The successful use of the helicopter for air mail services in the metropolitan areas of Chicago, Los Angeles, and New York, and for rescue work in the Korean War have brought the helicopter beyond the purely experimental stage. Now appearing upon the transportation scene are indications that the rotary wing aircraft is also a coming means of passenger transport in the short-haul market. An essential part of a helicopter passenger service -- as with all methods of passenger transport -- will be the provision of terminal facilities or passenger stations. The post office heliports and the improvised landing areas on left-over pieces of land found adequate enough for the mail service will hardly do for a scheduled operation carrying a number of persons who are in a hurry to get to the airport. This means that planned heliports will have to be provided if a commercial service is to operate effectively.

One of the most significant signs of the imminence of helicopter transport is the publication by the Port of New York Authority of estimations made of the future of helicopter transport in the Greater New York Region. Transportation by Helicopter 1955-1975 - A Study of Its Potential in the New Jersey-New York Metropolitan Area (Aviation Department, Port of New York Authority, Ill Eight Avenue at 15th Street, New York 11, New York. November 1952) points to the probability that a 10-place helicopter will be used in common carrier service within the next few years.


* Copyright, American Society of Planning Officials, July, 1953.
the Federal Airport Act, shows a total of 148 heliports which are planned and will involve a total of $4,000,000 of which $2,100,000 will be federal funds subject to appropriation. Two bills, still in committee, would authorize the establishment by the CAA of heliports on or near government buildings and would authorize the necessary sums for construction. (H.R. 74, H.R. 1924)

Depending upon the international situation, the government's policy of aid to commercial air transport including helicopters, and other factors, the P.N.Y.A. publication predicts that the airport shuttle-type of helicopter operation will be established by 1960 and that other services will be under way within the following five years. The chronological analysis of probable market development in the New York region is shown in the following table.

<table>
<thead>
<tr>
<th>Type of Service</th>
<th>Initial Period</th>
<th>Period of Growth</th>
<th>Period of Mature Expansion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aero cab*</td>
<td>1953-60</td>
<td>1960-65</td>
<td>1965</td>
</tr>
<tr>
<td>Suburban</td>
<td>1963-65</td>
<td>1965-75</td>
<td>1975</td>
</tr>
</tbody>
</table>

*Airport shuttle service

Source: Transportation by Helicopter, 1955-1975, Table 2.4, page 17

Whether or not this chronology fits other metropolitan areas will depend to some extent upon the market conditions in those areas. In any event, it seems likely that helicopter passenger service will enter the short-haul market throughout the country within the next ten years -- the normal time scope of the long-range city plan.

What we are witnessing with the helicopter is the unfolding of a new transport system, and one which occupies a special role in the history of transport. A British planner observes that "in all other forms every new vehicle requires a much more expensive system of permanent structure for its operation. For the first time a new invention in transport reverses the trend and reduces the size and cost of permanent structures in comparison with its predecessors." (J. S. Shapiro, report
The permanent structure for its operation -- the heliport -- is one link in the growth of a transport system which the P.N.Y.A. has likened to a chain reaction:

The study of transportation history reveals that the growth process of a new method of transport involves a chain reaction among economic and technological elements. The growth of its traffic depends upon service and price relative to those of competing carriers. The charges for the new service further depend on traffic volumes, the standards of its service and the costs of providing the service. The costs depend, in turn, upon traffic volumes, operating methods, capital cost of equipment and facilities (or at least the portion to be borne by the carrier and the service standards adopted by the carrier). Service standards and the capital cost of equipment and facilities are functions of their design and engineering. If, as a result of all the concomitant and sequential variations in these economic and technological factors traffic volumes increase, the chain reaction proceeds upon another spiral.

One may penetrate the chain at any point. But the economic and technological ingredients are the same: design of equipment; operating methods; capital cost of equipment and facilities; the costs of producing the service; charges for the service; and the market areas that are responsive to the service. These elements change at differential rates and their aggregate impact upon the new form of transport and the transportation market will differ from the patterns established by pre-existing forms of transport. (p.6)

Provision of heliports, then, is both a link in the process of helicopter transportation and an active agent in its promotion. Granting that helicopter transportation is more or less inevitable, the provision of suitably located heliports in an urban area will probably hasten the coming of scheduled helicopter operations to that area. Transportation by Helicopter goes so far as to say that none of the potentialities of the helicopter as a common carrier can be realized "unless attention is given promptly to the study of actual sites... and to the design and development of air-stop facilities fitted to the needs of the common carrier helicopter and the traffic it will be ready to serve."

This Information Report makes no claim for definitiveness. It does attempt to bring together in one place the various standards for heliport design and site location together with some considerations of the relationships between the heliport and other uses in the urban area. PLANNING ADVISORY SERVICE believes that the
probability of helicopter passenger transport on a commercial basis is strong enough that it is time to start planning for heliports. This is an effort to make available some of the data that will be needed in heliport planning.

A great deal of material has been secured from *Transportation by Helicopter*, a publication highly recommended for methodology concerning costs of helicopter operation, estimates of passenger traffic, air mail, and air cargo, as well as for sources for the data reproduced herein, and a general analysis of the development of helicopter passenger transport.

We wish to acknowledge the considerable assistance given us by the Helicopter Council, Aircraft Industries Association - particularly the use of their compilation of information on the helicopter submitted to General J. H. Doolittle of the President's Airport Commission - and the valuable material furnished us by Bell Aircraft Corporation and Sikorsky Aircraft Division of United Aircraft Corporation.

**THE HELICOPTER**

Although the helicopter observes the same laws of aerodynamics as the airplane, it is not an airplane at all in the usual sense of the word. In fact, its peculiar and distinctive flight characteristics place it in a class by itself, and these, in turn, create the need of a terminal facility that also is entirely unique.

The principle of helicopter flight has been described in many places and is now generally understood. Briefly, the characteristics of the helicopter which are fundamental to it and which govern its potentialities are:

1. The helicopter can ascend and descend vertically or at any desired angle as well as maintain horizontal flight, forwards, side-wise, or backwards.

2. It can fly from zero airspeed (hovering) to its maximum rate longitudinally, and it has a low maneuvering speed in other axes.

3. It can take off and land on very small areas -- if necessary, in an area only a few times the diameter of its main rotor.

4. It can land safely in event of power failure. If this happens, the rotor automatically disengages from the engine and, pursuant to the principle of autorotation, continues to rotate in such a manner as to permit the helicopter to make a safe landing.

The implications of this strange craft are only barely comprehended. Just as it was some time before the impact upon urban patterns made by the railroad, the automobile, and the airplane were appreciated, so it will probably be a number of years
before the impact of the helicopter upon our cities and way of living can be determined. L. Welch Pogue of the Helicopter Council, Aircraft Industries Association, remarks that the distinguishing operational characteristics of the helicopter are almost as striking as the initial art of flight itself. "The moving wing, that is, the power-driven rotor, has for the first time given flight a humming bird omni-directional agility."

For the transport field, these characteristics mean that a passenger vehicle is now able to get immediately and directly into the heart of the building-crowded center and travel to other points along a route that has no competing traffic. When used as a taxi, the helicopter can supply the missing link in rapid, city center-to-city center air travel. If heliports are properly located, the helicopter will have the terminal convenience of surface transportation together with the flexibility and a measure of the speed of airplane transportation.

