Airports in Architectural Competitions 1920-40

Mats T. Beckman
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Lehigh American Airport Competition 1929; Proposal by Howard Bordewich & William F. Koenig

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ACRONYMS and EXPLANATION of TERMS

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<tr>
<td>CAA</td>
<td>Civil Aviation Administration</td>
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<tr>
<td>KLM</td>
<td>Royal Dutch Airlines, established 1919</td>
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<td>RIBA</td>
<td>Royal Institute of British Architects</td>
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<td>WWI, WWII</td>
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<td>FHS</td>
<td>Acronym for Flyghamnsstyrelsen, Municipal Board for Airports, Stockholm 1928-46, responsible for the planning and construction of Bromma Airport.</td>
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- **Aircraft**: Synonyms are airplane or aeroplane. Aircraft most common today. Seaplane is the corresponding term used for aircraft constructed to operate from lakes or the sea. Flying boats is a term for multi-engined aircraft, constructed to take off and land on water.

- **Airfield, airport, aerodrome**: Airfield is an open field possible to operate aircraft from. An airport consists of the airfield, the buildings and the technical equipment necessary for secure operations with aircraft. Commercial airport is used as an expression for an airport customized for regular commercial air travel. The term Aerodrome is a synonym for airport and was used until WWII, mostly in the UK.

- **Airport Building, Air Station**: The buildings necessary for the operational functions of an airport, e.g. the Passenger Terminal, until the 1950s mostly referred to as the Air Station, which normally consisted of a station building with adjacent hangars. Other airport buildings are control tower, hangars for services and maintenance of aircraft, ramp, vehicle garages, fuel farm buildings and other kinds of service buildings. During the 1930s separate Restaurant Buildings and Airport Hotels also began appearing.

- **Apron**: A paved area at the airport, where aircraft are parked, unloaded or loaded, refueled and serviced.

- **Runway**: An area at an airport, reserved for aircrafts take-offs and landings. Dedicated runways were up to the 1930s often named runway strips. Originally they were parts of grassfields, up to 250 m wide and with a length up to 1000 m. At modern commercial airports runways are paved (asphalt or concrete), usually with a width of 45-60 m and with a length of up to 4000 m, depending on the airports altitude and the intended air traffic.

- **Taxi**: A verb used for the ground movements of an aircraft. Taxiway is a paved road dedicated to aircrafts groundmovements.
ABSTRACT

Stockholms first land airport opened 1936 in Bromma, to day a suburb 7 km west of Stockholm City Center. The final organization and design of the airport buildings was the result of an invited architectural competition. The airport is still operating and in 2012 it was Sweden's fourth airport in number of passengers. The air station building of 1936 and the first hangar are still in use as airport buildings and were declared national historic buildings in 2000.

In connection with a study on the planning- and construction process of the Stockholm-Bromma Airport, which included the aforementioned architectural competition, a number of issues have arisen.

- Did there exist any internationally accepted recommendations or models for the design of airports and their buildings, that would have been possible and suitable to use for the programming and planning of the Bromma Airport?
- Did the solutions presented in the Bromma competition represent best practice or did they represent a new, innovative way of designing a civil airport for the future?
- Were architectural competitions appropriate methods to obtain the best solutions for the still uncertain future of aviation and airports?

To deepen the understanding of what was the the background and role models for the solutions chosen for Bromma Airport, this paper describes different activities in Northern Europe and in the USA 1920-1940, to improve the state of knowledge in terms of airport design. Two talked about idea competitions for airports and some ordinary architectural competitions in Europe are reviewed. The paper also gives a detailed review of the Bromma Airport competition and concludes with a discussion about architectural competitions as a tool to develop expertise in airport planning.

