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THE PROBLEM OF AIRPORT SIZE*

FRED D. FAGG, JR.†

I. AIRPORT SIZE AND CAPITAL INVESTMENT INCREASE

1. **Airports—A Municipal Responsibility.** Nearly ten years ago, Mr. Justice Cardozo, then Chief Justice of the New York Court of Appeals, in a single-page decision that held the establishment of an airport to be a "city purpose," found space to ornament his opinion with the following lucid observation: "Aviation is today an established method of transportation. The future, even the near future, will make it still more general. The city that is without the foresight to build the ports for the new traffic may soon be left behind in the race of competition. Chalcedon was called the city of the blind, because its founders rejected the nobler site of Byzantium lying at their feet. The need for vision of the future in the governance of cities has not lessened with the years. The dweller within the gates, even more than the stranger from afar, will pay the price of blindness."

2. **The Size Problem, or How Big Is an Airport?** The municipalities of America have not doubted the truth of these prophetic words. Recognizing the tremendous transportation and other values which aviation has had to offer, they have dug deep into municipal treasuries to provide the proper facilities for aviation's rapid and splendid growth. The very rapidity of that growth, however, has brought with it some fundamental problems which must be faced frankly, and solved quickly, if continued development is to be expected. At the moment, the foremost of those problems relates to airport *size* and, undoubtedly, the year 1937 will be remembered by most of the American municipalities as that which raised the thought-provoking question: "How big is an airport?"

(a) *Early Flying and Early Airports.* Of course, the question has been asked before by each municipality—from the time its local boys had chosen one particular cow pasture for preferential treatment by barnstorming war-time Jennies to the time when its

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mayor delivered the keys to the city to the first air-mail-carrying plane that stopped enroute. But, at that time, the only matters involved were the removal of a few stones and trees, and the leveling of a few rough spots.

(b) *Multi-motored Aircraft and Airline Beginnings.* And, of course, the question was asked again—when the first multi-motored transport planes began to circulate and the passenger-carrying era began. Heavier; and more inert, they required a longer take-off run and smoother runway. The answer still was not difficult to supply. One cow pasture was extended to include two, or perhaps three. But now, for the first time, the location of airports close in to the metropolitan areas began to present problems where urban land values were high. Hence, the formation of local committees to provide the information and enthusiasm necessary for airport financing and development. Oratory again came into its own, and the significance of aviation to a community was so firmly impressed upon the local citizenry that they were even willing to mark an "X" in the proper space on the ballot and so provide an increased indebtedness—a process of municipal keeping up with the Joneses.

(c) *Paved Runways and Financial Difficulties.* Still later, the question was asked again—when the air transport companies suggested the need for paved runways and increased airport dimensions to provide for newer, larger, and more luxurious aircraft models. The local committee members again removed their coats, pointed with pride to the volume of air traffic moving more swiftly across the heavens, and viewed with considerable alarm their settling down to graceful landings by virtue of consummate pilot skill, luck, and sturdy brake-linings.

(d) *Federal Airport Aid Programs.* Then, just before the flow of oratory went down to possible defeat at the polls at the hands of a Chalcedonic public, the Federal Government instituted programs (through CWA, FERA, and WPA) which offered ways and means to keep the airport abreast of the aircraft. For a brief breathing space, questions as to size were submerged beneath the mechanics of providing the necessary legal relationship fitting the municipality for a sharing of federal aid. When asked again, the question was voiced less vigorously and sponsors' contributions were provided by the customary bonding process as a result of a solemn, and supposedly final, promise that, at least, the city would have a first-rate airport.

(e) *Four-engine Equipment and Airline Cancellations.* In

1937, however, new problems were presenting themselves—problems which were to cause embarrassment and confusion to airport sponsoring committee members and to public officials who had given freely of time and municipal funds to provide adequate airport facilities.