Helicopter models used for civilian purposes -- chiefly airmail pick-ups and special functions such as patrol work and crop-dusting -- have heretofore been single-engined, two- or three-seaters. The larger 10-place types, with two engines, have been used with notable success in the Korean War and some have recently been released to civilian operators. A number of still larger models, as yet in the experimental stage, are under construction, and it is to these latter that the helicopter industry looks for success in commercial operations.

For the purposes of predicting future helicopter transportation, the authors of Transportation by Helicopter secured from helicopter manufacturers their estimations of the specifications of helicopters that will be available in the period 1955-1970. These specifications, shown in Table 2 following, will give some idea of what is to be expected in the near future. Furthermore, they constitute the basis of heliport site specifications.

As may be inferred from the following table, the helicopter has not reached the end of its evolutionary development. Various "compound" configurations having the conventional rotary wing with the addition of stub wings to provide additional lift during horizontal flight and generally employing conventional propellers for added horizontal thrust are in various stages of experimentation. The possibilities of helicopters driven by jets mounted at the rotor tips are being explored by a number of manufacturers, and several prototype machines including the pulse-jet and the ramjet are being flown. (For a very interesting article speculating on the future of the helicopter see Tomorrow's Helicopters by C. Lester Walker, Harper's Magazine, May 1953, pp.28-35.)

It is the general belief, however, that the most important type for some time to come will remain the basic helicopter -- the aircraft in which all lift and all forward motion are derived from the action of one or more power-driven lifting rotors.

I. I. Sikorsky, in a memorandum entitled "The Probable Future Trends in Design
and Performance of Commercial Helicopters" (a part of the memorandum submitted to the President's Airport Commission by the Aircraft Industries Association) believes that the following types may be anticipated for the coming ten years:

(a) The conventional helicopter powered with a reciprocating engine would remain a very important type, with a total range that may exceed a thousand miles although the economical operational range with a payload should preferably be not over two or three hundred miles.

(b) A similar helicopter powered with turbine engines would probably have somewhat higher performances and better lifting capacity for short ranges but would have somewhat smaller maximum range, due to greater fuel consumption of the turbine engines.

(c) Helicopters in which the power is applied to the rotor by mounting jets at the tips may prove the most advantageous for carrying heavy loads on very short distances. So far, it is believed that their usefulness would be limited because their range would, as a rule, remain several times shorter than the ranges of types (a) or (b).

Most of the discussion in this report assumes the continued use of the reciprocating engine. The introduction of other types (jet or turbine) into the commercial market may drastically affect the dimensional standards and site criteria that have so far been established. It is almost certain that early models will be extremely noisy, and it is possible that the advantages in power and maneuverability gained by the employment of different power sources may be offset by the resulting noise insofar as passenger service is concerned. The noise aspect of helicopter traffic is discussed in a later section.

HELI OPTER PASSENGER MARKETS

GEOGRAPHIC LIMITS

The natural operational area of the helicopter is the short-haul travel market heretofore largely unpenetrated by air carriers. It was found in connection with the September 1946 Civil Aeronautics Board Passenger Traffic Survey that only 5.7 per cent of air line passengers traveled 100 miles or less, whereas 20.4 per cent of passengers traveled in the 100-199 mileage bracket, 18.3 per cent in the 200-299 bracket, and 13.5 per cent in the 300-399 bracket, with gradually diminishing percentages thereafter.

On the other hand, according to estimates made by the Air Coordinating Committee in Federal Policy Regarding The Development of Commercial Transport Helicopters, about 88 per cent of inter-city bus passengers traveled less than 100 miles per trip.
**SPECIFICATIONS AND AVAILABILITY OF COMMERCIAL HELICOPTERS**

<table>
<thead>
<tr>
<th>Approximate Specifications</th>
<th>Estimated Period of Availability</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dimensions</strong></td>
<td></td>
</tr>
<tr>
<td>Fuselage Length (feet)</td>
<td>32-42</td>
</tr>
<tr>
<td>Overall Length</td>
<td>48-55</td>
</tr>
<tr>
<td>Width</td>
<td>6-9</td>
</tr>
<tr>
<td>Height</td>
<td>13-16</td>
</tr>
<tr>
<td><strong>Rotors</strong></td>
<td></td>
</tr>
<tr>
<td>Number</td>
<td>1-2</td>
</tr>
<tr>
<td>Diameter (feet)</td>
<td>53-33</td>
</tr>
<tr>
<td><strong>Engines</strong></td>
<td></td>
</tr>
<tr>
<td>Number</td>
<td>1</td>
</tr>
<tr>
<td>Type</td>
<td>R²</td>
</tr>
<tr>
<td><strong>Weight</strong></td>
<td></td>
</tr>
<tr>
<td>Gross (pounds)</td>
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<tr>
<td>Empty</td>
<td>3900-4800</td>
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<tr>
<td><strong>Capacity</strong></td>
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<tr>
<td>Seats</td>
<td>8-10</td>
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<tr>
<td>Payload¹ (pounds)</td>
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</tr>
<tr>
<td><strong>Speed</strong></td>
<td></td>
</tr>
<tr>
<td>Maximum (mph)</td>
<td>110-115</td>
</tr>
<tr>
<td>Cruising</td>
<td>85-100</td>
</tr>
<tr>
<td><strong>Cost</strong></td>
<td></td>
</tr>
<tr>
<td>New ²</td>
<td>$120,000-140,000</td>
</tr>
<tr>
<td>Modified</td>
<td>$100,000-120,000</td>
</tr>
<tr>
<td><strong>Direct Aircraft Operating Costs</strong></td>
<td></td>
</tr>
<tr>
<td>Per Available Seat-mile ²</td>
<td>$0.09-$0.10</td>
</tr>
</tbody>
</table>

³ At 50-mile range  
² Reciprocating  
³ Reciprocating/Turbine/Pulsejet or Ramjet  
⁴ These costs, as well as all others in this report, are based on current price levels

Source: Manufacturers' Specifications.

Table 2

Source: *Transportation by Helicopter* 1955-1975, Table 2.2, p. 12
About 98 per cent of passenger automobile trips extending outside of city limits are less than 100 miles in length, and the average length of haul in railroad coaches is 94 miles (excluding commutation traffic, which is, of course, very short-haul in character). The ACC observes that "a very large part of this short-haul passenger travel consists of trips of less than 100 miles to and from metropolitan areas and other large cities from the suburban, satellite and other communities for which the large cities serve as trade centers."

Although it is largely from surface carriers that transport helicopters will draw their customers, the operating range of this craft suggests that it may also successfully tap the 100-199 mileage bracket in which a relatively large percentage of airplane passengers now travel.

In order to determine the efficient range for helicopter travel as compared with travel by airplane, the Air Coordinating Committee set up a hypothetical situation to measure downtown-to-downtown overall speed by airplane vs. helicopter for distances ranging from 25 to 300 miles. An account of their calculations follows:

The airplane was assumed to have a cruising speed of 170 m.p.h., and a total of eight minutes was allowed for take-off, climb, let-down, and landing. These conditions are understood to be about average for most local service operators using DC-3's today. Thirty minutes was allowed at each end of the journey for ground transportation and transfer from ground to air transport, which is believed to be a reasonable national average.