INTRODUCTION

This paper is an interim report summarizing a deepening phase of an ongoing work about Swedish commercial airports from 1920 to 1950. It's based on archival studies, literature studies and knowledge gathered during my work 1990-2005 as an architect for the Swedish Civil Aviation Administration. The archival studies are carried out as reviews of three different archives, namely the Stockholm City archive, the archive of the Swedish Museum of Architecture and the archives of the Swedish Aviation authorities.

My purpose with this paper is to highlight airport competitions and some exemplary airports from the actual period, to clarify how they eventually influenced the design of Bromma Airport and what recommendations or general models for commercial airports, that eventually were at hand. A part of the main study concerns the architectural qualities and styles that were preferred in the new airport building types that emerged. These matters are only briefly touched in this paper. My essay The Architecture Competition for the

2 Swedish Museum of Architecture was 2013 renamed The Swedish Centre for Architecture and Design.
Stockholm-Bromma Airport, 1934, constitutes a first interim report, which mainly was based on information gathered in the Stockholm City Archives.

To give a deepened insight into the details of one competition and as a back-drop to my discussion of the impact of competitions, my paper gives an account of the 1934 competition for the Bromma Airport. This part of the paper is based on a review of the competition brief, the submitted drawings and other materials found in the portfolios from the participating architects in the archives of the Swedish Museum of Architecture. The portfolios have been determined to contain the main part of the drawings and descriptions submitted to the arranging body. However, some known drawings from the competition that earlier have been published in different media, are missing from the archives. Another deficiency in the studied material is that some documents listed in the competition brief as annexes, are missing from the archives. The study has been supplemented with the architects written descriptions of their proposals and the verdict of the competition jury.

What sources and which influences affected the solutions for Bromma airport, presented in the competition? The assumption is that professional architects during the 1930s had access to and made themselves familiar with the kind of professional knowledge, necessary for the design of an airport, e.g. through pictorial and written information on airport planning and competitions for airports, in literature and in professional journals. My method has been to examine literature addressing airport design, a selection of journals from the period in question and the archived competition proposals, to find circumstantial of possible models and solutions which may have influenced the proposals for Bromma airport.

1 BACKGROUND

The two decades between WWI and WWII brought the establishment of civil aviation and a network of commercial airports serving regular air traffic, both in Europe and in the USA. The skills of aviators and the capacity and technical qualities of aircraft developed rapidly. People's confidence in air travel grew. The first air carrier companies were established around 1920. They took important roles in the development of aviation and its key infrastructure, the airport.

After WWI, the design and construction of airports for the anticipated expansion of air traffic in Europe became an urgent task. During the war a number of military airfields and aircraft factory airfields were built, mainly in Britain, France, Holland, Belgium and Germany. Some of these airfields were located in suitable proximity to towns and cities. After reconstruction, a number of those fields were adapted for civil air traffic.

According to the peace treaty after WWI, Germany was forbidden to possess an air force or develop any military aircraft. Given Germany's vast wartime experience in developing aircraft, airships and airports, they instead developed it's civilian aviation industry. This included the establishment of commercial airports and facilitating intercity air travel by aircraft and airship. Germany thus became one of the important nations in the development of commercial aviation between WWI and WWII.

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3 Tamelander, M.; Slaget om Västeuropa; Pages 27-28.
WWI had led to a comprehensive technical development of aircraft. During the last years of the war the first multi-engine bombers were constructed. After the war some of these aircraft types were redesigned to serve as passenger aircraft, with capacity for 8-10 passengers. During the 1930s new generations of transport aircraft came into service, with even greater capacity. The most significant is probably the legendary Douglas DC-3, which meant a considerable step forward for air transport, in terms of capacity, speed and passenger comfort. In the end of the 1930s four-engined flying boats with further extended range began long-distance traffic from Europe to other continents.

An endeavor to establish new international airways grew stronger, but the construction of airports and connecting them in a network of sufficiently equipped airways, was an extensive, significant and costly task for any country. Even if there were no general agreements on who should take economic and managerial responsibility for the airports, municipalities and governmental bodies as well as private interests in many European countries took initiatives to locate, plan and construct them. The high rate of unemployment in the beginning of the 1930s also meant, that the preconditions for labour-intensive projects, like the construction of freeways and airports, were favourable.

