railway stations, where he can get his ticket simply by stating his destination and paying his fare Here also he should see the board with the time of departures and arrivals He will then appreciate being whisked to the embarkation floor by elevator or escalator, where he should find signs indicating the platform or assembly points for the departure of the rotor plane service to his destination That, in brief, is my idea of the simple and slick cycle of station service the public user will want and should get at a well run Rotor Station

Discussion

A L Oliver (*A and A E E*) I wish to preface my contribution with the statement that I am speaking solely as an individual

Early in his paper Mr Whitby quotes, under the heading " dimensions and disposition," an approach angle of 35° and a required rotor station length of 400 ft between 30 ft high obstacles The minimum length required must, I agree, be largely a matter of conjecture at present, as we have no experience of the behaviour of multi-engined helicopters, but perhaps Mr Whitby could explain why he has considered an obstacle height of only 30 ft instead of the more usual 100 ft , since this considerably affects the space required ? I was under the impression that 100 ft displaced the 50 ft screen of fixed-wing aircraft because 50 ft was considered inadequate in view of the peculiar properties of helicopters

For any particular " screen " height, the size of the rotor station depends upon the performance and handling characteristics of the aircraft and the techniques employed in take-off and landing

Tests made recently with a current type of helicopter showed that, in still air, the steepest approach angle which could be comfortably attained was about 20°, using an approach speed of approximately 11 kts E A S and a rate of descent of 400 ft /min The pilots did not like a lower airspeed because of less satisfactory control characteristics and poor indication of flight condition, while any small increase in the rate of descent makes the approach rather " rough " Incidentally, if the rate of descent is of the order of 1,000 ft /min , this " roughness " practically disappears, as the aircraft is at low pitch and low power , although the pilots liked it, I doubt whether passengers would appreciate either the descent or the subsequent flare-out landing The angle of the flight path to the horizontal increases rapidly with windspeed—in a 5 kt wind, for example, it is about 35° A limit of about 60° may be imposed, however, by the restriction of pilot's downward view by the aircraft structure The dangers of power-failure are, of course, much greater than in the normal approach, which is only at about 10°

The over-riding factor in defining the size of the airstrip will most probably arise from take-off and not landing, however, as the change of flight path following power failure is much greater A considerable amount of experimental work is necessary on the question of take-off techniques and aircraft behaviour following power-unit failure The angles of climb and glide and the critical heights have to be determined and the handling qualities of the rotorcraft assessed for the various cases

The take-off technique which I personally favour is the normal or " cushion " type, in which the aircraft reaches best climbing speed at about

50 ft and climbs away at that speed to clear 100 ft in about 100 yards The reasons for this are

(i) it is the quickest way to gain height,
(ii) it is the safest way to gain height, and
(iii) should power failure occur safety is less dependent upon pilot-reaction time than in a vertical take-off

I agree that a rather larger airstrip may be required—about 1,000 ft between 100 ft obstacles, probably—than Mr Whitby specifies, but I would rather pay a little more for my ticket and live a lot longer

Mr R Hafner (*Member—The Bristol Aeroplane Co Ltd*) I have a few comments to make on the very interesting Papers of the four speakers today, and I propose to do so in the order of their delivery Mr Whitby has mentioned a very controversial subject, the size of Rotor Stations I have made a number of investigations on the subject and have come to look upon a Rotor Station as a set of shortened runways or hoverways, preferably three in number in order to permit landing into wind I have in mind not so much the normal landing with power but an emergency landing, and especially an emergency landing during the take-off manoeuvre In other words, the take-off is going to be a critical manoeuvre determining the size of the landing platform The safest take-off, I believe, is along a straight line going upwards and backwards, so that the platform can be kept in view all the time during this manoeuvre, and should there be engine failure at low height a safe return to the platform can be made

I visualise that we shall use for passenger transportation, mainly multi-engine helicopters, as we shall fly above built-up areas The multi-engine helicopter must be capable of flying on one engine within a given speed range and maintain height under these conditions, but it will probably not be able to hover out of the ground cushion with one engine inoperative Thus the only safe take-off is in the way already described, permitting, in case of engine failure below safety height, a return to the take-off point If, however, the safety height is reached or exceeded then the available potential energy can be converted into forward speed, sufficient to enable continuation of flight on one engine, under the conditions described

Bearing the above in mind, I believe three strips of a size of about 300 ft in length and 150 ft in width, will probably be sufficient for helicopters up to about 30,000 lb A U W

