Discussion

The **Chairman** said that among the visitors were city and borough engineers from many important cities and towns, including Torquay, Plymouth, Edinburgh, Derby, Nottingham, Bristol, Newport, Liverpool, Bolton, York, Chesterfield and London In addition, there were present the Director of Works from Rotterdam, Mr J A C Tillema , and Mr Lothar Prang, Architect, Dusseldorf The Paper had, therefore, aroused great interest among potential providers of operating stations M Vernieuwe, Director of Operations for Sabena, and a great helicopter enthusiast, had been invited to attend but had been unable to do so He had, however, submitted a written contribution which the Chairman then read

Written contribution received from **Mr A V J Vernieuwe,** *of Sabena Belgian Airlines, Brussels, Belgium (Member)* First of all, I would like to congratulate Mr Hough for his very clear presentation of the short haul problem I th nk it may be useful, and even necessary, that a representative of a large city stresses, as Mr Hough does, the need of some official pronouncement on the subject of helicopter development in order that town planning officials may be informed and take the necessary steps to include helicopter landing sites and all the correlated problems in their plans

As for the text of the lecture itself, I would not make any further comments on the choice between the international term " heliport " and the British term " helicopter station " or " rotor station "

I would regret, however, that no reference is made of the work of the I A T A Helicopter Working Group which published its report some months ago The I A T A Helicopter Working Group has made some definite statements which may be considered as the official airlines views on the matter since it consolidates the opinion of practically all present helicopter operators and some organisations like the Port of New York Authority and the Air Transport Association of America

The forework of the conclusions and recommendations of Agenda Item 1 , ' Heliport Criteria,' says " This section of the report has been developed to provide guidance to the helicopter operator and to those concerned with the planning, construction, regulation and operation of heliports "

About the platform dimensions, it will be noted that the members of the group have agreed on the platform of 400 × 200 feet, taking into account that two times the diameter would be sufficient in width instead of 3 times proposed by Mr Hough

It has also been assumed that a bi-directional platform would be suitable since some crosswind operations may be accepted with helicopters

As far as the helicopter waiting spaces are concerned, our experience has been that the minimum distance that should be accepted between two rotors in movement would be in the order of 1 25 the diameter of the rotor Thus, in the case of future helicopters with 100 feet rotor diameter, a provision of an apron of 125 feet or 130 feet wide per helicopter would be recommended

On Mr Hough's statement that fuelling will be carried out by mobile equipment, I would point out that our heliports are equipped with a hydrant of the flush type system which seems to be the best solution for quick and easy refuelling

I hope these comments will be of some use in the discussion of Mr Hough's very interesting lecture and again express my regrets that I am unable to be with you on that day

Mr G W Stallibrass (*Director of Aerodromes (Technical) Ministry of Transport and Civil Aviation*), began by disclaiming any connection between his remarks and the official view of his Ministry

It had been interesting to listen to the Paper because in it an engineering expert had set out the practical consideration confronting him in searching for a site in his own city They had to be faced and overcome if the helicopter and its passengers were not to be tied to open fields and the long airline 'bus journey

Personally he did not believe the helicopter was a certain success for commercial inter-city operation Many problems had to be solved and it could not be taken for granted that the helicopter would overcome them During the struggle, it would

need a good deal of help, including a certain amount of faith, such as the Association stood for, as well as reasoned calculation, bearing in mind that the objective was not to get inter-city service because helicopters were pleasant vehicles to fly—although sometimes they were—but because they might bring a new and useful means of transport to the community The Lecturer had asked for guidance based on certainty here and now, but that could be obtained only by freezing development If they wanted complete certainty they would have to over-insure, possibly expensively A useful line had been suggested in an article by Mr SHAPIRO, in one of the flying journals a fortnight earlier This was that, to begin with, a site which would serve single-engine helicopters would very probably suit multi-engined helicopters later

Having said that, he wished to make it plain that he agreed with most of the lecture First, however, he did not agree that the helicopter was not yet sufficiently safe for the general public, as compared with other forms of public transport Apart from some examples of structural failure some time ago, the helicopter seemed inherently a much safer vehicle than a fixed wing aircraft

Turning to points of detail, an important feature in a city centre was good road access This applied even more to roof-top sites than ground ones, because the use of big buildings naturally brought to mind multi-storey garages and warehouses There must be waiting space for warehouse vehicles loading and unloading and enough space for the multi-storey garage to take all the cars likely to arrive at a time Without this, there would be serious traffic difficulties with the general city traffic

High buildings near the site need not have a prohibitive effect provided they were not in the approach paths and did not cause turbulence He did not see how the question of turbulence could be overcome by a wind tunnel test, as suggested by the Lecturer, short of making a scale model of the local surroundings—all the buildings in that part of the city—and putting it into the wind tunnel The experience so far gained was that turbulence varied very much from site to site and the characteristics of a site which produced turbulence in one case could be an advantage in another in reducing the distribution of wind