Two transport helicopters were assumed, one cruising at 85 m.p.h. (the speed of two transport helicopters in current military service) and the other cruising at 100 m.p.h. The latter ship was included as a conservative indicator of future transport helicopters, and in order to illustrate how the effective radius of operation increases with higher speeds. A total of four minutes was allowed in connection with each take-off, climb, let-down and landing, and ten minutes for ground transport and transfer time. This assumes, of course, that the helicopter will operate in a downtown or very close-in heliport. It should be understood that the 60-minute and 10-minute total ground time for airplane and helicopter, respectively, are from the airport and heliport to a central downtown distribution center.

Results are shown in the following table:
<table>
<thead>
<tr>
<th>Distance (miles)</th>
<th>@ 85 m.p.h.</th>
<th>@ 100 m.p.h.</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>42</td>
<td>38</td>
</tr>
<tr>
<td>50</td>
<td>57</td>
<td>51</td>
</tr>
<tr>
<td>75</td>
<td>71</td>
<td>62</td>
</tr>
<tr>
<td>100</td>
<td>83</td>
<td>72</td>
</tr>
<tr>
<td>150</td>
<td>99</td>
<td>86</td>
</tr>
<tr>
<td>200</td>
<td>112</td>
<td>97</td>
</tr>
<tr>
<td>300</td>
<td>130</td>
<td>111</td>
</tr>
</tbody>
</table>

This analysis indicates that the 85 m.p.h. transport helicopter has a downtown-to-downtown speed advantage over the 170 m.p.h. airplane for distances up to 150 miles. The 100 m.p.h. helicopter would have a similar advantage up to 220 miles.

For the port of New York Authority, a similar kind of analysis was made using actual routes and travel points, and comparing the helicopter with surface transport as well as airplane. Probable helicopter times were compared with rail, bus and airline times. The results are shown in the following table.

Other helicopter specialists have placed different limits on the range of the transport helicopter. For Great Britain, the Interdepartmental Helicopter Committee, Ministry of Civil Aviation (First report, September 1950) believes that the helicopter must be regarded as a coming medium of commercial transport suitable for distances between 50 and 300 miles. This range may be thought advantageous in the British Isles because of the relatively shorter distances between population centers. Birmingham, for example, is approximately 100 miles straight-line distance from the center of London, York is approximately 172 miles, and Glasgow approximately 340 miles. The consensus at the April 1953 meeting of the International Air Transport Association Helicopter Symposium, apparently held that the passenger service range in the immediate future would be 200 - 250 miles at a maximum.

For the immediate future, then, it seems reasonable to conclude that the short-haul distances over which passenger helicopter will effectively operate will range from 25 to 200 miles, with the inner range of 50 to 150 miles generally being the most advantageous. In a particular transport market area, such factors as extent of urban area, efficiency and coverage of existing surface and air transportation, and fare differential will affect the length of any particular route.
## PROBABLE COMPETITIVE LIMITS OF INTERCITY HELICOPTER SERVICE

Where Intercity Speed Will Influence Passenger Participation  
New York/Newark Area 1955-1975

<table>
<thead>
<tr>
<th>Trip Distance in Miles</th>
<th>Combined Carrier and Limousine or Taxi cab Running Time (in Minutes) From Local Point of Origin to Local Point of Destination</th>
<th>Suggested Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Bus</td>
<td>Rail</td>
</tr>
<tr>
<td>40</td>
<td>82</td>
<td>68</td>
</tr>
<tr>
<td>60</td>
<td>128</td>
<td>82</td>
</tr>
<tr>
<td>80</td>
<td>170</td>
<td>107</td>
</tr>
<tr>
<td>100</td>
<td>212</td>
<td>142</td>
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<tr>
<td>120</td>
<td>256</td>
<td>178</td>
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<tr>
<td>140</td>
<td>298</td>
<td>205</td>
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<tr>
<td>160</td>
<td>340</td>
<td>234</td>
</tr>
<tr>
<td>180</td>
<td>382</td>
<td>263</td>
</tr>
<tr>
<td>200</td>
<td>426</td>
<td>292</td>
</tr>
<tr>
<td>220</td>
<td>468</td>
<td>321</td>
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<td>240</td>
<td>510</td>
<td>350</td>
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<td>260</td>
<td>554</td>
<td>380</td>
</tr>
<tr>
<td>280</td>
<td>595</td>
<td>410</td>
</tr>
<tr>
<td>300</td>
<td>640</td>
<td>438</td>
</tr>
</tbody>
</table>

1. Official schedules and timetables used for computation of rail, airline, and bus times. Helicopter travel developed by using suggested route and service patterns (1960-1965) plus estimated block speeds of commercial type helicopters. Twenty minutes each have been added to rail, bus, and helicopter times to allow passengers to move from local point of origin to origin terminal and from destination terminal to local point of destination. Sixty minutes have been added to the airline times for the same reason.

Table 4

Source: Transportation by Helicopter 1955-1975, Table 12, p. 105
TYPES OF ROUTES AND MARKETS

Both the Air Coordinating Committee and the Port of New York Authority agree concerning the types of passenger markets to be served by helicopter transports in the future. These are labelled somewhat differently for the two reports, and in the case of the New York region, the market areas are described by distances that may or may not be meaningful for other areas. However, one, several, or all of the types of markets to be served in the New York region will in time probably develop in other metropolitan areas.

The schematic representation in Figure 1 illustrates the four types of anticipated routes and markets. The names of the routes, that is, Aerocab, Feeder, and Local intercity are borrowed from Transportation By Helicopter; the descriptions from the ACC report.

Aerocab Market

The disproportionate amount of time spent in travelling on the ground to get to an air terminal is one of the most troublesome obstacles to fast city-to-city transport. In the case of transcontinental flights it is questionable whether the inconvenience of ground travel to the airport is a competitive disadvantage to air travel as against train travel. On shorter routes, however, there is evidence to show that the time differentials actually work against air transportation.

One of the most spectacular instances wherein terminal time delays reduced air traffic occurred when the Detroit municipal airport was moved to Willow Run, 32 miles away from its previous site. As a result of this move, air traffic from Detroit to Cleveland dropped from 17,000 a month to around 7,000, and to Grand Rapids from over 1,400 to around 400. (Manuscript of Hearing in the New York Case, pages 741-743, C.A.B. Docket No. 946, et.al.). The 104 miles separating Detroit and Cleveland is usually covered in 52 minutes flying time, but nearly twice as much time is need for the ground trip between the principal airports of these cities and their downtown centers, due to poor highway facilities on a portion of the ground which must be covered.

Another example of disproportionate ground-air traveltime is seen in the trip from San Francisco to Los Angeles which normally takes 120 minutes in the air. On the average, however, passengers spend in peak hour of traffic, 75 minutes traversing the 26 miles of highways which connect the principal airports of these cities with their downtown business centers.

Although these illustrations are extreme, this kind of disparity between ground travel time and air travel time is far from uncommon in most urban places both here and abroad. The Civil Aeronautics Administration has just released a study of this problem together with suggestions for improving highway and
traffic conditions between cities and airports. (City to Airport Highways, April 1953. Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C. 20c) Two graphs which directly concern aerocab service are those showing distance between principal airports in 55 cities and their downtown business centers; and travel-time required between principal airports in 55 cities and their downtown business centers. (See ASPO Newsletter, February 1952, p. 10 for a reproduction of the second graph)

Aerocab operations, then, will probably appear first on the helicopter transport scene in most cities because the demand for time-saving transportation will be greatest in the airport shuttle service. Aerocab service combined with air mail service was initiated this month between the three major New York Airports. The flight from New York International Airport to Newark takes 19 minutes and costs $10.00. (Ground travel time between these two airports can seldom be accomplished in less than one hour and a half and often takes longer) The flight between La Guardia and New York International, taking 10 minutes as compared with a surface run of a half-hour, costs $5.00. The Airport to Manhattan shuttle is not currently possible because of the lack of heliport facilities in Manhattan. Load capacity of the helicopter model in use is eight passengers plus the pilot and one flight attendant.