Mr Littler has mentioned a number of points in connection with town planning and has made reference to the "good neighbour" principle I used to live in London before the war, in a flat fairly centrally located, and I remember one or two so-called "good neighbours" There was the "underground" Every time a train passed underneath, a vase on the mantelpiece literally broke into resonance and was in danger of falling down And then there was the "bus" Whenever one passed by the Georgian type window rattled The helicopter could hardly do worse in town than that, even without any planning Obviously residential districts must, above all, have quietness, and communication is only a second requirement Different arguments, however, apply to business districts Here communications are a primary requirement and a higher noise level can be accepted Some years ago at Bristol, when we had the first helicopter flying over our roofs, the noise of the rotor caused quite a disturbance because, probably out of curiosity, everybody went to the windows to watch, but today the helicopter

https://doi.org/10.1017/S2753447200001074 Published online by Cambridge University Press

is hardly noticed and I suggest that, once the novelty has worn off in business blocks, the fact that the helicopter is overhead will not cause much disturbance

Mr Colquhoun raised a controversial point when he suggested that a helicopter station should be built on two floors If he means by this that the lower floor is used exclusively for office accommodation, etc, whereas the upper is to be used entirely for helicopter operation, I fully agree with him But if he suggests to extend helicopter operation to two floors and use lifts for this purpose and expect the helicopter, during this operation, to fold blades, descend, ascend, and unfold blades again, then my answer is no, this is too complicated and wasteful of time If there is a delay at intermediate stops of more than three or four minutes, helicopter transportation will lose its main selling point, namely, high effective speed of transportation

With roof sites providing two or three runways of the size already mentioned, there is ample space for helicopter operation, including parking, and consequently extension to two floors would be an unnecessary complication

Undoubtedly we must look ahead to the future helicopter potential, particularly with regard to the size and the carrying capacity of the Rotor Station At present we think in terms of 12-seater helicopters, but in the years to come we shall have larger ones, up to something like 30 or 40-seaters, and we have to bear in mind the weight of these aircraft when we design our station roofs On the helicopter design side we are sensitive to the problems of the architect and have adopted for the larger aircraft the four-point undercarriage because it gives a better distribution of load for the landing platform In this, and any similar problems, I believe the helicopter designer and the Rotor Station architect must go very much hand in hand and have a clear picture of what the future has in store

Finally, I would make one general observation Whilst these Papers have been extremely useful I have missed the important reference to the general economics of helicopter operation It should be borne in mind, it is not the helicopter *per se* which brings economy into this new form of transportation, but it is the Rotor Station Mainly because we can use compact and suitably centrally located Rotor Stations as distinct from large and relatively unaccessible airports, will the helicopter become an attractive proposition to the general public I like to compare the helicopter *versus* the fixed-wing aircraft, with the bus *versus* the railway train The railway is mechanically more efficient than the highway The steam engine is more economic than the petrol engine because it burns cheaper fuel, etc, etc On the other hand the overheads of rail transport are high There is the maintenance of the permanent way and the operation and the maintenance of the signalling system, etc Road transport has only small overheads Similarly the operation of airliners, with its aerodromes and flight controls, etc, carries heavy overheads, whereas helicopter operation, I believe, will be possibly on a much simpler pattern In my view this point cannot be stressed enough

Mr J Briscoe (*Ministry of Civil Aviation*) I speak not on behalf of the Ministry of Civil Aviation but from the aspect of that Department dealing with the licensing of Rotor Stations, and as such we have been approached by a number of municipalities who wish to obtain advice on what should be

https://doi.org/10.1017/S2753447200001074 Published online by Cambridge University Press

provided for a Rotor Station We have recently prepared a short paper which we hope to send to those Councils who are interested, and in doing this we have approached the problem more from the angle that Mr Oliver has mentioned, in obtaining a clear approach surface to the Rotor Station We thought, from our limited experience of flying helicopters, that Mr Oliver's method left a fewer number of seconds in which the helicopter was not at safety speed than Mr Hafner's method of going backwards, when there might be some four or five seconds in which the helicopter was in a hopeless position if it had an engine failure In considering these approach surfaces we have looked at constructions from the point of view of getting a surface right down to ground level

Mr Whitby has suggested that we have an area 400 ft square with buildings 30 ft high close to all round, but looking at his plan I suggest that if he had air taxied his helicopters to the position where they were shown on the North side of the hoverway he would find he had several rotor blades of rather shorter length than he had previously

One also has to remember that it will be some years before multi-engined helicopters are regularly in service, and we do hope that helicopters can at least approach somewhat nearer the centre of cities before the twin-engined helicopter is in general use, and therefore it seems necessary to consider the approach angles which will provide a safe approach and get-away for both the single-engined and the twin-engined helicopter, and that is an aspect which has not been spoken of by previous speakers We have actually gone down to a clearance angle of 10°, which Mr Oliver, from the Boscombe Down angle, has mentioned, but we think that for twin-engined helicopters we can go to an obstruction angle of one in two, or 26½°, which allows for a safe approach of the helicopter descending at an angle of 45°, or one in one

