congestion in the streets, will be important factors both in the location and in the detailed layout of the site

Implications

Consideration of each of these three aspects of danger, noise and traffic —which to some degree are likely to be inherent in urban helicopter operation —leads in every case to the conclusion that a Rotor Station site should be *outside* the true Central Business Area of any large existing town

This does not imply that a satisfactory "in-town" site cannot be found In a New Town, for example, there is a special opportunity to plan the central area in such a way that a Rotor Station may be satisfactorily incorporated In most existing large towns the central business area is encircled by a fringe of mixed users on less valuable land Similarly blighted areas are commonly found alongside railway yards and tracks, extending radially from the Town Centre, and in many cases these areas have been already cleared by bombing

In the replanning of many towns, where these conditions are found, the opportunity for early redevelopment in such areas is being used to lay out major road links or by-passes designed to relieve the congestion on central area streets The purpose of these roads is to help to redistribute traffic entering and leaving the Central Area, to provide for more direct and rapid movement between important traffic points, and to serve the major traffic generators, such as the bus and rail stations, wholesale markets and car parks These roads will open up extensive areas for redevelopment, and it is in such areas that the Rotor Station should find an ideal location, capable of fulfilling all the various planning requirements that have been described

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INTRODUCTION BY THE CHAIRMAN

Mr L S WIGDORTCHIK Our next speaker this afternoon is Mr R S COLQUHOUN, who also has asked me to say that he is speaking as an individual and not as a representative of his Ministry Mr Colquhoun is a Chartered Civil Engineer on the Headquarters Staff of the Ministry of Local Government and Planning He was educated at the City and Guilds Engineering College and Harvard University He has worked on a variety of civil engineering and building projects in Europe, Canada, India and the Far East He served in the Royal Indian Engineers from 1941-1946, specialising in the rapid construction of forward airfields, he joined the staff of the Ministry of Town and Country Planning in 1946, and has been associated with many engineering aspects of the development of new towns

Rotor Stations—Some Architectural and Engineering Aspects.

By R S COLQUHOUN, AMICE, AMTPI

Previous papers have dealt with the operational and planning criteria for Rotor Stations The architectural and engineering aspects will derive directly from the site selected in accordance with these requirements Such

sites can be classified into the categories of ground level, roof-top, bridge-platform and flexible pontoon sites These will be examined in detail, together with some estimates of the clear spans and floor areas of the buildings required to serve the stations

Ground Level Stations

Ground level sites have much to commend them from the engineering point of view For relatively low rates of operation, the landing area may be turf, provided that the subgrade is well drained For aircraft movements of the order of 10 to 15 per hour, however, a paved surface will be required The buildings necessary will comprise the terminal building and control tower, fuel store, and open air parking facilities for aircraft passengers' and staff cars, and in some cases hangars and workshops From the layout aspect, it would be desirable to keep all buildings to one side of the landing area, though the car parking area need not be so located

The price of land in central areas, apart from any other consideration, is likely to preclude the siting of ground-level Rotor Stations in city centres If a journey time of 12 minutes between city centre and Rotor Station can be accepted then it should be possible to find suitable sites 3 to 4 miles from the centre of a city the size of Birmingham which can fulfil the necessary area and height criteria at a reasonable cost

Roof-top Stations

The possibility of using roof tops as Rotor Stations has received considerable publicity Site area requirements are less than for ground level stations and siting can therefore be nearer the city centre Multiple user of the building—for commercial car parking, warehousing, and possibly as a bus station—becomes feasible on a central area site While existing roofs of certain specialised buildings can and have been used for mail services, such are not suited for the operation of passenger services of the frequency here under consideration With a landing area of say 250 ft by 250 ft, it will generally be necessary to provide for aircraft parking on lower decks Assuming a flight deck at 100 feet above ground level, the building would provide one aircraft parking deck which would also be used for passenger handling, and five floors of car parking, office and storage use

Speed of handling of aircraft will necessitate the installation of a lift, with a clear platform of about 80 ft by 40 ft These dimensions will also determine the column spacing of the aircraft parking deck (It is assumed that all aircraft will be equipped with rapid folding rotors and with undercarriages which will permit movements in any direction on the flight or parking decks)

Problems in connection with aircraft lifts have already been met in aircraft carrier design, and their application to roof-top stations would be an extension of existing practice The aircraft lift should be hydraulically operated in order to avoid all unnecessary obstructions at flight deck level The column spacing of the aircraft parking deck will not provide an "economic" structural solution, but recent advances in the technique of prestressed reinforced concrete construction will permit of a considerable reduction in the depths of beams required, when compared with more orthodox reinforced concrete or steel construction On the car-parking floors column spacing could be considerably reduced, and some structural

economies would thus be achieved But in such a speculative field as this, it would be an insurance against obsolescence to maintain the column spacing of the parking deck right through the building If the main structure is designed with wide spans, the subdivision of the enclosed space may be varied to suit changing requirements To reduce column spacing may, in the long run, be false economy

