ENGINEERING ASPECTS OF HELICOPTER BUS OPERATIONS IN CITY CENTRES

Three Papers presented to The Helicopter Association of Great Britain at the Library of The Royal Aeronautical Society, 4 Hamilton Place, London, W 1, on Friday 10th February, 1956, at 5 30 p m

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General Introduction

By J S SHAPIRO,
DIPL ING, A F R Ae S

Proposals for a Roof Top Station

By C ST J WILSON,
M A (Arch) Cantab, A R I B A

Some Proposals for Helicopter Approach Aids

By L J WARD,
B SC (TECH), A M I E E

DR G S HISLOP (*Chairman of the Executive Council*)
occupying the Chair

INTRODUCTION BY THE CHAIRMAN

The Chairman welcomed the visitors from local authorities, as well as friends in the architectural, electronic and other professions Helicopter bus operations from city centres might seem a long way off, some of the more gloomy public prognosticators talked of 1966, and sometimes 1976 if they were particularly despondent, but he felt that such bus services would be in operation before the end of the 1950's or in the early 1960's Long before that they must sort out their ideas—how helicopters were to be brought into city centres, what sort of landing ground was required, how to lay it out, what sort of equipment was needed on the ground, what aids were required and what handling characteristics were required of an aircraft in order that these operations should be conducted satisfactorily

Mr SHAPIRO, who would give the general introduction, was well known in the helicopter field, particularly to members of the Association After a long and distinguished career with the Cierva Company, he had become a consultant He was also a founder member of the Association

Mr WILSON, who would speak next, obtained a degree in architecture at Cambridge and was an associate of the Royal Institute of British Architects He spent five years in architectural design with the L C C, dealing with multi-storey structures and was now a principal architect with a planning and development company

Mr WARD was a B Sc (Tech) and an associate member of the Institution of Electrical Engineers At present he was chief electronics engineer to the English Electric Company at Luton, and was engaged on guided weapon work

Contributions to the discussion would be limited to five to seven minutes, in order to permit as wide a discussion as possible

https://doi.org/10.1017/S2753447200003929 Published online by Cambridge University Press

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INTRODUCTION

By J S Shapiro, Dipl Ing, A F R Ae S

These three talks must be short, but the subject is wide and my purpose in introducing it is to try to give some general connecting thoughts on the pattern of operations which we should like to discuss It is a pattern which we envisage in the future

I should like to say this with all possible emphasis we do not claim that any of the equipment or machines which we are discussing tonight are actually in existence , what we claim is that we have selected a few items which represent engineering solutions to what we think are desirable operating requirements When I say " engineering solutions," I mean solutions which require nothing more than engineering development—not new inventions, not new, untried ideas but engineering development

The second point of emphasis which I should like to select in our approach is that we have tried to look upon the pattern of operations of public transport helicopters, or helicopter buses for short, in a comprehensive manner, and it is this comprehensiveness which is perhaps the main watchword in this discussion Naturally, we cannot be comprehensive in discussing every detail, but we have selected a few points which we believe are the missing links, as it were, in a pattern in which many other links require very little discussion

Looking especially at the history of helicopters, I think we must be struck by the fact that this history moved along at a very slow pace until a point was reached when one, or perhaps two, not exactly pioneers but engineers took this line of a comprehensive approach They began collecting all the knowledge and engineering experience which had been accumulated and produced the helicopter

The third point I want to make is this the helicopter as we know it today has come into its own mainly for one quality which it shares with no other vehicle It can go anywhere , it requires virtually no operational facilities It is this quality which has made the helicopter what it is today —something we cannot dispense with in a number of activities The part which the helicopter has played in rescue is probably the most prominent— a performance which has earned its fame and its place in society

We now come to discuss a pattern of operations and an application for helicopters where this utmost simplicity of the helicopter is no longer quite true Here the helicopter does require *some* operational facilities In a closely organised pattern of operations for public transport this system of operational facilities, though moderate both in its demands and in its cost —is nevertheless absolutely indispensable

After these general points, I should like to make a few remarks on those aspects of economics which are the determining feature of any operation designed for public transport The helicopter does something which is unique in isolated cases but in the big pattern of transport it is not unique In this field it merely performs a function which has been performed and is being performed by other means both on the surface and in the air We want to achieve an improvement in communications, and this improvement must be either in speed or in cost, or in a blend of both

I have always argued that we cannot expect the helicopter to yield

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merely an improvement in speed at very high cost That is a prospect which in my opinion will not establish the helicopter in transport Many people may say that there is no need to establish anything in transport since it goes on quite happily as it is, but I believe that something is needed which will improve present-day communications To take one example, I think it is rather archaic that we have to spend 2¼ hours travelling from London to Birmingham That is perhaps one of the most striking examples and one which we might always keep in front of us It does not correspond to the rhythm of our time