Many speakers have told us of the value of land in the centre of towns where, to get the greatest convenience from the helicopter, it is essential that the Rotor Station must be, as Air Commodore Primrose has so ably told us, and in order to reduce the area of land that is required, and the area for the approach surfaces, we have been considering providing two strips only, formed either in the shape of an " L " or a "T," which give a very much smaller area of land required, and I think that on surface sites we may find that the unit value of the land is so high that the total cost of the Rotor Station is very similar to an aerodrome for aircraft of comparable size

One then has to think of the side clearances that are necessary in approaching the actual strip or hoverway, and our idea on that is that we should have side clearances at an angle of one in one I do not know whether Mr Whitby would have any comments to make on that Also, in order to reduce the amount of walking for the passengers and to clear the strip at the earliest possible moment, and that will be very important if a rotor Station in the centre of a town is to become an economic possibility because one must aim at a large number of movements to cover the cost, I think we must adopt a concept of approaching along a strip and when the helicopter is safely sited at an altitude of, say, two or three feet above the ground it then air taxies sideways to a position clear of the strip, which will then leave the helicopter close to the point where the passengers are going to be conducted to the lower regions

There is one other aspect which other speakers have not commented on. Mr Whitby talked about the lights and radio required at the station but I

think something else one has to think of is a holding aid If the previous helicopter has not cleared the hoverway and there are possibly one or two waiting to come in, in not very good weather conditions, one must have a holding aid of some sort We have not got very far ourselves in thinking of that, but there does seem to be a possibility in using high intensity lamps which could perhaps be arranged in the form of a bar, and by using different combinations of lamps or different colours we might be able to have two or three holding points and at the same time provide a threshold bar for the approach in poor conditions Otherwise it might be necessary to have holding aids, which might be lamps at some little distance from the helicopter area and if one has more than one rotor Station in a town then the holding areas, of course, must be kept apart

Mr C Colin Cooper (*Associate Member—C B Helicopter Hire Ltd*) On the economic side, roof-top Rotor Stations have the advantage over surface Rotor Stations in that they can look to the internal facilities of their building for a subsidy No Rotor Station can hope to pay its way entirely by landing fee receipts If possible, landing fees should cover the operating costs of the Rotor Station, but the overall cost of the roof-top and the ground rental of the building should be a charge on the rental of the internal offices or facilities of the building In a ground Rotor Station your sole source of revenue is from the helicopter traffic, and landing fees would be burdened with very high and expensive ground rentals, etc One speaker mentioned the possibility of having tractors for moving helicopters on the landing platform , as an alternative one might consider the use of winches and cables around a block and tackle arrangement This might prove simpler, and cheaper while employing less personnel The question of noise level and interference with work in the neighbourhood is one to which I would refer briefly, in that during a certain roof-top landing test in France a sound detecting apparatus was situated at street level and was unable to detect the time of the helicopter roof-top landing Although some Continental towns are noisier than our own, it is not thought that the noise of a London Rotor Station will be very noticeable to others than those employed in offices immediately below or adjacent to the roof-top

Wing Commander R A C Brie (*Founder Member—British European Airways*) For many years I have been actively interested in the nature of sites and their dimensions for rotary-wing aircraft operation My earliest experience of rooftop conditions goes back to some experiments with which I was associated, in association with Harold Primrose, many years ago when the Post Office showed interest in the possibility of mails being carried into and out of London I had a dispensation from the Air Ministry to fly a C 30 Autogiro over London at any height I liked, and one has only to fly over a densely populated area on one occasion at a hundred feet to appreciate just what would happen if one's engine were to fail at the wrong moment. Therefore however enthusiastic we might be about the future for rotary-wing aircraft we have to be very careful indeed about safety equally as much for those on the ground as for those who are flying in the aircraft

I have also been interested in the possibilities of waterways The Riverdrome scheme of 1935 was my conception, and I still feel there is a lot we can do in that connection If you consider the matter you will find that most of our densely populated areas are bisected by a river There you immediately have provided a natural area of adequate size for helicopter

operation, and one which provides maximum safety at minimum cost Imagine a platform measuring about 100 ft by 50 ft with one end pivoted about a support at the shore end With this orientable feature we have provided a most flexible rotorstation and one which will cause the minimum of interference with normal river traffic Of course, we have to get our passengers on and off the shore-line and occasionally maybe our aircraft, but it will be seen that there is a simple concept of a practical nature which could be turned to great advantage during the next few years No one can say which sites are likely to provide the best ground level or elevated areas for passenger transportation It is easy enough to say that we will put them on a roof, or that there is a useable bombed site at St Pancras, but who will accept financial responsibility for a possible costly error of judgement To make a start we have to get in somewhere where the financial risk entailed is of a modest nature and in connection with waterways Mr Colquhoun, I think, mentioned what was done at Arromanches