The port of New York Authority study expects that by 1960 approximately 25% of passengers who would normally use taxicabs will shift to aerocab, while in the case of limousine service 10% will shift to aerocab. They emphasize, however, that these expectations are susceptible of considerable modification, depending chiefly upon the availability of 30-40 place equipment.

**Feeder Market**

Helicopter feeder service will bring to many cities which cannot support an airport direct air service from a local downtown heliport to the major airports. In turn, the market for travel by fixed-wing aircraft will be expanded because of the direct accessibility of the major airport via helicopter feeder service. In the New York region, it is expected that initial feeder operations will be inaugurated during 1954 on mail schedules operating from airports to suburban areas. As larger equipment becomes available with fares of 8-10 cents a mile, the geographic limits of the feeder market will be extended outward, in some instances 100 miles. For the Los Angeles area, the County of Los Angeles Regional Planning Commission has prepared a Master plan of heliports showing the general location of 152 potential sites and including the 32 existing heliports in this 4,084 square-mile region. These heliports would be connected by direct airway routes to the four existing and one proposed air terminals. Other market routes indicate that the helicopter will be used also for aerocab shuttle service connecting the airports. Most of the routes, however, are of the feeder type, and it is apparent that the feeder market will be significant in this metropolitan area also.
Aerocab:
inter-airport and
airport-to-downtown
shuttles

Local Intercity:
downtown to suburban
and satellite
communities

- heliport
- airport
- urban area

Feeder:
airport to suburban and
satellite communities

Regional Intercity
between suburban and
satellite communities
Perhaps the greatest potential of the helicopter feeder service will be realized in the future if and when jet transports become common in transcontinental air travel. Because jet powered airplanes require longer runways it is not improbable that many airports now in operation will become obsolete due to lack of land for expansion. Beyond this is the fact that the noise of jet planes is so intense and so objectionable (the jet engine noise has been called the loudest man-made industrial noise), that unless it is brought down to tolerable levels, airports will have to be moved out to locations even more distant from urban centers. Some observers have speculated on the possibilities of developing giant-sized airports made to serve a much larger passenger area and located 40 or more miles away from city centers. If this occurred helicopter feeder service would be an invaluable link. Although too little is yet known about the impact of jet transport upon urban patterns, it seems certain that the parallel development of helicopter transport with jet transport will work to their mutual advantage.

Local Intercity (Suburban) Market

Because of the high fares expected for commuter travel by helicopter (about five times the current commutation fares in the New York Region) it is not believed that the helicopter will ever replace any considerable portion of surface transport in this market. The suburban market will exist where time saving is more important than fare differential, and it has been estimated that the helicopter will reduce time consumed in travel between suburban areas and Manhattan from between 50 to 75 percent. Executives living in the suburbs who spend only one to three days a week in their offices in Manhattan, or who have occasion to come to town at odd hours will probably be the main customers. Weekenders from Manhattan and suburban theater-goers are expected to supplement the regular business commuters.

Although it is too early to measure the effect of the helicopter upon industrial decentralization, it has been suggested that intercity routes will facilitate the administration of decentralized plants and offices by easing travel between them and main offices.

Regional Intercity Market

Little investigation has been done concerning the extent of this market. In the New York area, where it lies outside the 175-mile geographical area covered by the Port of New York Authority study, it would consist of travel between Bridgeport and Trenton, for example. Plans have been announced by the Air Transport Association for a scheduled, round-the-clock test flights, using multi-engine helicopters, between New York and Washington or between Chicago and Milwaukee. Possibilities of scheduled helicopter passenger service between cities in less densely populated regions of the United States have yet to be explored. But it is not unreasonable to suppose that the helicopter may be just as suitable for intercity travel in areas not dominated by the very large
metropolis, and that this type of market will flourish in the midwestern and southern states where metropolitan areas are more uniformly distributed by 30 - 75 mile intervals.

Some evidence of the feasibility of the helicopter as a means of transport between cities in the less highly urbanized areas of the United States may be secured from activities in Belgium and England. Intercity passenger service by helicopter (the first international service) is to be inaugurated in Belgium in September, with flights to be scheduled between Brussels and each of the three cities, Cologne, Rotterdam and Lille. The total saving of time over express train schedules will be three hours on the Brussels-Bonn route (131 mile); 1 hour 50 minutes on the Brussels-Lille journey (sixty miles); and 1 hour 20 minutes on the Brussels-Rotterdam trip, (73 miles). In the heart of each of the seven cities that will be serviced by the flights a site is being prepared as a landing place. Although the Belgian Sabena Air Line, using the S-55, expects to operate at a loss for several years, they hope to make the short-distance traffic profitable when 2-engine, bi-rotor machines, carrying 30 to 40 passengers will be put into service.

In the United Kingdom, the helicopter officially is regarded as a coming means of air communication between cities. Because of the pattern of urban settlement, much of this will consist of the regional intercity type of travel, with the suburban routes tending to be restricted to the London area, and the feeder routes tending to service international airplane flights.

HELIPORT STANDARDS

The minimum size of the landing area of a heliport is the function of many variables, among them dimensions of a helicopter (including diameter of rotor), its power characteristics, and the number of simultaneous landings and take-offs expected. Obstructions surrounding site and soil conditions also will influence the size of landing area. The Civil Aeronautics Administration has published (in Airport Design, * January 1949) minimum size and dimensional standards required for safe operation for a single engine helicopter of the type in use in 1949. These, it appears, can still be taken as effective minima, although in the face of anticipated development of new helicopter types, larger dimensions will probably be more useful in many instances.

According to CAA,

The size of the touchdown pad should be a minimum of 50 feet in diameter where not more than one helicopter is to land at one time. The safety area to be improved around the touchdown pad will vary depending upon obstructions and dust conditions. This area should extend a minimum of 50 feet from the outer edge of the touchdown pad. Where more than one helicopter is using the site simultaneously, touchdown pads should be arranged in appropriate multiples having a minimum edge-to-edge distance of

100 feet between safety zones to eliminate dangerous air currents between aircraft. However, the combined touchdown pad areas may be paved as an integral unit provided they are satisfactorily marked.

These minima are diagrammed in the following figure.

![Diagram](image)

**FIGURE 2**

CAA Minimum Standards
For Heliports (single landings)

The following heliport design criteria, taken from the Port of New York Authority, and based on the size and weight specifications of three possible commercial helicopters covering the period 1955 - 1975 (see Table 2), take into account the probable maximum developments for some time to come.
### TABLE 5

**HELIPORT DESIGN CRITERIA**

**Space-Weight Criteria**

<table>
<thead>
<tr>
<th>Description</th>
<th>Dimension/Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Landing-take-off Area</td>
<td>200' x 250' one landing and one take-off platform</td>
</tr>
<tr>
<td>(b) Wheel Loading*</td>
<td>19,000 lbs.</td>
</tr>
<tr>
<td>(c) Loading-Unloading Area</td>
<td>30' x 90' 3-17 loading positions</td>
</tr>
<tr>
<td>(d) Weight to be carried by each</td>
<td>25,000 lbs.</td>
</tr>
<tr>
<td>loading-unloading unit*</td>
<td></td>
</tr>
</tbody>
</table>

**Obstruction Criteria (Major and Secondary Airstop)**

<table>
<thead>
<tr>
<th>Description</th>
<th>Dimension/Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Desired maximum elevation of</td>
<td>100'</td>
</tr>
<tr>
<td>operational area above street level</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>(b) Minimum lateral obstruction clearance</td>
<td>100'</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>(c) Minimum approach obstruction</td>
<td>35°</td>
</tr>
<tr>
<td>clearance</td>
<td></td>
</tr>
<tr>
<td>(d) Desired minimum width of approach</td>
<td>500'</td>
</tr>
<tr>
<td>and departure path</td>
<td></td>
</tr>
</tbody>
</table>

* 30-place helicopters anticipated. This would have to be increased 50% when 40-place equipment becomes available.
**Measured from end of landing platform plus 100 feet.