It was desirable to provide more than one strip but the second strip need not necessarily be at right angles The helicopter operator must be prepared for cross-wind approaches and take-offs to achieve regularity, for it was too much to hope that, with the obstruction-free gradients called for, they would get four directions of approach to every city site Progress in cross-wind techniques had been marked, but perhaps B E A could speak on this subject Something might also be said on whether cross-wind operations were basically easier with twin rotor lay-outs than with single lay-outs with tail rotor, in particular through having to use more power in the tail rotor

So far there had been more complaints about noise during the climb away from the site than in the immediate vicinity of the site itself As with fixed wing aircraft, the moral was that it is not enough merely to concentrate on reducing the noise at the source When the biggest reduction possible had been applied, large units still made a lot of noise It was important to aim at the steepest practicable gradient of climb after take-off—in order to increase the distance between the aircraft and the areas flown over after take-off With low ceilings this was also another argument for being able to fly in cloud on instruments

The need for fire-fighting could seriously affect the finances of a city air station Accident reports indicated that the risk of fire to a helicopter on or near the air station was fractional compared with the risk which must be allowed for in the case of fixed wing aircraft operations The reasons were obvious in the different characteristics of the aircraft Reports on two accidents with small helicopters in the United States this year aroused rather unpleasant possibilities, however In one accident the two occupants had to crawl through the flames and one died on the way, having tried to crawl on the downwind side In the other, the two occupants fell out of the burning aircraft and were dragged to safety by someone who rushed from the next floor, the crash having occurred on top of a building

The accident reports stressed the lethal results to be expected from fuel tanks in an exposed position and far too close to the passenger compartment, which itself was not sufficiently fire-resistant If this could not be taken care of in future design and airworthiness standards, it would require much larger fire-fighting facilities at air stations, which would be much less satisfactory Not only would it leave the risk

in but, by adding to the equipment and running costs of even small air stations, it would increase opposition to their establishment

Roofs could be considered under two headings—elevated platforms and roof-top sites By " elevated platform " he meant an alighting area built over a structure built for a different purpose in the first place Obvious examples were platforms built over big railway stations or over river bridges The main feature about these was that they would nearly always have to be self-supporting, because the original structure had not been stressed for the extra helicopter function This was not always easy An independent structure built over a river bridge, for instance, raises the possibility of interference with river traffic

For railway stations in London it could be expected that the ground beneath would have a network of underground railway tunnels, which greatly increased the cost and complexity of engineering the roof supports

With roof sites—used in the sense of a roof provided as part of the original design of the building—the prospects were different It had been estimated in the first Inter-Departmental Helicopter Committee's Report that the requirements might be met through the addition of only 5-10 per cent of the original building cost, the idea being that the higher the building the less the percentage increase required for a roof for helicopter purposes Only the roof and perhaps the top two floors would be required for helicopter station purposes

How big should the roof be ? For single engine helicopters they were tied by safety requirements to about 400 feet in length, unless the site were surrounded by open spaces In any event, there must be enough open spaces around for the helicopter to put down if the engine failed

But if the helicopter were to be a practical rather than a plutocratic means of travel, it must be able to use sites smaller than this In the initial stages it ought perhaps to be able to climb at a gradient of about 30 deg on emergency power even after the failure of one engine Such a performance could halve the space requirement

As the Lecturer had said, some form of shelter would be required to protect waiting passengers from downwash B E A had carried out trials with the downwash from an S55 and perhaps they would say something about them With a Bristol 173 at hovering power, downwash effect generated a 10 kt wind increase at the edge of a rough circle with a diameter of 300 ft This was enough to blow a good deal of dust into one's eyes

He did not agree with the Lecturer that the helicopter would relieve much congestion on the roads During the rail strike it had been evident that many cars on the road carried only one or two occupants The Lecturer proposed that road congestion might be relieved by people crowding, 20-40 at a time, into helicopters Surely the travellers would obtain a satisfactory result more cheaply if they crowded into 'buses instead and reduced road traffic at the rush hours to a fraction of its present figure

Reverting to the Lecturer's emphasis on the need for a firm ruling to be given on the provision of air stations, it seemed to him that the responsibility for deciding whether they wanted a service and how much they were prepared to pay for it was one for the community and the local authority to decide for themselves They knew the travelling habits of their citizens and were better placed than anyone to weigh, on the one hand, the cost of reserving a site and the possible prejudice of local amenities and, on the other hand, the advantage to their community of keeping the door open for this form of travel, which might be a great asset within the next 10 years One thing was clear, it was hoping too much to expect to be a pioneer and to gain the resultant advantages without taking any chances at all