Our waterways are spanned by bridges, and I know what I am going to suggest may not be received with the immediate support it deserves, but one of the finest rotor station sites that exists in London, or will ever exist, is over the top of Waterloo Bridge There we have a perfectly good basic structure so located that it can provide ideal unobstructed approach and take-off flight paths It is surprising that nobody has thought of it before That bridge has been designed to carry very heavy traffic It is the best part of 1,200 feet long and it is 80 ft wide, and yet without interfering with any normal amenities—passenger, road or river transport—we could put our rotor station right in the midst of existing communications, with Waterloo Station on one side, Charing Cross on the other, and buses and underground railways immediately at hand I put that forward as a suggestion, which re-occurred to me when Mr Littler used the expression that we should make full economic use of existing facilities Nothing could be more straightforward with maximum economy in effort and expense than to erect a simple steel and timber platform above the central span of Waterloo Bridge There is no need at the outset to go to the expense of a lot of reinforced concrete The more simple our initial approach the more likely we are to achieve our objective

One other point In talking about how to move these aircraft about rotor stations once they have landed it has been mentioned that they should be towed and Mr Cooper has suggested the use of block and tackle I go a stage further and say " Get rid of the undercarriage altogether " We are talking of aircraft which, by their concept, and by their design should never have to make a forced landing The assumption is that with twin-engined reliability the prospect of our aircraft having to land other than at predetermined bases is extremely unlikely Therefore, why not have mobile undercarriages located at these bases on which the helicopter could land, from which it could take-off, and on which it could be towed Designers should be pleased at the simplification Pilots would be pleased at the better performance The operators should be pleased at the prospect of increased payload and revenue

I should say here that I am merely reiterating personal views to which I have hitherto occasionally given expression both verbally and in writing

With regard to the question of noise, the B E A Helicopter Unit operated a night service for six months during the winter of 1949/50 and it

was significant that we never had one word of complaint We operated, it is true, from two sites that had been fixed-wing airfields, one at Norwich and the other at Peterborough Admittedly, in the Norwich area the inhabitants were accustomed to jet aircraft, although not at night, but one compares objectionable things by some sort of standard and that may have been why we did not get any comments about the noise of the helicopters I do think the noise can be somewhat troublesome at first, but as somebody else mentioned you can get used to anything Anyhow, I think with very little effort engine noise should and can be brought down to a more tolerable level

One final point is the question of rotor station surface Grass appeals, of course, but with much traffic it will bog down Somebody did suggest asphalt At night when a hard surface is wet you will get reflection from landing lights which has a nuisance value to the pilot The difficulty can be overcome to a certain extent by rippling or roughening the actual touch down area Surface colour is also a matter of some importance

Replies to Discussion

Mr R H Whitby (*in reply*) Dealing first with the apparent differences of opinion between myself and Air Commodore Primrose, I think that if you get the opportunity of reading the Papers afterwards you will find that fundamentally they are not so very great Perhaps the major source of difference is that Air Commodore Primrose is looking well ahead, one might say into the rosy future, and I have attempted the rather more prosaic task of seeing what we might have to do in the more near and less pleasant future

Mr Oliver asked why not specify the distance between 100 ft high obstacles I was referring to the actual clear space on the ground which would be necessary for the Rotor Station, and when I suggested 30 ft high obstacles, I had in mind small buildings, telegraph wires, etc , which might be right up on the edge of the 400 ft area On the same assumptions with regard to approach angles, about 500 ft between 100 ft high buildings would be needed for a large helicopter of, say, the 30,000 lb mark (See Fig 2, which is reproduced from Reference 1 by permission of the Journal of the Royal Aeronautical Society*)

With regard to the angle of descent, I quite agree that all the evidence we have on the present single-engined aircraft suggests that 20° or even lower than that is the practical angle of descent From Fig 1 it will be seen that if a 20° angle of descent over 30 ft high obstacles is assumed, a considerably larger ground space of about 900 ft diameter is required The characteristics of future helicopters may be such as to make this a hard reality which will have to be faced up to, but I suggest that it has got to be put to the aircraft designers that they provide helicopters which have satisfactory handling properties at steeper angles of descent than the single-engined ones have at the moment

The other limitation on steep descents which Mr Oliver mentioned was the pilot's view , this is obviously rather more readily under the control of the aircraft designer, and I think with the newer types it will probably be rather better If these steeper angles of descent cannot be used, then clearly it is going to be much less possible to make an economic proposition of helicopters operating in the restricted town sites We do not yet know

https://doi.org/10.1017/S2753447200001074 Published online by Cambridge University Press

whether we shall be able to get them and that is why I prefaced all my remarks on the size of Rotor Stations with the comment that what is wanted are trials of a multi-engined modern helicopter before we can specify what is needed in the way of landing site dimensions