The primary goal of many European countries was to achieve a national network of airports and connecting it to the emerging international network. The swift development of commercial aviation, the forming of new air carrier companies\textsuperscript{4}, the scale of the airport construction task itself combined with the lack of well-founded knowledge about relevant airport designs and an economical uncertain time, seems to have slowed down the development. In many ways the planning situation for European airports in the end of the 1920s, seems to have been somewhat unsettled\textsuperscript{5}.

2 GENERAL REQUIREMENTS FOR AIRPORTS

The first and simplest form of airfield standard was an obstacle-free flat circular grassfield with a maximum gradient of 1:100, a radius of at least 500 meters and enough carrying capacity for aircraft regularly using the field. This meant a sufficient size for aircraft to take off or land into any winddirection. Hangars were usually placed side by side, close to the perimeter of the field. When air stations were introduced they mostly were located close to the hangars. It became best practice to arrange a common apron for the station and the hangars. To mark the airport and to make it easier to detect from the air, it was common to mark the middle of the airfield with a white circle.

\textsuperscript{4} British AT&T was established 1916, Danish DDL, Norwegian DNL 1918, Dutch KLM 1919, German DLR 1917 and Swedish ABA 1924. John Zukowsky, Ed.; Building for Air Travel, page 32.

\textsuperscript{5} See W. Voigt; From Hippodrome to Aerodrome, from the Air station to the Terminal; page 27-65.
Until the end of the 1920s this was the most common model for airports. Ultimately the surrounding terrain governed the form of the airfield. Based on this model and international practices, the Swedish CAA e.g. published its first regulations "Provisions concerning approval and classification of airports for land aircraft" in 1932\(^6\), which was to become basic requirements for new airports in the country. However those regulations did not impose any requirements for the airport buildings, despite the fact that such requirements were needed. As air traffic grew the need for separate facilities for the passengers, dedicated paved runways and separate taxiways became apparent.

The first physical recommendations for the design of airports were published in USA in 1919\(^7\). A common requirement for localization was that the airport should be situated within a radius of 4-5 km from the business centre of a city served. Noise-disturbances were not yet considered a problem. The heavier aircraft became, the more it was realized that paved runways were necessary. In coastal cities the airfields preferably were positioned at shore locations, with an air station for land aircraft and boarding bridges for the sea-planes, to function as a so called amphibious air station.

Until the middle of the 1920s the limited number of passengers were mostly directed to simple waiting spaces, integrated into hangars. In the beginning of the 1920s, the art of designing and constructing hangars and giving them architecturally attractive facades towards the airfield became commonplace. But the growing number of passengers became increasingly important as an economic base for aviation. Security matters also affected the need to control the flows of passengers and cargo to and from the aircraft. The deve-

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\(^6\) Meddelande från Luftfartsmyndigheten, nr 1 1932.

\(^7\) Municipal Landing Fields for Air Service, US Army Air Corps; see G. Szurovy; The American Airport, page 20-21.
Development necessitated the erection of a separate air station buildings, complementing the hangars.

During the first half of the 1920s it was still common to locate passenger amenities in the hangars. The Swedish cities of Malmö and Gothenburg opened municipal airports for commercial air traffic in 1923. In both cases ticketing and waiting spaces for passengers were integrated into hangars. From the middle of the 1920s, separate air station buildings became common at European airports. They were fairly diverse in their architectural styles. It is argued that the first purpose built air station opened 1921 at the Königsberg Airport, East Prussia. It was located in one corner of a 800x800 m rectangular grassfield, with a concrete apron for the aircraft in front of the air station and standalone hangars on both sides.