Mr J A C Tillema (*Companion Member*) (*General Director, Public Works, Rotterdam*), said that as a colleague of the Author he, too, had to ask for their indulgence Being a city engineer and concerned only in the construction and management of an aerodrome and a heliport, he felt inclined to look at the real experts of helicopter flying with a very special respect, and only the circumstances that he would be in the safe and equivalent company of the Author had given him the courage to participate in the discussion

In his opinion the Author had given a very worthy contribution to the solution of a problem which a great number of Continental and British towns would have to

face in the near future—the situation and construction of a heliport or, as the Author suggested, a helicopter station In Rotterdam the word "heliport" had been put on the station building some years ago because they thought that the name, written in a similar way in English, French and Dutch, would provide an easily-to-be-understood name of international significance Nevertheless, the Author's arguments for the term "helicopter station" were valid Rotterdam had chosen its term on the advice of Mr Viernieuwe

The paper was for that reason very important because in his opinion the future significance and the future possibilities of helicopter traffic would depend a great deal upon the way in which the problem of the helicopter station was solved Important were the situation in the town, the road communications with the station and the choice between a surface and a roof station A normal aerodrome, situated a certain distance from the town centre and even in an open field, possessed in a much stronger way its own laws and was, from the point of view of urbanism, an object which had to be accepted anywhere at the border of the town, linked with the centre by means of sufficient roads But the efficiency of the complete system of the future helicopter network had a close connection with the facilities which the traveller wanted to meet in going to the heliport and, what was more, with a minimum of official duties for him to carry out

If they wanted to see—as the Author did—the helicopter in its future development as an air-bus not only making possible an intensive traffic over the shorter distances but also giving relief to the intensified road traffic, then the helicopter would have to demonstrate the special facilities belonging to the normal system of surface vehicles This was a question which had to be faced by the central Government and the local authorities

When the helicopter was assuredly accepted by the public as a safe machine, when it was ready to operate in large numbers over our crowded streets—and Mr Hough was not overbold in making such statements in the Paper—what function would it then perform in the traffic system ? He thought there were mainly two functions the short-distance flights—that was to say, the inter-city flights, national and international—and communications, as feeder lines, for the big town centres and the not-too-far-off smaller cities and the great aerodromes

He did not think the helicopter would be the right way to solve the problems of road congestion, because capacity played an important part in that problem The underground could make a real contribution towards solving road congestion, but a similar effect brought about by helicopters would demand in rush hours an enormous fleet of machines—and where would they be parked in quieter hours and how would they be distributed over different stations ?

His first question to the Author was, therefore what did he mean by saying that the helicopter was suited to relieve surface traffic congestion ?

Connected with the problem was the question of noise Even in Holland they had heard that there had been objections from civil servants of the London County Council and the Houses of Parliament against the noise of the Westland S 55 operating between London Airport and the South Bank It was remarkable that there had been no objections against the Rotterdam-Brussels service, which had a terminus in the town centre, between dwellings and situated quite near a church Perhaps the reason was that there were only three flights a day Noise measurements indicated that the 92 decibels of a helicopter take-off had to be compared with 82 decibels of street noise at ground floor level in Piccadilly, but in his view this comparison meant nothing, for a noise which was heard even several times a day but for only a few minutes at a time could not be compared with a less strong noise going on for hours Perhaps in the future, when helicopter traffic was intensified, the noise problem would be of greater importance than nowadays In particular, in order to make the helicopter popular manufacturers would have to study the problem of the noise in the cabin

His second question to the Author was could he not accept the opinion that in the near future the noise problem was of no great importance ?

Turning to the dimensions of the field, he said the Author had introduced two strips, in a right-angle, with recommended dimensions of the International Helicopter Committee of 300 ft $\times$ 150 ft , and in future 400 ft $\times$ 300 ft Did these recommendations mean a total field of 400 ft $\times$ 400 ft ?

In Rotterdam they had three aprons, for landing and take-off in different directions, connected by taxi-ways, and the central apron connected by taxi-way to the station building Aprons and taxi-ways were concrete work or paved and the field was a grass field This system was a good system to prevent Lord Mayors from being covered with dust !

The third question to the Author was was the idea of a strip the right one for giving dimensions to a helicopter field ? Was it not better to fix the total dimensions of the field with certain slopes from the aprons, restricting the surrounding buildings ?

The Author's suggestions for the terminal buildings were ample and right, in his opinion For most towns he thought it would be better in this early stage to make provisional arrangements rather than to construct terminal buildings to a full extent, according to their present knowledge of the problem It would be preferable to start modestly and enlarge and renew later

Refuelling led to the next question to the Author did he not think that static refuelling by hydrants was a better system, especially for small helicopter fields with a relatively small parking area, than a mobile equipment ? The three heliports in Holland had all accepted the system of static refuelling

Dealing with night and bad weather navigation aids, he said it was clear that at night and under bad weather conditions only twin-engined machines could be used for normal commercial flights Had anyone an opinion of the system and the management of these aids ?

