowing conformity with all relevant legislation pertaining to noise levels.

Noise reduction within the subterranean take-off tunnel is particularly significant as most noise pollution occurs as aircraft take-off.

The subterranean runway tunnel is designed and constructed to incorporate systems which allow for the reduction in air pollution through the extraction of exhaust gasses from aircraft during take-off. It should be noted that the point at which maximum pollution is created is during take-off.

Exhaust gasses are extracted from the tunnel and scrubbed to allow for recycling. These processes will not be described in detail here as they are well known to those familiar with the art.

As exhaust gasses are extracted fresh air is introduced to maintain a safe and clean atmosphere within the tunnel.

The subterranean runway tunnel is designed and constructed to allow for enhanced fire-fighting capability. At present an aircraft fire during take-off cannot be fought by firefighting crews until they reach the aircraft. Within the present invention there will be incorporated automated firefighting systems to include foam and halon gas situated within the tunnel. Through these systems it will be possible to extinguish fire more quickly and efficiently that in a conventional situation.

Evacuation safety side tunnels/exits are also positioned at regular interval along the length of the tunnel enabling passengers to escape and emergency personnel to access the scene of any accident.

The use of a subterranean runway has significant advantages during bad weather events. Reduction of rain, snow, and cross winds during the take-off increases safety substantially and reduces the need for costly and time consuming clearing of snow affected runways.

CLAIMS

1. A subterranean airport runway system comprising at least one runway situated above ground for the landing of aircraft in conjunction with at least one runway situated underground for the purpose of aircraft take-off movements and where the said invention also allows for the use of multiple pairs of such runways within the same airport.

2. An airport runway system according to Claim 1, where the runways are positioned one above the other.

3. An airport runway system according any preceding Claim where the runways are off-set whilst parallel to each other.

4. An airport runway system according to any preceding Claim where the runways are positioned at divergent angles.

5. An airport runway system according to any preceding Claim where the runways are positioned in any configuration required to enable construction according to the invention and fulfil the requirement for safe aircraft movements.

6. An airport runway system according to any preceding Claim where the exit position of the subterranean runway is positioned so as to maximise safety and minimise the potential interference to ongoing aircraft movements.

7. An airport runway system according to any preceding Claim where suitable electronic guidance systems are employed to facilitate safe aircraft movement through the tunnel during take-off.

8. An airport runway system according to any preceding Claim where the design and construction of the subterranean runway maximises sound reduction during take-off.

9. An airport runway system according to any preceding Claim where the design and construction of the subterranean runway enables a substantial reduction in air pollution due to the exhaust gasses emitted by aircraft during take-off.

10. An airport runway system according to any preceding Claim where the design and construction of the subterranean runway allows for enhanced fire-fighting capacity.

11. An airport runway system according to any preceding Claim where the design and construction of the subterranean runway allows for increased safety in relation to weather related issues.

12. An airport runway system substantially as hereinbefore described with reference to the accompanying diagram.

ABSTRACT

A subterranean airport runway for the take-off of aircraft from airports where design and construction are limited by the availability of suitable land, the surrounding geography and environmental pollution.

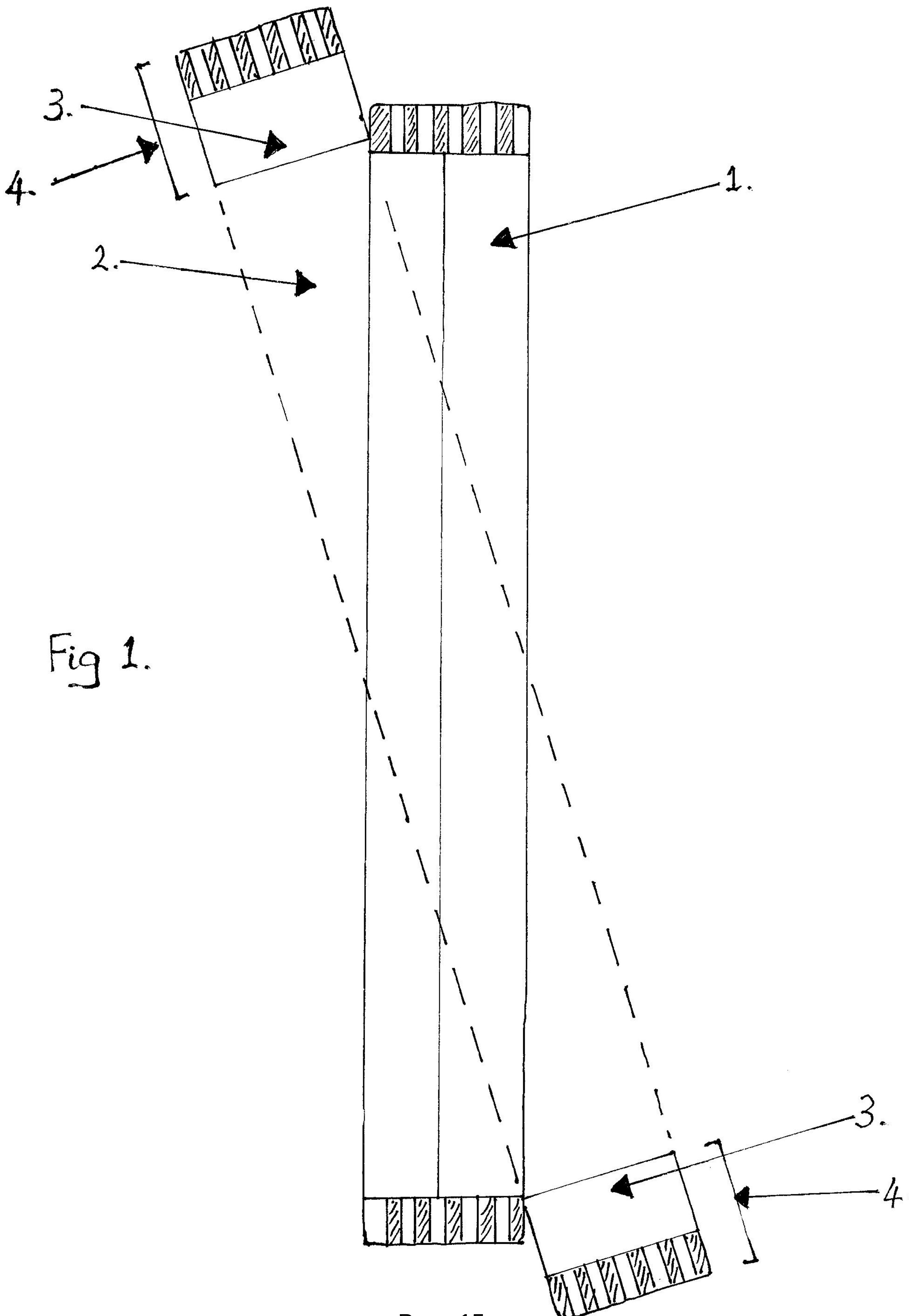

Fig 1.