Out on the West Coast, within the seclusion furnished by guarded plants, new and greater aircraft were rising from the drawing boards, as if by magic, to assume concrete form in the jigs. Immense, four-engined planes, capable of carrying some forty passengers and air mail and express—whose performance characteristics were as yet unknown and whose operation might require greater landing areas than yet provided. These huge craft were soon to be placed in service—to meet the needs of competition and to offer the public the latest advancement as to speed, reliability, safety, and luxury of air travel. Remembering that the take-off and landing performance characteristics of the present-day transport aircraft are not equal to those of earlier models, the municipal representatives were quick to fear that the same performance characteristics of these new giant liners would not be as good as those of the present, and that, therefore, they must anticipate the need for even larger and better-equipped landing areas for their use. Of course, they recognized that until the new aircraft have been actually completed and flight-tested, no one can accurately determine what the performance record will be. However, the municipal representatives, to be safe in their own necessary estimates, were relying on their experiences of the past.

Further, the airlines, with new or recently acquired equipment, were canceling stops at numerous points where sizable-airport expenditures had been made and yet where the facilities provided were deemed unsuitable for airline use either by the airline, the Department of Commerce, or (as generally was the case) by both.

(f) *What of the Future?* To date, thanks to the efforts of a legion of loyal, but unsung, aviation enthusiasts, the municipal airport development has kept good pace with aircraft improvement. But we are now confronted with the growing fact of municipal unwillingness, or positive legal or financial inability, to be led on to unlimited expansion and unlimited expenditure. Already there is a well-voiced request for a respite in connection with municipal airport spending. More and more communities are sending delegations to Washington asking just what is the expected limit to airport size. Tired of guessing at minimum airport requirements for first-class airline service, tired of presenting new bond author-

izations to a somewhat disillusioned public, and tired of making explanations for a canceled airline service due, supposedly, to inadequate landing facilities, these municipal representatives are demanding that, if a continuance of municipal funds be forthcoming, then the proper Federal agency shall set up some definite standard for airports which shall suffice for the next ten or twenty years, and which will force airline operators to use aircraft which will be capable of utilizing such airports with safety.

And so, in the year 1937, the voices of the American municipalities have swelled into something of a chorus to ask again, but perhaps in a more sinister tone, "How big is an airport?"

II. AIRPORT RATING STANDARDS

1. Inadequacy of Legal Definitions. As defined in the Air Commerce Act of 1926, the term "airport" means any locality, either of water or land, which is adapted for the landing and taking off of aircraft and which provides facilities or shelter, supply, and repair of aircraft; or a place used regularly for receiving or discharging passengers or cargo by air. By the terms of this law, the only difference between an airport and a landing field is that the former is provided with facilities for the supply and shelter of aircraft, or is used regularly for passenger or cargo operation.

This definition was written many years ago and offers little aid in the determination of airport rating standards other than the useful formula of adaptation for aircraft landing and taking off. That standard is the prevailing one in use today, but there are many other new elements not foreseen by the framers of the original legislation.

2. Standards Based Upon Service Offered. At the present time we are of the opinion that airports should be rated as to their capacity to serve as a safe base of operation for one or more types of aircraft in use. We further believe that such capacity must be determinable by practical standards which are themselves determined by actual aircraft performance and not by the whims of any particular individual.

There is nothing mysterious about such a procedure, and we commonly accept a similar practice in other fields. A private boat-landing at the edge of a shallow lake may easily accommodate a rowboat or a canoe, but not an excursion steamer. The excursion steamer facilities, in turn, may not accommodate a *Queen Mary*. And no one expects them to. The facility provided is adequate

only to the particular kind of service it is calculated to offer. So, also, with airports, as we shall proceed to demonstrate.

3. The Relation of Aircraft to Airport. Perhaps the easiest way to prove the point is by tracing the history of the Bureau of Air Commerce regulations relative to aircraft and airports.

(a) *Aircraft Performance Regulations.* The first airplane performance regulations (effective December 3, 1926) required the following performance with full load: (1) Take-off within 1,000 feet; (2) climb at least 250 feet for the first minute after taking off, and (3) stop within 1,000 feet after landing.