Dealing with the question of surface stations or roof stations, he said he did not think that, when helicopter traffic had increased in the future in the way they all expected, they would be allowed to say that valuable building land should be sterilised by constructing a surface helicopter station This view meant that he could not agree with an opinion heard at the Helicopter Congress in Rotterdam this summer, that in future a good helicopter station principally must be a roof station In some war-damaged towns it was even a realistic thought to make a surface station and the necessity of choosing between the two systems was becoming urgent in a normal district where open spaces were rare Making use of parks and playgrounds needed for recreation was no solution of the problem

If a helicopter station were worth while, however, it was not a bad thing to designate a well-situated field or open space in the town for that purpose

Nevertheless, in an overcrowded town centre the construction of a roof station had its advantages Perhaps the building difficulties would not be too excessive, but an important problem was that of the parking space needed for waiting helicopters, which demanded a large and unbroken roof surface For that reason perhaps only a few types of building would make possible the construction of a roof station He agreed with the Author that the possibility of combining a roof helicopter station with the buildings of a railway station was well worth considering

He was grateful to the Author for his clear explanation of a problem which would perhaps be of new and great importance to the town planners in the near future

Mr Lothar Prang (*Member*) (*Architect, Duesseldorf*), said Mr HOUGH had demonstrated extraordinarily clearly the difficult problem for the town planner in preparing suitable helicopter stations He agreed completely with the author's basic propositions

The title " helicopter station " seemed almost as long as the German word " *Hubschrauberflughafen* " Moreover, in his own country, there was a distinction between " *Hubschrauber-Flughafen* " and " *Hubschrauber-Landeplatz*,"—*i e* , roughly speaking, the difference between a helicopter station with extensive equipment and facilities, and an area suitable only for helicopter landing without these facilities Would it not be easier to choose the title " Heliport," which was already familiar internationally, in the same way as there were maritime ports for short-haul sea traffic, as, for example, from England to the Continent ? However, this question was of only small importance

Much more important was the selection of the landing site—the helicopter station or heliport The author had shown very clearly the difficulty, if not impossibility, of finding suitable areas within towns and cities Experience in Germany was exactly the same

Another severe problem was how to approach a heliport and how to leave it after take-off It had to be a very strict requirement that the helicopter must never hurt anybody in case of an emergency landing when flying over built-up areas This would obviously be less difficult when multi-engine helicopters were in operation

He sometimes had the impression that public objection against helicopter noise was mainly psychological, caused by the fear that the helicopter might fall into people's houses With no other means of traffic was this possible to such an extent as with aircraft, and the population became nervous if frightened by a danger that might overcome them in their homes, where they wished to enjoy rest and recreation

It was necessary, therefore, to examine also the question of flight routes over built-up areas and to satisfy people that nothing would hurt them in their homes This could be done by the preparation of emergency landing areas in the direction of the flight-paths The noise certainly was uncomfortable but, as the figures of decibels had shown, there were other traffic noises of greater strength

As to the landing area size of 400 ft by 300 ft , he was in agreement with Mr Hough His recollection was that this was also the result of the last I A T A Helicopter Meeting, when 400 ft by 300 ft was suggested, including the additional space on both longitudinal sides The angle of approach differed between 1 in 6 and 1 in 10 The I A T A had mentioned 1 in 8

With regard to the different tasks that a heliport could fulfil, it seemed advisable to provide a classification of heliports as was done by Annex 14 of the I C A O regulations for airports The size and role of a heliport could vary greatly in regard to the special kind of short-haul transportation by helicopters Even if discussion so far had concentrated on the use of helicopters for passenger transportation, it must not be forgotten that their use by private individuals or by industry might prove to be important

He recommended that there should not be too much freedom in the " unrestricted development area " as shown in the figure of the hypothetical helicopter landing ground In this area near the heliport, it seemed better also to restrict the height of building This problem could be facilitated if only one strip was needed, and he called for an examination by flying experts to ascertain whether this would be sufficient, even in cases of unfavourable wind direction

He agreed also with the author that roof-top heliports would be the best solution for cities The structural difficulties which were so often mentioned were less formidable than was assumed Especially by the use of steel frame construction, an impact load of 3 G or 4 G could easily be supported This had been proved by several experts in Germany more than a year ago, and it had helped him to make the designs in the booklet ' Heliports in Steel "

At any rate, this problem was no more difficult than the construction of railway bridges In addition, the questions of interior lighting, ventilation and air conditioning were not insoluble, even if utilisation of space was restricted There was, however, no doubt that in connection with the large daylight areas of such a building, indoor parking areas in cities would be welcome