With regard to Mr Hafner's suggestion as to backward take-off, I think that this does allow one to get away with a much smaller site than would be the case with a forward take-off, which Mr Oliver suggested was the best method (See Fig 3, which is reproduced from Reference 1 by permission of the Journal of the Royal Aeronautical Society*) It may be that we shall be driven to the forward take-off, and again my remarks about the unfortunate effect on the economics of helicopter operation with regard to the dimensions of Rotor Stations apply

I could not help feeling that Mr Briscoe's thinking was to a certain extent based on the single-engined aircraft with which we are familiar With regard to the use of two strips—two runways or hoverways in the form of an " L " or a " T "—if it is considered satisfactory and it is found practicable under conditions of poor visibility and by night to approach as much as 90° out of wind—and remember the aircraft cannot switch from one runway to the other during the approach when the wind veers—so much the better, since it will allow much bigger dimensions than would be possible with a symmetrical site of the same surface area

On the subject of holding, I could not help feeling that Mr Briscoe was being rather optimistic in visualising that a number of helicopters could be held within visual sight of a light in conditions of poor visibility (See Reference 1 for a discussion of what I consider to be a more practical scale of holding patterns which have been related to the accuracy of the navigational aid)

(Mr LITTLER expressed the view that there was nothing essential for him to say at that stage)

Mr R Colquhoun (*in reply*) I have only two points to make, and the first is with regard to the suggestion made by Mr Hafner as to the type of building to take multiple strips, but the only building which I know of that kind is a prison, and one does not often find those within a central area

Then with regard to the economics of having all your operations on one deck or getting the passengers on to the parking deck and taking them to the flight deck, my point here is that if you have your blades fully open you require larger column spacing and a larger lift in order to get your passengers on to the helicopter under cover If you are going to have your passengers on the top deck and a lift up from the parking deck only sufficiently large to handle the folded rotor then your passengers are going to have a less pleasant time under wet conditions

With reference to Wing Commander Brie's remarks on water landing areas, I think that three of the Arromanches pontoons with suitable linkage would provide the requirement that he specifies With Waterloo Bridge you would still have to provide some method of getting up and down to this second level and also some form of a parking bay where the taxis and private cars could get on and off, but I agree that it is a very simple structural problem

* Figs 2 and 3 are reproduced on page 232

I am all in favour of having no undercarriage, and it is quite possible to make a matt surface asphalt landing-ground with the minimum amount of light reflection if only the operator will specify it

Air Commodore Primrose (*in reply*) There is practically nothing that has not already been answered, but the point of having two decks I feel very strongly about If we have folding wings for aircraft carrier machines, that fold as the machine is taxying, surely it is not beyond the designer to produce folding rotors which will fold mechanically as soon as the machine has landed It could then be taken down and, by a mechanical means of a moving platform and cable-ways, it could be run round loaded with passengers I visualise two lifts , one on the landing area and one on the taking-off area, and the machine movement and passenger loading all being down below and under cover

Mr L S Wigdortchik (*Chairman*) When we arranged this meeting it was our intention that we should listen to the two ends of the problem firstly to the people who were intending to operate the helicopter services and then to the people who wanted to use them It is always a puzzle to me that in commercial aviation we provide a service and then find out by trial and error whether people want to use it We are subsequently a bit surprised when people do not use it It is rather like somebody sitting in a back room making a pot or pan and then putting it on the market and being frightfully surprised because nobody wants that particular design Perhaps what people should do when they are starting a new venture is to find out first what is needed

We have started this afternoon by saying first of all what we are going to provide, and then finding out at the end that it is not what Air Commodore Primrose wants ! That really is the crux of this particular series of lectures which we have heard this afternoon Mr Hafner said that Rotor Stations are possibly the most important thing, and there is a lot in what he says The helicopter is perhaps secondary in this respect , it is merely the link between Rotor Stations We have to realise from the very first that the rotor station is the heart of the helicopter transportation problem, not only because it is the place where we are actually going to market our product but also because, as Mr Hafner says, the background, overheads and the economics of the helicopter are such that only if your helicopter Rotor Stations are low in cost will the helicopter pay for itself

Admitting that, and also the fact that we want to market our product in the centre of the city where the people want it, we then have the problem of operating it from that place As has been pointed out the factor which governs the Rotor Station is the nature of the safety limitations which must be provided If we trace the history of aerodromes we find that they have got progressively larger because no-one sat down in the early days and stated a maximum landing speed and approach technique Thus aerodromes have grown up in a mushroom way If we are going to avoid that with helicopter operations we shall have to sit down very soon and try to decide practical limitations for at least the next twenty years