In 1928, the permissible take-off run was raised to 1,500 feet, the other requirements remaining the same. This was again reduced to 1,000 feet on July 1, 1929, however, and has remained so up to the present time. On November first of this year the 1,000 foot take-off run requirement will be again modified to permit some airline carriers a longer run in cases where the airport terrain and the airplane's performance are considered suitable. The general requirement of 1,000 feet will remain in force for all other cases however.

In 1929, a landing speed requirement was introduced for the first time, restricting aircraft with brakes to a maximum landing speed with full load of 60 miles per hour. On July 1, 1929, this was raised to a maximum of 65 miles per hour where it still remains except that aircraft of 30,000 pounds gross weight or more are permitted to land at 70 miles per hour. No landplane of this size is operating as yet so, in effect, the 65-mile rule still applies.

Meanwhile, during the period from 1928 to the present, the landing roll requirement became unnecessary—due to adequate brakes—and accordingly, disappeared. The requirement as to climb immediately after take-off was amended during this interval in the direction of forcing better performance in this respect.

There is one more important performance requirement which applies to the question under discussion. This has to do with maneuverability. Part of the flight test procedure required for licensed aircraft in 1928 consisted of a series of five successive figure 8's around two markers 1500 feet apart with specified turning radii. This disappeared from the January 1, 1931, regulations, being replaced by a general statement as to maneuverability. This change was undoubtedly the result of a realization on the part of the regulations drafters that the larger aircraft which were then in the future could not be expected to maneuver so sharply.

Summing up the foregoing, therefore, it is apparent that the

performance regulations have not changed materially since their early conception except for the significant modification as to turning radius. Keeping this thought in mind let us examine the airplane itself.

(b) *Actual Airplane Performance.* Actually in the early days and up to within approximately three years ago, airplanes did not approach the 1,000 foot take-off limitation, that is, they left the ground in substantially less distance. The reasons for this were the 65 mile per hour landing speed limitation which dictated a certain minimum wing area and the climb requirement which called for an established minimum power output. When these requirements were met the take-off was automatically no problem at all.

A third reason, not a part of the regulation, was the relatively small size of the aircraft then flying. They did not have the inertia of the giants now in use and anticipated for the near future, and could be accelerated rapidly to take-off speed.

Then came, not only larger aircraft, but aircraft with wing flaps. These developments were partially but not fully offset by controllable pitch propellers which delivered more power during the early stages of the take-off.

The significance of flaps lies in the fact that they permit smaller wing areas to meet the landing speed requirement but have so far been of little or no help on take-off. This has meant faster take-off speed which in turn signifies a longer take-off run.

An additional factor lies in the engine development. Early engines were designed for full-power operation at sea level with diminishing power output as the altitude increased. In obtaining the present remarkable engine efficiency at high altitude the engine designers have now reversed the situation. That is, engines deliver their maximum power at altitudes of 5,000 to 15,000 feet dependent upon the particular design, and the power output decreases with decreasing altitude.

Other factors incidental to the development of a rapidly growing industry have also contributed—such as the commercial necessity to carry every possible pound of pay load while still providing all the luxuries attending modern air travel, which has put a tremendous strain upon the designer and the operator and has led to what we would previously have probably called “over-loading.”

The foregoing statements are substantiated by our Bureau records which show that the 12,000 to 12,500 lb. Fords and Fokkers could take off with full load in less than 400 feet whereas the modern air carriers, which weigh up to 24,000 lbs., are crowding

the 1,000 foot line. We are advised that the larger aircraft soon to appear must be so loaded as to require a 1500 foot run if they are to be commercially successful. So much for the aircraft.

(c) *Airport Rating Regulations.* The Airport regulations issued in 1928 give the following figures as to lengths of runway at sea level:

- Class 1—2500 ft.
- “ 2—2000 ft.
- “ 3—1600 ft.
- “ 4—1320 ft.
- “ 5—Less than 1320 ft. (for specific uses)

Now consider those dimensions in the light of 1928 aircraft. The average length of run at take-off was in the neighborhood of 300 feet. To be safe we might assume 500 feet, which is generous. The smallest runway length, excluding the special Class 5, was almost 3 times that distance and the largest was 5 times. Add to this the short turning radius of those aircraft which would in most cases permit a turn at low altitude and return to the field in the event of engine failure after take-off and you have a picture of satisfactory airport facilities.