### Multi-Landing Areas

When multiple helicopter flight operations are carried on, the landing facilities naturally will become more complex. The major airport being the terminus for both the aerocab and the feeder service, will probably be among the first locations to require facilities for multiple landing and take-off operations. However, it is not unlikely that heliports serving local and regional intercity travel will, in the future, need more than a single touchdown pad.

The differences between multi-landing area requirements for the multi-engine helicopter of the present and the multi-engine helicopter of the future may be illustrated by a comparative description of the space needs of two different models. The Piasecki H-21 "Work Horse", available now only for military uses, is designed to carry 12 litters or 14 men. Its commercial counterpart which will be designated PD-22 will carry 11 passengers with "Deluxe" accommodations, or up to 21 passengers in the "Commutor" model.
it is expected that the PD-22 will operate from the heliport of the dimensions specified by CAA in its 1949 publication Airport Design.

Contrast these with the dimensions of a landing area predicted for a number of helicopters the size of the experimental 44-passenger Piasecki H-16, calculated on the basis of its flight, landing, and take-off characteristics. According to F.N. Piasecki, in the memorandum submitted to the President's Airport Commission by the Aircraft Industries Association, the size of landing area for this large craft will depend on first, the power characteristics of the helicopter, and second, the maximum number of helicopters expected to be parked on the ground at any one time. Whereas the single-engine helicopter must have approaches to the landing area which will permit a safe auto-rotative landing to be made from any stage of the landing and take-off flight path,

...the multi-engine helicopter which will become available in the period under review, [to 1960] will be able to maintain height and climb-away should engine failure occur while their speed is in excess of 65 m.p.h. (This is based on the assumption of a required one-engine out performance of 200 feet/minute climb at best climb speed). When engine failure occurs during the take-off procedure while the forward speed has not yet reached 65 m.p.h., the multi-engined helicopter must be able to land back on the originating area. A rearward take-off at 45° would permit such a landing to be made from any stage of the flight path since the helicopter would reverse its direction and descent substantially along its ascent flight path. Allowances for over and under shooting would require a clear (into wind) area of three times the length of the helicopter, i.e., 400 feet in the case of the Piasecki H-16.

On the other hand, a forward or vertical take-off would require the provision of a larger (into wind) area unless the area was surrounded by sufficiently large emergency landing areas as might be available at a major airport. The latter would be mandatory if single-engined helicopters were being operated. The 40° into wind landing area would also suffice for the landing case where the multi-engine helicopter would have a steep approach path, preferably 30° - 35° so that it could substantially continue its originally intended path and land in event of engine failure.

The number of movements under I.F.R. conditions into any one landing area will be controlled by the required air clearance time between movements (probably 1 1/2 minutes) and the time taken to move the helicopter onto or off the landing area, (perhaps 2 minutes). This would permit a peak of seventeen movements an hour, or approximately a maximum of 850 passengers per hour when using helicopters of 50 passenger capacity. Space for seven parked helicopters would probably be needed depending on turn around time and the number of helicopters terminating at the airport or awaiting later departure times.
The into wind landing area plus parking requirements would thus require a minimum circular area of 400 feet diameter. The attached illustration [Figure 3] shows how this might be arranged. The parked helicopters would have to be moved as the landing area was changed to suit the wind.

For purposes of comparison, the dimensions of the heliport schemes shown in Transportation by Helicopter are summarized below:

- **Roof Heliport**: Landing area: width - 200'; length - ranges from 200' to 336'6''
  - Flight platform: width - 200'; length 800'
  - (overall dimensions)

- **Ground Heliport**: Landing area: width - 300'; length - 700'
  - Flight area 412' x 700'
  - (overall dimensions)
  - (the station building is located off flight area)

**Approach**

While the helicopter can rise and descend vertically, safe operation in built-up areas with models now in use requires a shallow approach angle. Although the helicopter is a remarkably safe craft, no form of transport can guarantee absolute safety at all times. Flight regulations are usually written to provide for the worst emergency, which in the case of the helicopter would be engine failure under conditions of bad visibility. Therefore the routes and altitudes chosen must allow safe autorotative landing to be made at any point along the flight path. With the advent of multi-engined craft and the development of instrument flight techniques and rules, the requirements given below may be modified in the future.

Despite the helicopter's great versatility and maneuverability, it cannot proceed at cruising speed to a point above the landing area, stop in mid-air, and descend gently at right angles to the letdown pad. Even in case of engine failure, the helicopter would lose forward speed gradually and descend along an angular glide path. The direction that the helicopter takes—whether forward, backward, up or at an angle—is dependent upon (1) the amount of power the pilot elects to draw from the engine and supply to the rotor, (2) the angle at which the rotor is tipped. Consequently, a change of direction from forward to downward is accomplished gradually, and the machine lands at an angle as speed and altitude are lost simultaneously.

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LAYOUT OF HELIPORT FLIGHT AREA REQUIREMENTS

Source: Aircraft Industries Association memorandum to the President's Airport Commission, April 10, 1952
For the single-engine craft in use in 1949, the CAA therefore emphasized that a clear channel of approach to the heliport is an absolute necessity. The approaches should permit landings and take-offs at angles from the outer limits of the touchdown pad of 10:1 in the prevailing wind direction and 5:1 in other directions. The CAA believes that these angles will permit safe and economical operations under all conditions.

The use of the two-engine helicopter will increase the depth of the approach angle. Although some future models may, under certain conditions, be able to land and take-off safely at 450 (see discussion of the XH-16 on page 15), there is rather general agreement that 350 is the steepest angle that can be safely negotiated for some time to come. The Port of New York Authority specifies 350 minimum approach obstruction clearance measured from end of landing platform plus 100 feet.

Waterways, railroads, highways, leading to the central landing site will all permit an obstruction-free approach and will be necessary to consider in selecting a site for a heliport, particularly in downtown sites. Because the helicopter is far less sensitive to cross-wind effects than fixed-wing crafts,* a uni-directional approach path may often be sufficient.

**Obstructions and Their Effect on Size of Heliports**

As indicated above, size of landing area is in part determined by the number and character of obstructions surrounding the site. Although the Port of New York Authority has established obstruction criteria which would probably be acceptable in other localities (see Table 5), it is believed that specific information on the influences of different types and heights of nearby structures will be useful when considering a possible heliport site.

For this reason we are reproducing below a rather detailed discussion of this aspect of heliports taken from a treatise prepared by Sikorsky Aircraft entitled "Helicopter Landing Areas" (SE-55-58, 4/1/53). The craft with which these specifications are concerned are all single-engine, the largest being the S-55, which is currently in use by New York Airways and Los Angeles Airways in their mail and cargo operations. Larger helicopters would, of course, require larger areas.