However, and as has been said during the discussion, we must have more experience with the modern type of twin-engined helicopter which we require for future operation before we can get any hard and fast ideas as to

what Rotor Stations of the future will need to be like This appears to be the next step

Many other facts have been discussed this afternoon but I submit that the major point emanating from the various papers is the fact that we must mould the helicopter's characteristics to fit, with practical and commercial limits, the type of rotor Station, its situation best suited to serve the passengers With so many municipalities eager to include Rotor Stations in their planning, it is evident that we must tackle this problem vigorously

I now call on Mr Hafner to propose a vote of thanks

Vote of Thanks

Mr R Hafner This has been a most interesting afternoon We have learned in a very pleasant way quite a lot about a subject which is going to be of the utmost interest in the future operation of the helicopter—the subject of Rotor Stations We have heard about it from the operator's point of view from Mr Whitby, Mr Littler gave us the Town Planning aspect, Mr Colquhoun spoke about it from the architectural point of view, and Air Commodore Primrose looked at it from the public user's point of view It gives me great pleasure to propose a hearty vote of thanks to those four speakers

The vote of thanks was carried with acclamation and the proceedings then terminated

WRITTEN CONTRIBUTIONS

Mr G H Tidbury (*Member—The Cierva Autogiro Co Ltd*) It must appear strange to many people who are only familiar with the simple idea of a helicopter as a machine capable of hovering and vertical flight that we should spend so much time discussing approach angles

Whilst having every sympathy with those who have to plan Rotor Stations for present designs and those likely to be available in the immediate future when a modest approach angle will be necessary, I feel that a far higher goal must be set Designers must aim at producing a machine that will land and take off vertically This involves acceptable control characteristics during transition from vertical climb to vertical descent in the event of one engine failing and a rate of vertical descent with one engine inoperative that allows a safe landing using either a long travel undercarriage or high energy rotor systems I believe these characteristics are obtainable without sacrificing so much pay load as to make operations uneconomic

If we are to plan seriously for future helicopter operation on the basis of the small angles of approach and the forward speed take-off technique suggested by Mr Oliver we will find that a fixed wing aircraft could be designed to operate from the same runway length and we could then eliminate the mechanical complexity of the helicopter transmission system

Another question that appears to be still a matter of opinion is that of passenger loading I believe it will be necessary to off and on load passengers with the rotors turning owing to the time taken to start up, clutch in, warm up and carry out routine checks (admitted that with turbine engines this time will be considerably reduced)

https://doi.org/10.1017/S2753447200001074 Published online by Cambridge University Press

I visualize passengers boarding the machine at the take-off point ultimately through retractable covered gangways, with the machine in a standard position ready to take off vertically without regard to the wind direction

The design requirements I have outlined will be regarded by many as not being immediately practicable, if however, they are capable of solution with the full use of our present knowledge, our Association, which is essentially an optimistic body, should take them into account when planning for the future

Comments on the Contribution by Mr C H Tidbury

Mr F H Littler In this time of speculation, with so many possibilities unproved, it is most important to ensure that the design of ground facilities and the evolution and design of the helicopter shall be geared to advance together

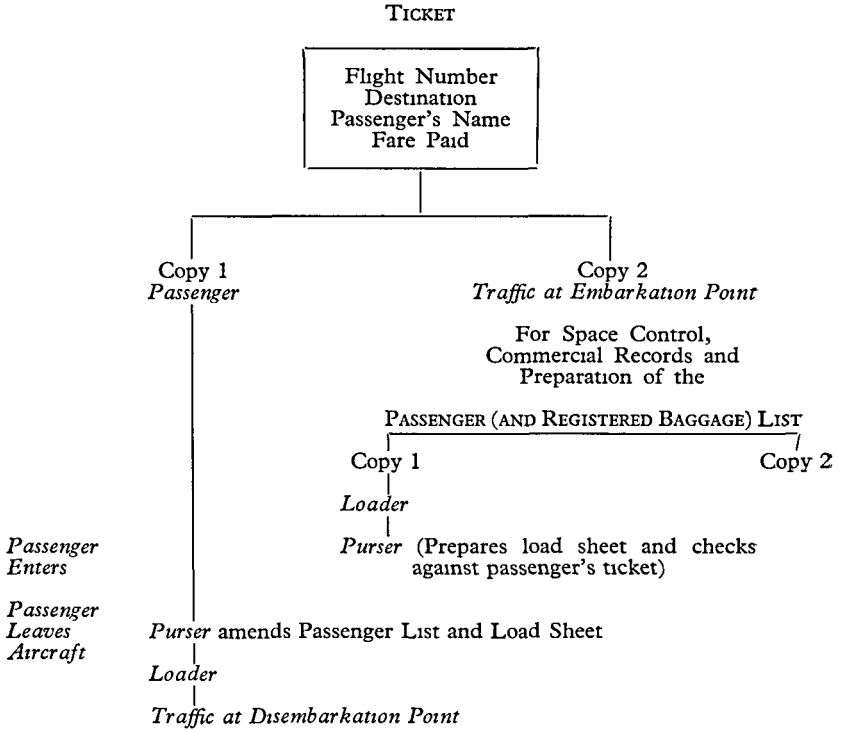
Fortunately, the history of fixed-wing aircraft development which brought with it ever-greater demands for landing areas, is unlikely to be repeated on the contrary, it may be expected that advances in helicopter design will permit reduction in the landing area, even though the number of sites may be increased