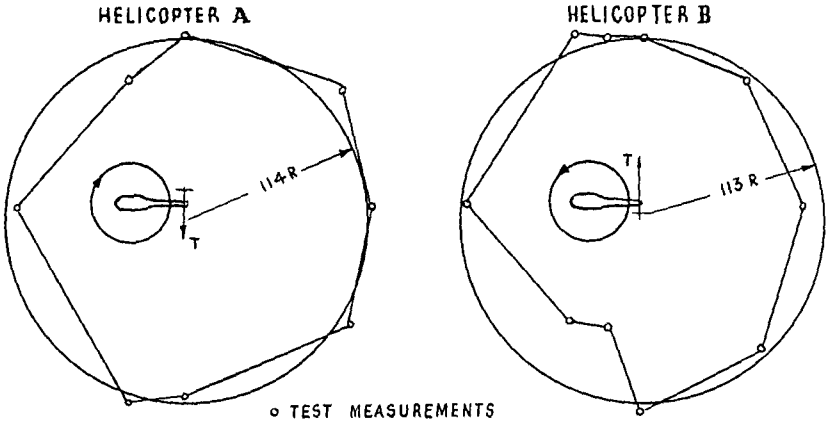
On the whole, he could not dispel the impression that the official town planning offices must have more initiative in connection with short-haul air traffic than they had shown as yet with the surface traffic system, and he was sorry that valuable time had already been lost

Mr R H Whitby (*Member*) (*British European Airways*), showed a slide which gave the results of measurements of the area over which there was interference due to downwash from the rotor of two small helicopters , the results are summarised in the table It was estimated that when people felt disturbed by the wash from the rotor, *e g* , they felt that their hats might blow off, the increment in wind velocity due to the presence of the helicopter was about 10 knots Irregular contours of such a 10 knot increment were found which seemed to fit into a circle quite well

In projecting from this small helicopter to the large helicopter of about 40,000 lb weight (right hand column of the table) various assumptions could be made One plausible assumption was that the flow below the rotor and in the neighbourhood of the rotor was similar, the measure of scale being the radius of the rotor

Assuming that the helicopter rotor was at the same proportion of the rotor radius above the ground when the aircraft hovered it followed that the radius of constant disturbance velocity of 10 knots was proportional to the square root of the weight and independent of the disc loading In the case of the 40,000 lb

Area of discomfort due to a Hovering Helicopter
Limit of discomfort — 10 knots



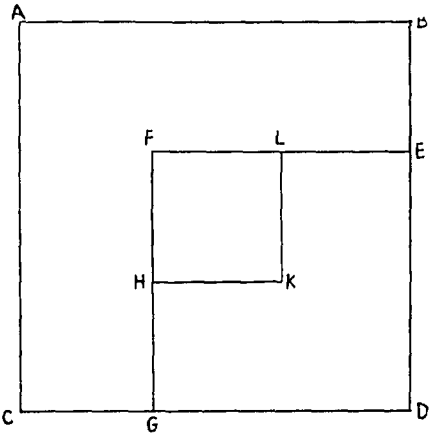
rotor this led to a rather large radius of 310 feet That would be much larger than the dimensions of any helicopter site mentioned during the lecture It was worth noting that the figure of 150 feet radius mentioned by Mr Stallibrass for the Bristol 173 was in conformity with the above working rule that the disturbance area was proportional to the square root of the all-up weight

Helicopter Type	*A*	*B*	*Hypothetical Estimate*
Weight	4,500	6,500	40,000 lb
Approx height of rotor above ground when hovering (h)	18	22	35 ft
Rotor radius (R)	24 3	26 5	44 ft
h/R	0 74	0 83	0 80
Approx radius of area of more than 10 knots disturbance speed	114	113	310 ft

Mr Raoul Hafner (*Member*) (*Bristol Aircraft Ltd*), who congratulated the author on the paper, said he agreed with many of the points in it and then proceeded to give what he described as a few of the things in which he believed He was convinced that the helicopter was going to be a useful vehicle in the short haul-field —that was an important point to be made at the outset However, in the case of public transport this was contingent upon it being capable of operation from the centre of cities If they went outside the towns they would be losing most of the advantages of the helicopter They would have to be clear about the fact that there

https://doi.org/10.1017/S2753447200002742 Published online by Cambridge University Press

was no possibility of compromising in this matter They realised that ground in the centre of cities was very costly The frightening picture which they had seen of a clearance scheme for a ground site looked like the work of an atom bomb on the town, having blasted most of it away ! This was the situation which would result from helicopters with insufficient vertical performance It was economically quite unacceptable Take-off and landing procedure was therefore most important He was looking forward to the time when they would be having multi-engined helicopters, for in his view the present stage of the single engined aircraft was only transitory The important thing to look for was the kind of solution which was acceptable for a permanent operation Multi-engined helicopters could be built powerful enough to permit hovering outside the ground cushion with one engine inoperative Such an arrangement, however, would probably be rather uneconomical A better solution in his view would be in a slightly less powerful multi-engined helicopter which was just capable of maintaining a small rate of climb at optimum forward speed with one engine inoperative In this condition the remaining working engines gave a power