The need for continuity of floor area over the whole site has its repercussions on the use to which the lower floors of the building can be put Though the clear height from floor to soffit of beam will be 15 ft , the size of the building will preclude natural daylighting over the greater part of the interior This limits the space which can be used for office purposes to a depth of 25 ft from the outer edge of the building The uses to which the inner areas can be put are storage—which would probably be in excess of that required for the Rotor Station—and car parking facilities, which will be required both for aircraft passengers and for the operating staff Additional revenue may also be earned by letting car parking space on a commercial basis The nearer the site is to the city centre, the greater the demand will be for commercial car parking facilities The parking garage would be provided with ramps to all floors and a further economy would be found in the omission of walls in this part of the structure The car parking capacity will vary with the type of ramp, column spacing and layout of parking stalls, but should be of the order of 200 cars per floor Space will also have to be allocated for passenger and freight lifts serving all floors All cars would be parked and delivered by attendants for the convenience of internal traffic control and to ensure orderly parking

Bridge Platform Stations

In cities situated on wide rivers, these may well provide the unobstructed open space for a Rotor Station which is so hard to come by in a central area The proposal is, briefly, to construct a flight deck over the river, supported on piles and served either by an existing bridge or by constructing a new one Immediate difficulties are the avoidance of obstruction to water navigation and the prevention of scouring or silting of the river bed Such a bridge platform would have to be located in a straight reach of the river, and would undoubtedly be an expensive structure, since it would produce no income from garaging or storage and would simply be a central stopping place for helicopter services Whether the minimum area of 250 ft by 250 ft could be reduced on this account is debatable, but such a bridge-platform station would have to be associated with a ground level terminal station situated elsewhere in the city

Flexible Pontoon Stations

One of the less publicised aspects of the " Mulberry " project was the design and construction of the " Whale " floating roadways This design was for bridges of 80 ft span between barge pontoons, and was capable of withstanding considerable translatory movement along, and rotational movement about each of three axes While it is not suggested that open beaches, as at Arromanches, are suitable sites for floating Rotor Stations, lakes or estuarine sites may be so used if provided with flexible pontoon landing areas Pierhead pontoons, of size 80 ft by 56 ft 6 ins , capable of carrying a 40-ton tank moving anywhere on the deck, formed part of the " Whale "

project and it is suggested that a flexible pontoon landing area could be constructed of such units

Conclusions

In a new field like this, where practical experience is still largely to come, it is difficult to draw any firm conclusions Estimates prepared without reference to specific sites are nearly always misleading As a general guide, however, the Rotor Station with the lowest capital cost is likely to be the ground-level one on the fringe of a built-up area, followed by the flexible pontoon, the bridge-platform and roof-top in ascending order But individual circumstances may well change this order, and only a full design and cost analysis will provide the correct solution to any particular case

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INTRODUCTION BY THE CHAIRMAN

Mr L S Wigdortchik Our last Paper this afternoon, which is to be delivered by Air Commodore Harold Primrose, concerns the public user aspect of Rotor Stations Air Commodore Primrose served in the Army in the 1914-18 War as a Captain and towards the latter part of that period was seconded to the R F C, which later became the R A F After a distinguished career in that Service he retired in 1933 and took up the post of Air Mail Advisor to the Post Master General, where he was responsible for initiating the early experiments in mail carrying from the roof top of the General Post Office, London

After a further period of distinguished service in the R A F he went into the aircraft industry and then joined the Ministry of Civil Aviation, where he actively sponsored the helicopter movement The notable first direct flight by helicopter from London to the Centre of Paris will be remembered by us all, and also the helicopter passenger service between London and Birmingham, inaugurated in May, 1950 He was responsible for the organisation of these two notable events He is an Associate Fellow of the Royal Aeronautical Society and, of course, a Member of the Helicopter Association of Great Britain

Rotor Stations—Public User View

By Air Commodore W H PRIMROSE, C B E, D F C

May I congratulate Mr Whitby on his excellent and lucid paper It has filled me with interest and admiration Interest, because the subject is one in which for some time past I have tried, by preaching and propaganda, to interest others Admiration, because, judging by my own reaction, he seems likely to succeed where I have failed

From this well deserved tribute to the lecturer I do not wish it to be inferred that I agree with all he has said on the subject

He has stated at the outset that the " public user " and other aspects are left by him to be dealt with by other speakers—in the case of the " public user " this is my unfortunate self But he nevertheless goes on, in the latter part of his paper under the heading of " Traffic requirements for booking