In the *immediate* future (with which the first three papers read on February 24th were concerned) it may be inevitable for technical reasons that helicopter design will demand quite extensive ground facilities The very fact that these will be difficult and expensive to provide will no doubt stimulate further advances in helicopter design , and while agreeing with Mr Tidbury that the ultimate goal must be set high, I believe it would be unwise to await perfection before starting at all

From the discussion on February 24th, I realised that I had perhaps overstated the " noise nuisance " as one of the limiting factors in siting Rotor Stations Mr Tidbury's confident predictions of vertical landing and take-off, if substantiated, would remove an even greater siting difficulty —namely, the *area* required for a Rotor Station Furthermore, if, as Mr Tidbury suggests, it will be necessary to save time by loading passengers with rotors turning, the need for helicopter parking and stowage space will be reduced, with consequent saving in building cost and site space Every advance in this direction will assist the provision of *central* sites, which are needed if helicopter operation is to be fully effective

Written Contribution in Reply to Discussion by Mr R H Whitby

Replying to Air Commodore Primrose Regarding passenger " handling," I have no expert knowledge of traffic matters, but it seems to me that the operations I outlined are rather modest They do *not* require pre-booking as a rule, " tickets in triplicate," weighing of passengers, or a " horde of expensive officials " The function of the documentation as it directly affects the passenger, *i e* , the ticket, can be represented diagrammatically as follows



From the passenger's standpoint it involves him in buying a ticket and having it checked on entering and leaving the aircraft—not so very different from the trials he has to undergo in travelling by rail

A good deal of experience has gone to the development of passenger "handling" methods on fixed-wing aircraft As a person not directly concerned with traffic matters, I think that the majority of them result in a very real improvement in the ease of travel Nevertheless, we must study each operation with an open mind and make all simplifying changes possible, provided that they do not detract from the safety and convenience of the traveller In this respect the procedures employed by South-West Airways are an illustration of how it is possible in some circumstances to use traffic staff more economically and reduce turn-round times In practical operation of the helicopter we shall find others

Replying to Mr Oliver and **Mr Tidbury** Mr Oliver appears to me to be unduly pessimistic about the limitations on angle of descent imposed by the handling characteristics of future helicopters at low forward speeds, basing his remarks on experience obtained on current single-rotor types which are imperfect in respect of stability and control On the other hand, Mr Tidbury appears to discount dangers of the vortex ring condition

Such experimental data as I have seen suggests that as the rate of descent exceeds about 500 ft per minute, and the angle of descent about 45° in still air, flight becomes progressively rougher and even dangerous

It is for this reason that I limited the assumed angle of descent to 35° in Fig 2 (For a fuller discussion see reference 1)

I agree with Mr Tidbury that passengers will normally board and disembark while the rotors are running Mr Oliver's forward take-off will need a half-mile runway for safety and if it has to be employed he is more likely to pay a little less for his ticket and waste a lot more time travelling by other means than helicopter

Mr Hafner should not be too sure that a fully-castoring undercarriage and even power-folding of rotors might not be necessary on roof-top sites , ground sites, of which I was speaking, are another matter

Mr Briscoe Air taxying would, of course, have to be resorted to with discretion and not as an invariable rule

https://doi.org/10.1017/S2753447200001074 Published online by Cambridge University Press

THE HELICOPTER ASSOCIATION OF GREAT BRITAIN

Londonderry House, 19 Park Lane, London, W 1

GRADES OF MEMBERSHIP

FOUNDER MEMBERS

Founder Members shall comprise every person who on August 31st, 1946, was on the Register as a properly qualified Member of the Association

MEMBERS

Fully qualified Members shall comprise every person who was on the register as a Member of the Association on the date of adoption of these Rules by the Association, and every person thereafter elected or transferred into the grade of Member

Every candidate for election into the grade of Member shall possess the following qualifications —

(a) He shall be twenty-five years of age or over

(b) He shall be actively engaged at the time of his application for election in the design or in the production or operation of such works as are comprised within the science of rotating wing aircraft , *or* in the application to rotating wing problems of special branches of science, mathematics or engineering