*Although most modern airplane transports are equipped with tricycle landing gear and are capable of landing or taking off across winds in the range of 20-30 m.p.h., and although special cross-wind landing gear is now being tested, it seems unlikely that the fixed-wing craft will ever achieve the independence from wind directions now enjoyed by the rotary wing craft.
HELIICOPTER LANDING AREAS

The suitability of an area for helicopter landings, whether on the ground or on a rooftop, involves the consideration of its size in relation to the proximity to buildings or obstructions, and whether the landings were to be occasional or as a part of a scheduled operation. Under ideal weather conditions, the minimum size for an occasional landing would be a square area equal to one and one-half times the main rotor diameter on each side. This would mean approximately the following sizes:

<table>
<thead>
<tr>
<th>Model</th>
<th>Main Rotor Diameter</th>
<th>Approximate Size Square</th>
</tr>
</thead>
<tbody>
<tr>
<td>S-51 (H-5, HO3S)</td>
<td>49 feet</td>
<td>75 feet</td>
</tr>
<tr>
<td>S-52 (H-10, HOS)</td>
<td>33 feet</td>
<td>50 feet</td>
</tr>
<tr>
<td>S-55 (H-19, HOS, HRS)</td>
<td>53 feet</td>
<td>80 feet</td>
</tr>
</tbody>
</table>

A square area is specified as minimum since helicopter landings are generally made into the wind. Where obstructions are involved or air turbulence is likely to be encountered, as in landings or approaches on the lee side of buildings, areas two or three times this square footage are desirable.

When planning helicopter airports for scheduled operations, it has been the practice to interpret 'obstacles' as any objects or surroundings which would project into a field of vision extending outward and upward from each edge of the touchdown area at the slope of six to one.

In considering various types of obstacles surrounding a landing site, buildings and signboards are of more concern than smokestacks of flagpoles, etc., because of the turbulence they produce on windy days. These latter are of concern principally only when flying with poor visibility.

For scheduled operation, an area which is clear from obstructions on all sides should be at least three times the main rotor diameter on each side. This would mean a 150-foot square for the S-51, a 100-foot square for the S-52, and a 160-foot square for the S-55.

The desirable size in event of obstacles can best be determined by consideration of the flight characteristics of these aircraft. They can accelerate from hovering to 40 miles per hour in a distance of approximately 250 feet while taking off in a gradual climb to about 40 feet altitude. At that speed they can climb at an angle of approximately 25 degrees. Approaches for landings are customarily made somewhat steeper, at an angle of 35 to 45 degrees. A convenient radius for turns in the S-51 or S-55 is between 300 and 400 feet, and 200 to 300 feet in the S-52.
Thus, for scheduled operation with an S-51 or S-55, a landing site having 50-foot obstacles on two adjacent sides might be approximately 400 feet square. This would permit operation in the undesirable condition which arises when a strong wind blows over the area from the blind corner. If these obstacles were only 20 feet high, the 400 foot dimension could be reduced to 300 feet. For an S-52, all of these size dimensions could be reduced by approximately 20 per cent.

For obstructions higher than 50 feet, these dimensions should be increased proportionally, but not by more than 25 per cent as a limit, since such an area would be adequate regardless of their height, provided two approaches were open. In the extreme case of landing area being surrounded by tall obstacles on three or more sides, it would be desirable to have space sufficiently large to permit the helicopter to spiral in and out in order to maintain a scheduled operation under adverse weather.

If the obstructions are not located at the edge of the landing area as assumed above, the affected dimensions can be reduced by one-half the distance the obstacles are so removed. If one or more helicopters are to be parked on any landing site less than 200 by 200 feet during operations, an additional area allowance equivalent to one and one half times the rotor-swept disc area should be provided for each. This would result in an allowance of about 2700 square feet for an S-51, 1350 square feet for an S-52, and 3300 square feet for an S-55.

The foregoing general recommendations can serve as a guide, but it must be realized that such cannot always fit each particular case, and that, in any event, the final decision of suitability should rest on the judgment of an experienced helicopter pilot.

Heliport Site Criteria

Having established the design criteria for heliports (see Table 5) the problem of site selection becomes one of finding suitable areas in or near traffic centers that satisfy these design criteria. As the Port of New York Authority points out, the size and location of a heliport must be based upon passenger and other traffic requirements as well as upon operational needs.

Traffic requirements and helicopter operational requirements together determine airstop size but the two are not independent of each other. Thus, it operational requirements dictate a landing and take-off area beyond a modest size, airstop locations near the traffic centers of cities will be impractical. If, then, the airstop is moved from the city
center to a location providing sufficient area to meet operational requirements, traffic volumes sufficient to maintain a profitable operation will not be realizable.

Accordingly airstop design criteria in metropolitan areas must attain an economic and operational balance between the need for locating airstops near the heart of traffic generating centers, on the one hand, and the operational capabilities of the helicopter, on the other; and it is just as important to balance the high cost of land and construction against its impact on helicopter operating cost and fares. (p.62)

The following site criteria summarize the various requirements for heliports that have been raised in other parts of this report. These are taken from Transportation by Helicopter (p.61):

Site Selection Criteria

1. Proximity to traffic generating centers.
2. Vehicular accessibility to traffic generating centers.
3. Nearness to Post Office.
4. Possibility of securing desired rooftop elevation.
5. Obstruction clearance.
6. Permanence of existing obstruction clearances.
7. Area available.
8. Possible noise nuisance.
10. Cost of developing site.

Auxiliary Facilities

Most of the standards and proposals developed so far deal mainly with the landing area itself. Future heliports serving as terminals for passenger traffic will need to have special buildings (or rooms, in the case of the roof heliport) to house waiting rooms, ticket offices, etc. for the people who will be using the service. Some writers have recommended that off-street parking facilities be provided in connection with the heliport, and the proposed Charing Cross Heli-drome (Figure 6) would have a ground floor "drive-in" leading to a common reception hall with express elevators to take passengers to the main concourse on the eight floor.

Since the central heliports probably will be serving the largest number of passengers—-they being one terminus of the aerocab and local intercity routes--the auxiliary facilities to be provided will be larger and possibly more numerous than those needed at suburban heliports. This fact will further
complicate the finding of suitable buildings for heliport operations, and it is not unlikely that in many instances, whole new structures built for this purpose may be found necessary. The combination of heliport facilities with airline offices would seem a particularly convenient arrangement. In Tokyo an eight-story aviation center in the heart of the city, housing airline offices, ticket offices, and including a rooftop heliport is now under construction.

For the Port of New York Authority's *Transportation by Helicopter* a series of prototype designs for heliports has been developed. Four of these are rooftop sites and one is for a ground-level location. According to the authors, these designs envision a highly efficient terminal operation with a high degree of utilization of rooftop area and a highly proficient loading and unloading operation. These schemes do not provide for parking or servicing of the helicopters, although the proposed Charing Cross Helidrome would have hangars and workshops on the lower platform. The Port of New York Authority rooftop schemes allow for a floor for mechanical equipment if required. Among the activities for which space is provided are concessions, waiting rooms, ticket counters, operations offices, passenger gates, bag lifts, escalators and elevators and bag checking.