corresponding to the so called one hour rating With such engines the helicopter could hover within the ground cushion but not outside The question arose then, was it possible with such performance to achieve safety in operation in built up areas such as for instance from a roof site in the centre of the city This question had to be answered in the course of designing the Bristol Type 173 and he had introduced a new take-off and landing technique which involved the concept of a certain safety height and a steep and slightly backwards inclined terminal flight path below this height He was not proposing to discuss again the details of this technique but only mentioned a few of its advantages It required for operation in all winds two runways at right angles to one another, the dimensions of each being 300 ft $\times$ 100 ft They could be arranged as best suited the circumstances, on the ground or as a roof site There was no need for extensive clearing of other space such as was shown in one of the slides tonight He appreciated that municipal authorities were not in a position today to assess with certainty the potential of the helicopter for the purpose of allocating adequate facilities On the other hand a decision had to be made soon as all available space was rapidly being used up for other purposes There were a number of possible patterns The roof of a railway station had been suggested This was a good idea as railway stations were already filling a similar transport need and so meeting similar requirements With the electrification of the railways the stations could be fully covered and extended to provide on one or more higher floors a car park which would greatly help to ease the present congestions in the streets, and finally—when the time was ripe—in its top floor and on its roof serve the helicopter Mr Hafner then suggested another stock solution which would provide a heliport capable eventually of large movements and yet permitting slow development if necessary without a great financial risk in the early stages He visualised an area A, B, D, C (see figure) 300 ft $\times$ 300 ft to be earmarked in the business centre of the city This area need

not be cleared immediately but one would commence only with one building of 'L' shape, A, B, E, F, G, C, which should preferably be as high as the surrounding buildings It would be finished with a temporary roof and would await in this condition the advent of civil helicopter operations At a suitable time the final floor which served the helicopter would be added This would be built in reinforced concrete and contain the strong roof capable of withstanding heavy helicopter landings At a later date the remainder of the site would be built up, that is the area E, D, G, H, K, L The completed building would then have the external dimensions A, B, C, D and contain a central court yard F, L, K, H The roof of such building would provide two parallel runways each 300 ft × 100 ft and in addition two parking spaces each 100 ft square Such a roof would permit simultaneous operation on two runways which appears to be sufficient to meet the highest density of traffic foreseeable for some time to come

The **Author,** in reply, said he had not many direct questions to answer for most speakers had answered their own questions Mr TILLEMA had suggested that helicopters would not solve the problem of traffic congestion, and that was true, but they would help to relieve it The traveller with an urgent mission would use the helicopter The Duke of Edinburgh was an example , he had to get to places quickly and to travel out of the main traffic in the streets The helicopter would help to solve this problem to some extent by taking away the person who would pay a little more to get out of the traffic quickly

Probably Mr TILLEMA was right in saying that the noise problem could be solved The AUTHOR had been watching the South Bank machine that morning and had not heard it at all over the Houses of Parliament The noise had been drowned by that of the ordinary traffic The trouble was that at the moment it was unusual Mr HAFNER said that at Bristol he did not hear his own helicopters because he was so used to them

Dealing with the strip, he said the main advantage of his method was that the whole area was paved and there were no landing pads If a pad were missed the machine could land on the grass, which might be soft, but with a paved area that was avoided Of course it was more costly Static refuelling is certainly an ideal method and he agreed with Mr Tillema's comments

Possibly " heliport " was a good short name which might well become an international name, in which event the AUTHOR would withdraw his name of " helicopter station " !

It was true that noise frightened people and they were afraid that the helicopter would fall on them, but he had dealt with the question about noise The area mentioned by Mr PRANG—400 ft × 300 ft —was a useful size, and a number of authorities had said so, too

He thanked Mr WHITBY for his explanation, which he would study in detail , perhaps the diagram would be published It was an explanation of the effect of downwash, and the AUTHOR would examine it closely when the Paper was printed

He was glad to hear that Mr HAFNER still believed in helicopters although he was dealing with them from day to day ! Land in built up areas was certainly costly, as Mr Hafner had said, and the AUTHOR would leave it to him to finish his designs and to produce a helicopter which could rise vertically to 200-300 ft and then fly away Obviously that meant a multi-engined helicopter

It was pleasing to know that the backward take-off technique assisted the helicopter to operate from a very small site He liked Mr Hafner's drawing of a roof with two right-angled strips The first design produced by the AUTHOR was an L-shaped building, so he was in good company !