Following the tentative steps taken in the 1920s, the 1930s became a century of extensive airport construction. Older airports were modernized and got their air stations. New airports to serve the emerging passenger traffic were planned and constructed. New navigational aids made it possible to fly in bad weather and at night. This development also influenced the general design of the air fields and the way air-craft docked to the air stations and moved around the field. The economy of aviation improved through the growing number of passengers. Paved runways became more common as aircraft got heavier and the interest for better operational security and passenger comfort grew. Through it's central role in airport operations, the air station became a natural main building. The 1930s led to the design and construction of a number of notable European air stations.

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8 Beckman, Mats; _Flygplatsens Arkitektur_. Pages 126-128.
9 Zukowsky, John; ed; _Building for Air Travel; From the Hippodrome to the Aerodrome_; Essay by Wolfgang Voigt; pages 33-34;
10 Examples: Air station buildings at Leipzig-Halle Airport (1931) in Germany, London-Gatwick Airport (1936) and Ramsgate Airport in Britain (1937) and Paris-Le Bourget Airport (1938) in France.
Airport Modernism - a suitable costume for the new building types

During the period between the two world-wars, airport buildings were new and emerging building types. The first airport building type was the hangar, the utility building to protect and maintain aircraft. Originally they were named *sheds*, an expression still sometimes used. When air stations became more common they were supposed to meet the requirements of expanding air traffic, new aircraft types and its ascending significance as the airports main building. Which architectural qualities would be appropriate and what style would be fashionable? In Europe and the US they occurred as local interpretations derived from varying architectural, economic and technological prerequisities and conditions. The general development of architectural styles that took place in different countries of course was a significant impact on airport building design.

In Europe a modest neo-classicisism dominated public buildings' architecture until the middle 1920s. It eventually had to give way to a modernistic architecture, which quickly came to dominate airport buildings and take advantage of the new construction technologies. Modernism became the most common idiom for airport buildings of the late 1920s and 1930s. Modernism varied in expression depending on where it occurred. Local and national architectural airport building styles were labeled modernism but also appeared under concepts such as Art Deco (USA, UK), Functionalism (Nordic Countries, Germany and in several other countries), Spanish Colonial Revival (California) and Adobe Revival (Arizona).

3 PROFICIENCY IN AIRPORT PLANNING

Architect's and engineers engaged in airport planning during the 1920s seldom had previous educational or professional experience within this field. Aviation was still something of a strange phenomenon for those who were supposed to plan and construct for it. There were no fixed standards for airport buildings and the possibility of finding good enough models among already existing airports were limited. Up until the beginning of the 1920s civil engineers and military fortification officers often were those responsible for European and American airport planning, architecture and construction.

As aviation expanded, knowledge of and interest in the construction of airports grew among professionals. Architects were early to show interest in this area of work. One of the first examples was the French architect Donat-Alfred Agache, who in 1912 received third prize in the international urban planning competition for Canberra, the new federal capital of Australia. He was one of very few competitors, who presented an airport as an integrated part of the urban plan.

Examples of more or less successful models for new airports appeared frequently in connection with important public exhibitions. The French architect Le Corbusier presented Ville Contemporaine, an idea of a future city, at the World Exhibition in Paris 1925. One of its main features was a city-integrated airport, forming a square between four gigantic high-rise buildings, with an underground motorway junction, parking garage and a railway station below the airport.
In order to collect, develop and improve dissemination of necessary knowledge to secure good performance of modern airports, a number of activities were tried around 1930. The emerging aviation authorities in different countries, municipalities, professional organizations and individuals, air carrier companies and others implemented

- the forming of semi-official airport committees, e.g. in England and France
- professionally organized study tours to collect facts and impressions
- research projects to collect, process and evaluate information about airports
- architectural competitions for the development of airport master plans and buildings
- dissemination and publication of information about airports and their technical and functional requirements

When architects began getting commissions to design airports, the pattern books of contemporary urban planning and architectural classicism were of little help. Modernism as an architectural style and as a working method fitted the airport planners. As there were no established role models for airports, a reasonable solution demanded that the architect did his/hers own basic research on what was to be drawn. Together with the client, architects had to clarify which minimum requirements should be at hand, when processing the brief for an airport project.