The actual building of the first group of auxiliary facilities at a heliport will supply us with more information on the extent of such services found necessary. In the meantime, it should be kept in mind that the heliport will produce the same demand for shelter, food, and concessions as train or bus stations now accommodating a comparable number of passengers.

**Ground Level Heliports**

One of the main concerns in connection with land sites is the preparation of a suitable surface for landing. In general, the surface should be grass or pavement and free of sand or pebbles which would be blown by the downwash of the main rotor blade. The CAA says that the touchdown pad may be either square or circular. It should be surrounded correspondingly by either a square or circular clearance and safety area in a contrasting color. "For example, the ground surface heliport should have a white concrete touchdown pad surrounded by a bituminous surface safety area, or a white concrete or dark bituminous touchdown pad surrounded by a turfed safety area."

The CAA also recommends that the ground heliport be enclosed with a substantial fence having a minimum height of 4 feet to prevent trespassing and suitable gates for passenger and vehicle entrance.

For lighting, wind indicators, and special markings, CAA regulations should be consulted.
Ground level heliports located near large buildings are apt to be subject to greater air turbulence than ground level heliports in more or less open country or rooftop heliports at the same location.

Illustrations:

Figure 4 shows the new Bell Aircraft plant at Fort Worth, Texas, devoted exclusively to helicopter manufacturing. Its heliport is 200 feet x 400 feet with markings for twelve landing spots and two hardstands having sunken concrete blocks with metal rings for tying down the helicopters. The asphalt paving is 9 inches thick. Wigton-Abbott Corp., engineers and constructors, estimate that a similar heliport exclusive of hangars, might be build for under $20,000.

A spokesman for Bell Aircraft reports that recently six Bell Model 47 helicopters, operating from this airport, made a total of approximately 100 take-offs and 100 landings in 75 minutes elapsed time. During the 75-minute interval, about 200 passengers were given helicopter rides in the six small helicopters. It is observed that this operation is indicative of the ability of small helicopters to accommodate numerous helicopter operations concurrently and schedule take-offs and landings at 20 second intervals.

The lower photograph shows the heliport constructed by the Department of Marine and Aviation, New York City, on the top of their new Pier 57.

Roof Heliports

Although there is a popular tendency to believe that almost any rooftop can be used as a helicopter landing area provided it is large enough, engineering considerations and space requirements lead one to conclude that is not the case. The Port of New York Authority believes that "rooftops of existing buildings, even in the few cases where they provide sufficient roof area and the required obstruction clearances, probably will not reduce the facility cost. Large expenditures will be required in all likelihood for reinforcing columns, additional elevator capacity, and other remodeling expenditures." (p.61)

Civil Aeronautics Administration recommendations regarding rooftop heliports state:

Where heliports are built on roofs, the strength of the contact surface should be greater--by a wide margin--than the helicopter alighting gear. Helicopter alighting-gear structures customarily are designed to withstand from two and one-half to four times the static load on each wheel without taking a permanent set, and to have a factor of safety of 50 percent in addition to this load without failure.
A land heliport at plant of Bell Aircraft Corporation, Fort Worth, Texas

Ground-level heliport on Department of Marine and Aviation pier, New York City

Figure 4  GROUND LEVEL HELIPORTS
Because no helicopter can impose its maximum load upon landing until at least three wheels are in ground contact, the maximum strength of either wheel gear structure is approximately two times the gross weight of the helicopter. Drop tests have indicated that this load can be built up in a period of from \(1/125\) to \(1/25\) of a second and is relieved back to static load in from \(1/8\) to \(1/5\) of a second. It is recognized that the strain on a roof surface induced by an impact load made by a hard landing will be appreciably greater than that of a steadily applied load. It is believed, therefore, that a roof structure would have sufficient strength if no part was stressed beyond a concentrated load equivalent to three-quarters the gross weight of the helicopter on any one square foot.

It is understood that this load could act anywhere in the contact surface simultaneously with all the existing dead loads and the applicable live loads as prescribed by the building codes governing the area.

For the largest equipment presently in general use, (the Sikorsky S-51, having a gross weight of 4,986 pounds), a concentrated design load of 3,700 pounds interpreted as above would be suitable.

(Airport Design, 1949, pp. 55-56)

Roofs not having the protection of a parapet of adequate height should be provided with a guard rail at least 4 feet high. The Sikorsky Aircraft monograph (SE-55-58, 4/1/53) observes that if additional strength for resisting the concentrated load is provided by a platform or matting laid on the roof surface, this should be 6 inches or less in thickness. Since a matting of this type would have to cover only the area of the roof which the wheels might contact in landing, a conservative minimum size for a low matting on a large roof under normal operations would be a square one-half the main rotor diameter on each side.

Because of the expense involved, rooftop heliports designed for scheduled passenger operations should probably take into account the larger helicopter of the future. Reference may be made to Table 2 for specifications of gross weights in the larger models predicted for scheduled use in the next twenty years.

Illustrations:

Figure 5 (top) shows a small helicopter in the act of alighting upon the touch-down pad of the roof heliport atop the Port of New York Authority Building in New York City. The landing area is elevated above the roof of a 16 story building and is approximately 40 feet square. Although the heliport is located in the congested lower west side district of Manhattan, the Hudson River, a few blocks west offers clear flight approach lanes. According to one observer,
the elevated landing area simplifies structural aspects of the platform, reduces air turbulence, provides an isolated landing area, and assures unobstructed landing and take-off approaches. The bright yellow circle with white markings on a dark background makes the heliport readily visible from the air. Approximate cost of construction was $21,000.

The lower photograph is a picture of the rooftop heliport used by the scheduled air mail service in Chicago, Illinois. Located on top of the 12-story main post office, it is in a particularly favorable location operationally, because clear approaches are available on three sides due to existing highways, railroad routes and close proximity to the Chicago River. The landing mat is 75 feet x 110 feet. The post office building roof was stressed for autogyro landings at the time of its construction several decades ago.

Proposed Helidrome in London, England

To date, one of the most ambitious structures for a major downtown heliport is the proposal for the International Helidrome at Charing Cross, London. Although its actual construction is uncertain, its plan is reproduced here both to show the possibilities of an imaginative and fresh approach to the provision of permanent facilities for this new and revolutionary means of transport, and to illustrate the magnitude of the problem of providing a multi-landing heliport in the heart of a city.

Designed to accommodate simultaneous loading and unloadings for several helicopters, the platform has two "runways" for landing and take-off, each acting independently from the other. Each "runway" is 300' long and 150' wide (complying with the requirements of the Inter-Departmental Helicopter Committee) and together they form a square 300' x 300'. This square is quartered into four smaller squares of 150' x 150' to permit landings and take-offs in any direction.* The helidrome is circular in shape to allow parking spaces around the "runways" and room for the two elevators which will take machines to the hangers below for servicing.

Noise was a matter of particular concern, and regarding this the designers believe that they have in part solved the problem. It is observed in the accompanying article that the maximum noise that will affect the areas near the helidrome will be that of a helicopter flying at high level, because the machine will never come down to the level of neighboring buildings and will

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* The dimensions of the individual squares are the same as those established by the Civil Aeronautics Association (see figure 2). However, it is to be noted that the CAA recommends a minimum edge-to-edge distance of 100 feet between safety zones.
Heliport on roof of Port of New York Authority Building, 16th Street and 8th Avenue, New York City

Figure 5 ROOF TOP HELIPORTS
PROPOSAL FOR AN INTERNATIONAL HELIDROME AT CHARING CROSS

by Messrs. Aslan & Froemc

THE ARCHITECT and Building News,
January 8, 1953

Figure 6
always fly at a considerable height above the roofs. When the helicopter is
directly over the helidrome, most of the sound waves radiating downwards
vertically or at an angle will strike the flat, hard, concrete and glass surface
of the platform and will be immediately reflected upwards.