But to return to airport rating regulations history. The runway lengths used as a basis for rating in Classes 1, 2, 3 and 4 remained the same through 1929 and 1930. Then, on September 1, 1931, there appeared in addition to the above a set of rating specifications for a new type of airport known as Class “T.” This called for 4 landing strips 3500 feet long or, alternately, 2 landing strips at an angle of not less than 60° and of a length not less than 5,000 feet. This was indeed a forward-looking step when it is considered that it occurred 6 years ago.

On July 1, 1932, there appeared a further modification of the rating regulations with the basic requirements remaining the same, but providing additional alternatives as follows:

- T rating—(a) 3500 feet in all directions
- (b) 3500 feet in 8 directions (4 strips)
- (c) 4200 feet in 6 directions (3 strips)
- (d) 5000 feet in 4 directions (2 strips)
- 1 rating—(a) 2500 feet in all directions
- (b) 2500 feet in 8 directions

- (c) 3200 feet in 6 directions
- (d) 3750 feet in 4 directions

- 2 rating—
- (a) 2000 feet in all directions
 - (b) 2000 feet in 8 directions
 - (c) 2500 feet in 6 directions
 - (d) 3000 feet in 4 directions

The ratings of 3 and 4 were similarly added to.

In 1933 the Airport Section was disbanded but, in the same year, another body began to direct its attention to airport problems as related to airline operation. This was the Air Line Inspection Service, and as a result of the study and efforts of this new service of the Bureau, and following conference with airline operators, there appeared on October 1, 1934, Aeronautics Bulletin No. 7-E, which contained this significant paragraph:

“Terminal airports shall comply with minimum requirements as to standards for size, obstructions to light, etc., which will permit the safe operation of air line aircraft to be used.”

This paragraph required a knowledge of certain aircraft performance figures which were not available to the Bureau as the regulation in effect up to that time did not require measurement of performance other than that sufficient to establish compliance with the airworthiness requirements. An attempt was made to remedy this situation by the drafting of Aeronautics Bulletin No. 7-J which was first submitted to the industry for comment on March 6, 1936. This bulletin was never made effective, however, and its essential parts will appear on November 1 of this year in connection with the Airworthiness Requirements for aircraft.

Meanwhile a revitalized Airport Section of the Bureau has taken cognizance of these problems, has developed suitable camera equipment never before available and is busily engaged in measuring accurately the everyday performance of modern air carrier equipment.

There is also a comparatively new element in the problem. Modern multi-engine aircraft can fly with full load with any one engine inoperative provided that they have reached a certain minimum speed known, although inaccurately, as “single-engine speed.” (Older air carriers could not do this and were therefore quite vulnerable in the event of engine failure at any speed.) This single-

engine speed is unfortunately higher than take-off speed. In our desire to completely eliminate the hazard which has always been associated with engine failure during take-off, we should like to protect that brief interval between "take-off speed" and "single-engine speed." The only way to do that is to provide enough airport space, so the airplane can land straight ahead in the event of engine failure during that time. A careful measurement of all of the maneuvers involved is obviously indicated and is vigorously proceeding.

When these studies of actual aircraft performance are completed, we shall have some tangible data to present and by which to offer some practicable airport rating standards.

III. THE PARTIES INVOLVED

1. The Airline Operator. The parties involved in our problem are five in number. The first is the airline operator, who offers an air transport service for the convenience of the public and, if possible, for his own profit. Spurred on by very real factors of competition, he attempts to take advantage of every new development in the field of modern aircraft. It is but natural for him to purchase larger and speedier equipment and no one regrets more than he the necessity to pass up important scheduled stops because of inadequate airport facilities.