There were a number of ways to learn about the design of modern airports and air stations. One type of source was printed information with reports from new airport planning and construction. The most common sources for European architects probably were presentations and discussions in domestic and international professional journals. Examples are the British RIBA Journal, Architectural Review or the Architectural Associations Journal, French Architecture Aujourd'hui, German Der Baumeister and Swedish Byggmästaren (the Master Builder), which published articles and presentations on airport de-
In the second half of the 1920s a number of organized attempts to collect and systematize information on the structure and design of new airports were launched. A background for this was the functional failures of important national airports, like London-Croydon and Paris-le Bourget, which eventually resulted in initiatives to form committees to investigate the problems and to come up with recommendations for the future. Those committees were, among other things, initiators of architectural competitions for airports.

In England RIBA together with the Air Ministry set up an Aerodromes Committee in 1928, which included architects chosen by the Institute and an equal number of experts appointed by the Air Ministry, the Ministry of Health, the leading British airline operator Imperial Airways and aircraft manufacturers. The overall objective of the committee was to collect all possible information about existing or projected airports and to stimulate interest in and stressing the importance of aerodrome provision. Among other activities, the committee implemented research groups to systematically collect and organize facts about airport development, e.g. through implementation of research-studytours to US and European airports. Another background was about fifty municipalities in Britain seriously considering the construction of a municipal airpor. The need of guidelines and ideas about airport design and construction was significant. The committee's first interim report, published 1931, was mainly concerned with the master plan problems of aerodromes.

From the late 1920s and onwards, an intensive period of construction of separate, purpose built air stations started at many European airports. To illustrate this the following table shows a selection of examples. It's important to underline that the table doesn't give a statistical account for all new air stations of the period. The table indicates, that it often took quite a number of years after inauguration of the airfield, until an appropriate air station was in place and that they quite often were subjects of competitions. From the Hamburg-Fuhlsbüttel airport 1929 to the inauguration of the first purposebuilt air station at the Copenhagen Airport 1938, at least 6 out of 15 new air stations presented in the table were results of architectural competitions. Still, several of the air stations presented may also have been preceded by a competition.

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The development of international commercial aviation and its airports was important news around Europe and the US in the 1920s. This was reflected in newspapers, popular and professional journals, exhibitions and in academic discussions about aviation and its future. During this period architects and engineers must have had many impressions of contemporary aviation and been keen to contribute to its future. Unfortunately their efforts were hampered by the often difficult economic situation around 1930 and the lack of but a few practical guidelines and regulations for airport planning.

In an issue of RIBA Journal 1932\textsuperscript{12} an illustrated report from the Aerodromes Committee was published. It is a broad and comprehensive presentation of contemporary airport design, from air field layout to design of air stations. The author, John Dower, gives a description of contemporary airport issues and different examples of good solutions, from Europe as well as from the US. Further he discusses the future of airport architecture and highlights several examples of new air stations as exemplary. It's probable that this report had a broad impact on European airport construction of the 1930s.

\textsuperscript{12} Dower, John, secretary R.I.B.A Aerodromes Committee; \textit{Aerodromes; Journal of the Royal Institute of British Architects}, 30 April 1932;
This chapter describes two idea competitions for airports conducted in Britain and the USA in the end of the 1920s. The overall objective of those competitions were to develop new models for the design of ideal airports for regular air traffic, including the localization and design of the buildings necessary. A final presentation of a selection of ordinary architectural competitions for airports and a couple of exemplary airports being results of competitions, summarizes the chapter.