(c) He shall produce satisfactory evidence of his technical knowledge and standing in the profession of aeronautics

Every such candidate shall moreover possess *one* at least of the following qualifications —

(a) He shall have had four years' experience in the practical or scientific development or operation of rotating wing aircraft

(b) He shall possess an honours degree or its equivalent, in engineering, mathematics or physics and shall have had two years' experience in the practical or scientific development of rotating wing aircraft

(c) He shall hold a professional pilot's licence issued by a recognised authority or be an officially approved Test Pilot or a fully qualified Service pilot, *and* with these qualifications, have been actively engaged in flying rotating wing aircraft for a period in excess of two years

(d) He shall have made some other contribution to the advancement of the science of rotating wings which in the opinion of the Council qualifies him as a Member

ASSOCIATE MEMBERS

Associate Members shall comprise every person who was on the register as an Associate Member of the Association on the date of adoption of these Rules by the Association, and every person thereafter elected or transferred into the grade of Associate Member

Every candidate for election into the grade of Associate Member shall possess the following qualifications —

(a) He shall be twenty-one years of age or over

(b) He shall be actively engaged at the time of his application in such works as are comprised in the development of flight operations of rotating wing aircraft

(c) He shall produce satisfactory evidence of his technical knowledge and standing in the profession of aeronautics

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Every such candidate shall moreover possess *one* at least of the following qualifications —

(a) He shall have had two years' experience in the practical or scientific development or operation of rotating wing aircraft

(b) He shall possess an honours degree or its equivalent in engineering, mathematics or physics and shall have had one year's experience in the practical or scientific development of rotating wing aircraft

(c) He shall be a qualified pilot *and* have been actively engaged in flying rotating wing aircraft for a period in excess of one year

(d) He shall be a qualified aircraft engineer with more than two years' experience in rotating wing aircraft

STUDENT MEMBERS

Every candidate for election into the grade of Student Member shall possess the following qualifications —

(a) He shall be at least eighteen years of age but shall not be more than twenty-five years of age (except in such cases as the Council may determine)

(b) He shall satisfy the Council that he is receiving training in connection with the science or development of rotating wing aircraft, *or* that he is interested in the development of rotating wing aircraft and wishes to use the Association as a means of qualifying technically in the science of rotating wings

COMPANIONS

Companions shall be those persons, who being ineligible for the technical grades, have contributed or are likely to contribute to the development of rotary wing science or rotary wing engineering, or to the furtherance of the objects of the Association

MEMBERS' SUBSCRIPTION RATES

ANNUAL SUBSCRIPTIONS

	Resident in G B	*Resident Outside G B.*
	£ s d	£ s d
Founder Members	3 3 0	2 2 0
Members	3 3 0	2 2 0
Associate Members	2 2 0	1 11 6
Students	1 1 0	1 1 0
Companions	2 2 0	1 11 6

ENTRANCE FEES (To be paid by all new Members residing inside or outside Great Britain, and in addition to Subscriptions for the current year)

	£ s d
To the class of Member	1 1 0
,, ,, ,, ,, Associate Member	1 1 0
,, ,, ,, ,, Companion	1 1 0
,, ,, ,, ,, Student	*Nil*

TRANSFER FEES

Students on transfer to any other grade shall pay the appropriate fee

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APPLICATION FOR MEMBERSHIP should be made to the Hon Secretary of the Association at its Offices

LONDONDERRY HOUSE,
19 PARK LANE,
LONDON, W 1

Tel Grosvenor 1771

The Journal of the
Helicopter Association of Great Britain

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Papers submitted for publication in the JOURNAL should be submitted to the CHAIRMAN, PUBLICATIONS COMMITTEE, LONDONDERRY HOUSE, PARK LANE, W 1

None of the papers or articles must be taken as expressing the opinion of the COUNCIL of the ASSOCIATION, unless such is definitely stated to be the case

The submission of matter for publication will be understood to imply that it is offered to this Journal alone

If accepted for publication, the copyright of papers becomes the property of the Association, but they may be re-published by permission of the Council, provided due acknowledgement be made of their having appeared in the JOURNAL

Papers should, if possible, be typewritten, they should be concisely written with subject matter logically arranged and sub-divided, and with indications of the position, in the text, of illustrations, tables, etc

TITLES should be as brief as consistent with clarity, and in many cases the value of a paper is enhanced by a short SUMMARY

CHARTS, GRAPHS and DRAWINGS should be, if possible, in Indian ink on white board or strong paper, with detail and essential lettering large enough to be clearly legible after reduction if necessary

ILLUSTRATIONS—if the number sent in is considered excessive, the author may be informed and given the opportunity of contributing to the cost

COLOURED PLATES are made only at the author's expense

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