The maximum noise will develop when the machine is taking off from the platform
and immediately after it leaves it. Here, it is believed, that sound waves will
mostly affect the structure, particularly the area immediately under the runway.
This area, planned for hangars and workshops, "will act as a pocket to receive
the sound waves." Structures and surfaces will be acoustically treated.

SOME IMPLICATIONS FOR ZONING

"Airport zoning," as the term is generally used, means the regulations adopted
by a municipality for the purpose of protecting an airport and its approaches.
Usually, separate airport zoning regulations are not intentionally related to a
comprehensive zoning plan, although they may in some instances be so integrated
and should be. Many cities possess the extraterritorial authority to zone for the
protection of public airports, although they do not possess other extraterritorial
land-use controls.

The kind of zoning we are primarily concerned with here is the familiar compre-
hensive zoning for land use, coverage, density, and height. We are interested in
the effect of heliports on surrounding uses, and we are interested in the compat-
ability of other uses with heliports. In anticipating the proper zone for the heli-
port, we must keep in mind the fact that it will be accommodating scheduled
flights, with landings and take-offs that eventually may be occurring at the rate
of 10 to 15 movements an hour. Furthermore, it is not outside the realm of
possibility that helicopter flights eventually will be scheduled on a 24-hour basis.

The question of zoning for helicopter landing fields resolves itself into two parts:
(1) regulations of the midtown heliport (whether roof top or ground level), and (2)
regulation of the town-edge heliport.

Because of the nature of the midtown operation, the heliport will necessarily fall
in locations zoned for commercial or industrial use, Assuming that special heli-
copter flight rules will be developed by the Civil Aeronautics Association and that
only operationally safe sites will be permitted, what then, are the aspects of this
operation that come within the domain of land use regulations?

The problem that arises over and over again in the discussion of site location for
heliports is that of noise. Some observers believe that unless helicopter noise is
reduced, the competitive advantages of the helicopter over ground transportation
may not be gained. Helicopter manufacturers are of the opinion that successful
solution of the noise problem will be a large factor in public acceptance of
scheduled helicopter transportation. In downtown locations, noise will almost
certainly affect persons in buildings located laterally to the approach path. In commercial areas the two groups to be considered are workers in office and store buildings and persons living, permanently or temporarily, in hotels. In some instances, apartment house districts may be so situated as to be within the range of helicopter noise. Whether the noise of scheduled helicopter operations will be greater than the noise of normal surface traffic is a matter to be determined.

There is reason to believe that helicopters landing on roof-tops will have a smaller radius of disturbing noise than helicopters landing on ground levels. The development of efficient mufflers will also minimize the range and loudness of helicopter engine noise. On the other hand, if jet-powered helicopters are brought into transport use, the noise problem becomes quite a different thing, and the question may be raised as to whether or not heliports found inoffensive for use by the helicopter powered by a muffled reciprocating engine can be tolerated when used by the jet helicopter. Some idea of the problem can be gained by imagining the noise effect of a jet fighter plane taking off regularly from the rooftop of the local post office in your city.

In any event, it is suggested that the method of attacking this problem is through the application of performance standards—the quantitative measurement of the effect of noise that increasingly is being used in zoning for industrial uses. (See PLANNING ADVISORY SERVICE Information Report No. 32, Performance Standards for Industrial Zoning)

One other aspect of the commercial helicopter operation that may come under zoning controls is that of protection of the approach path from future obstructions. This type of regulation is, of course, a primary one in the special type of zoning known as airport zoning. Heliport sites will be selected partially because of the existence of at least one obstruction-free approach path. Often, therefore, they will be near rivers, lakes, railroads, highways, or canals. Early in the site selection stage, the zoning ordinance should be consulted for height limitations permitted in the area of the approach path, not neglecting stacks, towers, flag poles, chimneys, etc. which usually are excepted from height provisions. The site having been selected, measures should be taken to ensure retention of navigable air space. In cities not having airport zoning it is probable that a zoning ordinance amendment or a special ordinance will be required to authorize obstruction controls.

One further problem that is likely to come before a planning commission or a zoning board of appeals is whether or not to permit the conversion of a downtown park to a heliport. A number of considerations will enter into this decision. One will be the inescapable fact that, unless the park is very large (for example Golden Gate Park in San Francisco or Grant Park in Chicago) it cannot serve both as a park and a heliport. The decision then may turn on the choice between a park and a heliport. Often times, a downtown park will be one that has existed since the city was founded and as consequence is a single remaining spot of green surrounded by blocks of high office buildings. In these cases, the value of such a park to the
public as a whole versus the value of a heliport to a portion of the traveling public have to be weighed. Another consideration will be the convenience of the park as the source of helicopter traffic. From previous discussions it can be seen that the fact that a piece of land lies open is no guarantee that it is also suitably located as a heliport.

With respect to the heliport at the edge of town noise again will be the main problem, with several important differences. For one thing, it is the permanent residential environment that will be invaded by an alien noise. Because of the availability and suitability (from the standpoint of helicopter flight) of sites on the outskirts of urbanized areas, the householders most affected may be just those who have sought a quiet, semi-rural location. Furthermore, suburban areas do not have the continuous traffic noise found downtown which partially offsets the effect of helicopter noise. The maximum level of noise tolerated in a commercial or industrial location, thus, is usually much too high for areas in or near residential districts.

These considerations suggest that minimum distance standards should be developed between heliports and the nearest residence. These standards should take into account the loudness and range of the noise expected to originate both from the heliport itself and from the approach paths.

Because of high land costs in central areas, it is possible that suburban heliports will be expanded to include hangers, gasoline storage, and helicopter repairs, servicing, and storage. Although for some time to come, most maintenance work will probably be done at regular airports, the potentialities of the helicopter indicate that special facilities eventually may be built for such purposes.

Just as the helicopter is a feeder to the airplane, so the automobile is a feeder to the helicopter. Suburban heliports will eventually need to provide space for off-street parking for the all-day parker as well as for the temporary parker awaiting take-off. Heliports will be generators of automobile traffic, and the possible effect of heliport automobile traffic passing through residential areas will be another item to consider.

The Doolittle Commission, which investigated the relationship between the airport and the surrounding uses, was mainly concerned with the safety of airports. However, a number of other points were considered, among them noise and other nuisance aspects. In connection with all of these, the Commission pointed to past negligence regarding the welfare of persons living near airports:

Some excuse may be found for failure to have foreseen the rapid rate of aeronautical progress in designing airports in the past but it is to be regretted that more consideration was not given to the comfort and welfare of people living on the ground in the vicinity of airports. To be sure, many settled near an airport after it was in operation, with little realization of the potential
nuisance and hazard. The public cannot be expected, however, to anticipate technical developments and it should be informed and protected by the responsible authorities.

(The Airport and Its Neighbors, p. 12. Our emphasis)

In turn, the heliport operator has the right to expect municipal protection against invasion of the navigable airspace. Appropriate land use regulation of heliports not only will protect the existing character of the neighborhood. In addition, it should benefit helicopter transport by preventing nuisance charges before they arise and by promoting the proper locations of heliports.