The **Chairman** said that in the inter-city helicopter development of the future it seemed probable that operational demands would be such that the aircraft had to be able to hover and also to climb away if one power plant failed This would complicate the design problem tremendously It might not come in the next generation of aircraft but it would ultimately have the effect of easing the town planner's problem and making the provision of a helicopter operating site a little easier

He thanked the Author for presenting such an excellent, provocative and stimu-

lating Paper and for finding time among his many other duties as the City Engineer of Liverpool to write the Paper

The vote of thanks to Mr Hough was carried by acclamation

WRITTEN CONTRIBUTIONS TO MR HOUGH'S PAPER

Written contribution from Mr C Colin Cooper (*Member*) (*Helicopter Sales Ltd*) In congratulating Mr HOUGH on his paper, I would like to commiserate with him on the fact that Liverpool has apparently no free water space, yet urge others to seek river space for heliports as being most suitable as well as the most economical of all sites

I believe that New York is now contracting for the installation of two floating heliports, one on the East River and one on a lagoon at La Guardia Among the types of floating heliports that were being considered by the New York people was the product of Standard Heliports Inc , who produce a variable size floating platform built up in sections Each section is supported by a series of Master and Reactor floats and is so designed to offer instantaneous and distributed buoyancy even under shock loads of auto-rotational landings Floating heliports of this type have the advantage that they can be extended with great facility, without being closed to operations, and even moved if the location proves incorrect Such a heliport designed to carry any of the currently proposed helicopters would need only a $2\frac{1}{2}$ ft minimum of water, and the platform itself, inclusive of a grated upper surface that absorbs rotor wash and ensures a dirt free and dry platform at all times—would work out at approx £3 10s 0d per sq ft plus anchorage and ramp charges according to location Thus Mr Hough s 300 ft × 150 ft heliport that requires a landsite valued at £790,000 prior to development, would cost when fully operational, only between £150,000 and £200,000 if floating at a suitable river location

Whether a heliport shall be floating or not, I do ask that serious consideration be given to the advantages of a grated landing surface to absorb the rotor down blast , ground cushion is not affected since a pressure plate is only a short distance beneath the grating

It might also be of interest for people to hear a little more about the Thompson rooftop helifloats that Mr Hough referred to briefly These helifloats are shallow tanks installed on flat roofs, and can be of any size On 2 in of water in the tank there is a close fitting floating platform The weight of the tank, floating platform and the 2 in of water adds only 10 lbs per sq ft to the roof loading Thus on a roof which has a 100 ft × 200 ft helifloat (which is thought sufficiently large for present helicopters), the weight of a 20,000 lbs helicopter landing would be evenly distributed over the entire roof—adding only 1 lb per sq ft

The theory may sound a trifle fantastic, but practical tests have been carried out with full sized helicopters, and these rooftop helifloats might well prove to be a practical method of economically utilising existing flat roof space without further costly and unsightly structures being necessary Invisible from ground level these roof floats do not alter the building's appearance—yet they cleverly provide a fireproof barrier of water between the building and the aircraft

Written contribution from Mr R Campbell, M T C A Mr Hough referred to the desirability of providing an asphalte carpet over the concrete landing strips at a ground level station with a view to reducing dust and glare I suggest that this is unnecessary as pavement quality concrete is more dustless than asphalte and can also be made with a low reflective quality surface Another point is that asphalte is more susceptible to jet fuel damage and could, if soaked with fuel, provide a fire hazard

The reference to the provision of covered gangways to a point near aircraft doors is sound from the point of view of passenger protection but it would be interesting to know how near Mr Hough had in mind, as to fix them nearer than say 50 feet, might form an obstruction to landing or unloading areas The ideal may be for the last 50 ft to be telescopic on the lines of the Ocean Terminal at Southampton

Regarding standards of fire fighting, these would almost certainly have to be of

a higher standard than at fixed wing airport and the L C C have, it is understood, issued a statement on probable fire fighting requirements for roof top sites in the built-up area of London

Fencing although necessary for security and public protection purposes, must be a fence and not a solid wall, to avoid the effect of turbulence

Mr Hough's view that the strengthening of a city centre roof initially would cost no more than the cost of sterilisation of building land involved in a ground level site is agreed

Regarding the possible use of roofs of Railway Stations, it is already known that the cost of providing roof sites over Cannon Street and Waterloo Stations is very high This is largely due to the necessity of taking new roof supports down through the brick vaults under the platforms to independent foundations The restricted working arrangements that would be imposed, due to the intensive use of platforms, tracks and consourse, and the presence of underground railways in the case of Waterloo Station, are other factors contributing to the prohibitive cost

With regard to probable maximum loading conditions for roof design, it is generally assumed that the ultimate " equivalent static load " to be designed against is 60,000 pounds based on an A U W of 48,000 pounds and tricycle landing gear with 20,000 pounds on each main wheel and an impact factor of 3 This impact factor is equivalent to a heavy power-off landing The maximum point load occurs momentarily in landing when one wheel touches down before the others The point load may be taken as spread on a circular area equal to the total contact area in each wheel or group of wheels

Regarding the use of a load distributing device such as the " Helifloat," full details and cost do not appear to be available in this country but problems which will need to be overcome are freezing, inspection and maintenance, and detection of leaks, to ensure safe operation