2. The Aircraft Manufacturer. The second party is the manufacturer of the aircraft who, until the present moment, has found that municipal airport spending would keep pace with the performance requirements of his greatest, and most luxuriously appointed, planes. His market has not been hampered by inadequate port facilities and he has been worried only by an inability to fill delivery orders promptly. However, if he should build a craft too large to be landed at a sufficient number of airline stops to make for profitable operation, then his market will be immediately affected by the falling demand from the airline operator. Here, then, is a very positive check to unlimited increases in aircraft size if not accompanied by proper performance characteristics.

3. The Municipality. The third party is the municipality, which is master of its own transport destiny. It must gauge its airport facilities to the type of scheduled airline service it desires. Nothing is clearer than that the modified cow pasture of yesterday will not harbor the super air liner of tomorrow. And municipalities without adequate facilities will yield air transport service to

others with greater vision. Geographical advantages, long preserved to some communities by virtue of location on navigable water or in accessible valleys for preferred rail routes, will not avail against the sky couriers who recognize no natural traffic barriers.

4. The Post Office Department. The fourth party is the Post Office Department, which today provides the fundamental financial inducement to scheduled airline operation and which specifies the type of equipment, the schedules, and service to be furnished upon specific routes and at specific stops upon such routes. This agency, alone, can order an airline to establish, or re-establish (when deemed safe by the Secretary of Commerce) air transport service into a community. No other agency, other than the airline itself, can provide such service.

5. The Department of Commerce. The fifth and final party is the Department of Commerce, which certifies the airline operation as to its competency for scheduled service in mail, passenger, or express business (or in combination thereof), and which determines whether or not the airport facilities offered at any given place are suitable for the safe operation of a specified type of airline equipment considered in conjunction with its crew and ground personnel and with its company operation and the other facilities.

At some day in the near future, these five parties should be brought together, in friendly conference, to exchange ideas with respect to the future of commercial air transportation and its relation to municipal airports. Until they can all sit down together and discuss this matter frankly, the chaotic conditions of the present must continue. The Department of Commerce now stands ready to sponsor such a meeting and hopes to announce a specific date within the next few weeks.

IV. FUTURE TRENDS

1. The Quest for Certainty. Today, we find a considerable spirit of unrest among municipal leaders. Lacking a definite standard to rely on, and worried by forecasts of increased facility requirements, it is but natural that the uncertainties in the present situation should loom large. But we must not become so impatient for certainty as to lose a proper perspective.

Our experience with other forms of transport shows us clearly that change is inevitable. We have seen flat-boats yield to side-wheelers, side-wheelers yield to river steamers, and ocean sailing

ships yield to steam liners. We have paid great sums for river and harbor dredging to accommodate boats of greater draft, and for better dockage facilities. Such changes came gradually, over a period of a hundred years.

We have seen steam locomotives and their rail roadbed progress over the period of a century from tiny models to the streamlined deisel high-speed modern express train. Millions of dollars have been provided for depots to serve them—yet, again, the changes have been witnessed by so many generations as to be readily accepted.

Within the past forty years, we have seen a gridiron of three million miles of improved highways supplant the roadways of the past to provide for an era of highway transportation. The changes here have come more quickly, but the future needs were always clear.

By way of contrast, within a brief span of ten years, we have seen air transportation rise and mushroom in its tremendous and striking growth. Its demands have followed so swiftly upon each other and its future is so immeasurable as to leave us breathless. In our quest for certainty, however, let us not yield to the temptation of those hurried decisions which will stifle the full and free development of one of our truly great socializing forces and national assets—American Transport Aviation.

2. Conclusion. In this brief resume, we have not found space to discuss the many problems incident to a Federal-State-and local sharing of municipal expense, or to the appropriate legal and economic spheres of each and the prevention of overlapping activities. Instead, we have attempted to state clearly the important problem of airport size, explain its historical development, and indicate the positive steps now being taken to effect a practicable and early solution. I invite your continued splendid cooperation and support in the interests of a lusty, if troublesome, infant industry—whose promise of future national greatness should prompt us to an immediately generous and patient indulgence—American Aviation!