It is the helicopter, and only the helicopter, which at some date and under certain conditions can give us a decisive improvement in communications between cities separated by short distances

This improvement need not be measured solely by so many hours of the traveller's time and therefore so many pounds which can be saved I believe that this improvement can be provided at fares within the same order of magnitude as that of present-day railway and air fares When I talk of air fares, I do not mean short distance air fares but fares in air transport within that range for which air transport was designed and built That is, roughly the 500-mile stage If you take one of the most shining examples, the shuttle service between Melbourne and Sydney, which is practically the main means of communication between those two cities, you will find that the fares are on the level of 2½d per passenger mile , and that is roughly the same as first-class railway travel in this country, although the salaries paid in Australia are considerably higher than those paid in this country There we have a classic example of the kind of service which we want to approach with the helicopter, because I think the pattern of helicopter operations will be this kind of shuttle service between, say, London and Birmingham, London and Paris, London and Manchester

Without going into details of cost predictions, we can on very general grounds foresee that a helicopter service in the range of 100-200 miles—the examples being London-Birmingham and London-Paris—can be provided at the flying cost of about 2d for what is known as a capacity passenger mile (that is, assuming that you get all the seats filled) That means about one-and-a-half times that figure for an actually sold passenger mile

Now we come to the question of the so-called indirect costs, which are not associated with the flying, and it is here, I believe, that we will find the greatest saving in a helicopter service If I were to give some form of general guidance to what we seek to establish in these talks tonight, I would say that we can foresee the time and foresee the engineering solutions to those problems which must be solved in order to organise a pattern of helicopter bus services, between the centres of cities, at a cost which is within the range of present-day aeroplane per-mile cost on medium-stage journeys Since it is inevitable that the flying costs of helicopters must be marginally larger than those of the aeroplane, the saving must be found in the indirect cost Indeed, I think it will be found there if helicopter services are conducted roughly in the manner that we visualise

This manner rests, from the point of view of the town planner and the architect, on the over-riding requirement that helicopter services must be made to fit into the pattern of cities and not the other way round I do not think there is any question that unless we are able to do that, then all the saving of ground which the helicopter can achieve compared with an aeroplane, by requiring a smaller landing ground, will be of no avail, because the ground which we require will be so much more expensive. It is for that reason that I believe that helicopter services will operate almost exclusively from roof top sites. It is for this reason that perhaps the central theme of the talks tonight is the operation from a roof top site.

The second step in our thoughts, starting from the pattern of cities as we know it today, is that we do not want to be tied in the choice of the roof top site by any particular type of building. Most buildings require natural light and therefore cannot be wider than 60 feet. We have therefore set ourselves the problem of devising operations which would allow us to take off and land on roof sites of a size wherein the width does not exceed 70 feet. We had an open mind about the length and decided that anything between 200 and 250 feet would be acceptable.

These few main requirements have directed our thoughts. In a rough and non-technical form various conclusions from these main requirements were set down in a Paper which I read at Rotterdam, and which was published in the November, 1955, issue of " Aircraft Engineering ". After this Paper, as one might expect, several questions were asked and several criticisms advanced. We decided to put some flesh on these bones and tried to make the picture a little more concrete. The two following talks, and perhaps two or three other contributions to the discussion, which you will hear tonight, represent the result of this attempt.

The particular points which were covered in these criticisms were mainly concerned with some features which must remain controversial and which no doubt will be discussed tonight—at least, I hope they will be, and we found that other features could be answered shortly and might find their solution without further controversy.

One aspect of the pattern of operations which was envisaged in my earlier Paper I have found since to have been independently, and no doubt with better argument, pursued by several other helicopter engineers: the vertical operation feature, vertical take-off and landing. I refer in particular to a Paper which I received from America, from the Aerodynamicist of the Bell Company, who read it before an American helicopter audience and who pursued roughly the same line of argument. Briefly, vertical operation means several things: it means that your approach and landing become independent of wind direction and operation can be completely automatic. It means that you always have the same type of operation and that you do not change your line of approach with the wind. That affects the feeling of the pilot and the actions to be taken in case of emergency.

Vertical operation further means that your noise problem is reduced. It means that your landing impact problem is one of vertical impact only. Finally, it means that you must have enough power. I have argued this point at some length in the published Paper and I do not want to repeat the argument, but I believe it can be said quite categorically that every helicopter which is adequately powered for *en route* requirements of one-engine-inoperative flight *must* be adequately powered for vertical operation from and to the site. I have not yet seen any valid answer to this statement.