From investigations already carried out it is generally true to say that a floating platform would be cheaper than a fixed platform on piles, particularly in a river subject to high tidal variation In addition the known operational advantages of the " ground cushion " are not always available in the fixed platform

Against this there certainly are problems associated with floating platforms on rivers with high embankments and high tidal variations, particularly when the platform has to be sited close to the bank to avoid interference with navigation, when turbulence and restricted approach clearance planes may result

When considering the adoption of existing buildings for roof top sites, only reinforced concrete or steel framed structures have the basic strength essential to enable suitable roof strengthening measures to be adopted In new buildings there is reason to believe that the additional cost of providing a helicopter platform over the roof area would not exceed 5% to 7% of the total capital cost of the building, based on say a 5 storey block

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Mr Hough's written reply to Mr Stallibrass' contribution to the Discussion and to the written comments received from Messrs Cooper, Campbell and Vermeuwe

The contribution to the discussion by Mr G W STALLIBRASS had obviously required a lot of careful preparation and the author took it as a compliment that Mr Stallibrass had given so much thought to the points he had made in his paper He was very pleased to find that they were both in agreement on so many points

Mr Stallibrass suggested that the author had asked for certainty, but he himself did not agree that he had asked for certainty, he feels that clarity is a better term

The Ministry's proposals for a single-engine helicopter, which the author endeavoured to translate into the requirements for the large machines, indicate that the size of site required for a ground level station in a city centre is such that the certainty would be that no stations would be forthcoming in our big cities

Mr Stallibrass' suggestion that if a Local Authority could not get a site in the centre at the moment, they could reserve an area near the centre, bearing in mind that they would have to start by restricting building because of the obstruction-free gradient imposed, prompts the author to point out that it just is not feasible at the

present time to restrict building for an uncertainty when so many people are seeking building land urgently

Mr Stallibrass stated that he did not agree with the Author's views that the helicopter was not yet sufficiently safe for the general public, as compared with other forms of transport In that case the author asks why do the Ministry not allow them to operate at present over city centres ?

Mr Stallibrass referred at some length to the need for good road access, and the author of course referred to this when he suggested the siting of helicopter stations near the centre of a town which must have good road access from all parts

The author agrees with Mr Stallibrass' remark that the question of turbulence could only be overcome by a wind tunnel test by making a scale model of the city and its surroundings The author's suggestion is that if a typical model of a city were tested in the first place, it would indicate the kind of problems which may arise He felt that the high cost of proposed roof-top stations would justify a wind tunnel test in each case, at a later stage

The author was very interested in Mr Stallibrass' reference to the arrangement of two strips and the possibility of cross-wind operation He is of the opinion that it would be an advantage to Local Authorities to know whether the Ministry felt that a successful station could be provided in a city centre with only one runway

Mr Stallibrass referred to the necessity for Local Authorities taking a chance and becoming pioneers The author would point out that Local Authorities have shown that they are only too willing to be pioneers They built airports in very early days of air transport and they undoubtedly will build helicopter stations when they have sufficient information to justify large expenditure

Mr COLIN COOPER in his written contribution gives some additional information in regard to floating platforms, which is very useful

The author would like to hear of the results of practical tests of the grated landing surface to absorb rotor down blast

The Thompson roof-top helifloats certainly seem to be a most attractive proposition, and again the author would like to hear more about practical tests and whether they are likely to be available for 45,000 lbs helicopters

The author was very pleased to read Mr A V J VERNIEUWE'S contribution and he is gratified that so great an authority on helicopter operation had found time to comment on the paper

The author was aware that he had made no reference to the report of the I A T A Helicopter Working Group He felt that with so many varying views from different Authorities he would design his hypothetical layout based on the British Ministry's general suggestions If the Ministry have considered and agree with the I A T A views, no doubt they will in due course inform Local Authorities The author hopes that this will be in the near future

The reference to platform dimensions by Mr Vernieuwe takes into account twice the diameter instead of three times " proposed by Mr Hough " The author would point out that he, not being an aviation expert, merely accepted the Ministry of Transport and Civil Aviation's suggestions in their recent paper

The author was glad to receive the written contribution from Mr R CAMPBELL, M T C A He noted his reference to the possibility of asphalt having certain disadvantages However, he feels that a good asphalt surface is an excellent weather protection for the concrete and is not necessarily a fire hazard

With reference to the provision of covered gangways, the author's proposal was that permanent covered gangways should lead to the edges of the helicopter waiting aprons and that the last fifty feet should be mobile or telescopic as suggested by Mr Campbell

He was very pleased to note that Mr Campbell's general remarks were in agreement with his own views, and gave some added useful information in respect of roof design data

He also noted Mr Campbell's opinion that the additional cost of providing a helicopter platform over a roof area would not exceed 5% to 7% of the total capital cost of a 5 storey block building He would point out, however, that it would still be necessary for the building to be capable of economic use