One or two remarks may be of use to those who have read the Paper to which I have referred before. They will also be of use, perhaps, to others when they listen to the main Papers this evening. First of all, we tried to be not only comprehensive but also concrete It means that we tried to discuss a special helicopter I must say, with regret, that this helicopter does not exist , we had to assume a somewhat hypothetical helicopter, and you will see in some of the illustrations that it is not quite the same as anything you have seen but is very similar to a particular helicopter which is one of the types developed with the idea that it might one day become suitable for helicopter bus operations

I may say that it is a slightly reduced version of the Rotodyne—slightly reduced because we had to co-ordinate various specific requirements with which we began What we have in mind is a single rotor helicopter of 80-ft rotor diameter, 25,000 lb all-up weight and a disposable load of 8,600 lb It would have a stage of 200 miles and would carry 30 passengers We have assumed 30 passengers to be the basic helicopter load

Another point which arises when comparing tonight's discussion with the earlier pattern is the considerable improvement apparent now in the possibilities of accurate navigation This is something on which I cannot now spend time, because I must finish in a few moments, but I hope that the representative of the Decca Navigator Co , to whom I mainly refer, will find it possible to enlarge on these remarks

Because of this very great improvement in navigation it has been possible to envisage operations which consist in flying on the navigational aid to the final approach space of a site and then using a let down beam to guide you into the site This assumes operations in zero visibility, and the pattern is roughtly that each roof top site serves one line, as it were, and each roof site can be identified by use of the navigational aid alone As soon as you have a fix of where you think the roof site is, you ought to have the landing beam on your instruments

Details of this will be explained by Mr Ward The point which I particularly want to make is that in order to be able to operate from roof top sites so small as those which we have envisaged it is essential to have a landing aid which will set you down with an accuracy of something between five and ten feet We believe that the solution to this problem can be found with, as I said, nothing more than engineering development

The Paper on the roof site which you will hear in a few moments will give you some figures of the cost of the roof site itself This cost is, in terms of building costs in cities, almost a flea-bite The fact that the cost is small has a very important significance Not only is the cost itself small but the part of that cost which is due to the landing impact of the helicopter is really a flea-bite when compared with the cost of such a building as that, of which a roof station of this type would be part

This means a lot from the point of view of the helicopter designer It means that he need not worry too much about his landing impact It further means that the cost of running the station—if I may make use of advance information—works out at about £30,000 per annum for a station which can handle a fantastic number of passengers If properly and fully used, with the known distribution of peak hours and dead hours, it would handle about 300,000—400,000 passenger movements per year What that means in terms of flying cost to the consumer is something which must be carefully chewed over to be believed It means roughly one-tenth of a pound per movement—about 2s per movement

If you contemplate that for a moment you realise that it boils down to

2s per movement for a journey from, say, London to Paris That is all that is required on the ground in order to operate these services

You will see that if my other thesis is true—namely, that the helicopter flying costs can be kept down—then the future for helicopter services is vast It means that we have discovered a way of moving from the centre of one city to the centre of another city which costs the city virtually nothing and that the helicopter is the instrument to achieve this improvement in communications

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PROPOSALS FOR A HELICOPTER ROOF STATION

By COLIN ST JOHN WILSON, M A (Arch) cantab , A R I B A

An architect is bound to view the helicopter as part of the overall complex of a city and the intercommunication between cities The group with whom I work (architect Peter Carter and structural engineer Frank Newby) have always envisaged this extension of communications (and sensations) as an organic element of the desirable city and it has been extremely interesting to concentrate for a while upon this particular aspect of planning with Mr SHAPIRO and Mr WARD

I shall assume that we are agreed upon the general desirability to the public of an inter-city helicopter service and reserve judgment on the dilatory attitude adopted by the majority of County and County Borough Development plans on this question As far as London is concerned Mr Masefield's proposed BEALINE BUS routing for Great Britain and three continental stations should quite easily accommodate itself to six or seven main centres already existing on the London Passenger service grid

Imagining ourselves approaching such a roof station from ground or underground or air, we will necessarily be made aware of it as part of a larger complex and so I wish to start by showing a panorama based upon a research project we have done for a C I A M Congress

Briefly we have tried to eliminate the sprawl of dormitory town and dormitory residential estates and taking advantage of modern structural capacities to propose a stratified city in which multiple use is once again re-asserted without congestion and without loss of amenity The residential areas with their promenades and cafes look across and down into broad squares where offices, commercial, theatre, stores, etc , are distributed In central zones some office use would break up into the Residential zone, *i e* , above the 80′ mark

Accepting from Mr SHAPIRO the limits of operational efficiency and the consequent broad requirements for flight deck size, transmitter equipment, etc , we found that it was possible to take as the basis for such a station a building of multiple use , (referring again to the C I A M project) which we already had in mind, namely an hotel mounted on office floors 50 floors high the disposition and structure (which is quite normal) permitting considerable variation in use over and above those mentioned The selection of a 50 floor building is quite arbitrary in this context generally we would suggest a lowermost limit of about 15 floors for height of flight deck I will