The RIBA Competition for Design of an Aerodrome

Initiative for the competition was taken 1928 by RIBA Aerodromes Committee. At that time there were about fifty municipalities in Britain, seriously considering the construction of a municipal airport, so the need of guidelines and ideas about airport design and construction was significant. The concrete aim of the competition was the design of a future aerodrome for London, thought to be implemented 1943. Besides the direct aim, the competition functioned as one of RIBAs actions to promote architects as airport planners. Twentythree submissions were received. Three prizes were awarded, two of them as shared first prize.

![Aerodrome for London 1943. First prize proposal by D.H. McMorran. Taxi-ing aircraft follow the white lines. 3+3 protected stands for arriving respectively departing aircraft. A semi-circular row of hangars protects the boarding area from the air-field.](image)

13 Journal of the RIBA 36, no 8 (Febr 23, 1929); Architect's Journal 69 (Jan 30, 1929). Documentation of the result of the competition.
The Lehigh American Airport Competition 1929-30

The Lehigh competition was triggered by new US aviation legislation, by a comprehensive national program for the construction of municipal airports and by the increased public interest in aviation created by Charles Lindbergh’s solo flight across the Atlantic 1927. The competition was financed by Lehigh Portland Cement Company. The general purpose was to stimulate the construction of airports, to develop new ideas on how airports should be designed and to help establish new standards for airport construction. The invitation to compete was addressed to "Architects, engineers and city planners, preferably working in collaboration with representatives of the aeronautic industry, and those with practical flying experience". A Committee was appointed to work out the brief. A nine-member jury was chaired by an architect and consisted of well known members of different professional specialist categories.\(^{14}\)

The competition brief was focused on a city integrated airport. The airports would ideally be able to fit in an average US city plan. A master plan and proposals for the different kind of buildings needed at a modern commercial airport, should be submitted. The site was determined as a field with the approximate dimensions 1070 x 1070 m, with the necessary open spaces around the field and with 30 m wide paved runways arranged so that aircraft could land or take off in a number of directions. The brief underlined the importance of the freest expression of new ideas and concepts.

257 entries to the competition were submitted. Four prizes and twelve honorable mentions were awarded. The jury summarizes that the collected results of the competition had given many future oriented new solutions to problems described in the brief.

Examples of proposed new solutions are

\(^{14}\) Black, A.; *American Airport Designs*; Documentation of the First National Contest for Designs of Modern Airports held in the United States.
• reserved taxiways to eliminate the need for runway taxi-ing,
• parallel runways reserved for either takeoff or landing,
• new principles for aircraft movements on the airfield,
• systems for boarding/deplaning of several aircraft at the same time,
• satellite air stations, e.g. with telescoping passageways to the aircraft,
• separation of departing and arriving passengers,
• new solutions for the passengers secure boarding,
• integration of commercial elements into the fabric of the stations building.

The examples mentioned are obvious and wellknown features of many of today’s airports.

The result of the Lehigh competition was presented in a book published in New York 1930. The book is informative and presents the brief and all the prize-winning and honorary mentioned and a selection of other submissions. The book is searchable as an E-book via www.15.

The Lehigh competition is probably the most talked about of the airport competitions of the actual period. The extensive publication of the results contributed to it’s relative importance. Information about the competition was also spread in Europe. It's likely that the ideas included in the many proposals had impact on contemporary airport designs. In descriptions of new airports from the middle of the 1930s you can find references to various Lehigh competition proposals. Examples found are e.g. the air stations of Budapest-Budaors and London-Gatwick and in the submissions of the Stockholm-Bromma competition.

The cover page of this paper shows one of the non-rewarded proposals. On the following pages the first prize drawings are shown.

Pic 6: 3rd prize Lehigh competition. Proposal for an air station by O. Nansen and L. Squire, city planners. Note two-level solution, passenger walks underground to and from the aircraft. It’s interesting to note similarities to the 1st prize proposal of the RIBA-competition.

15 E-version at www.archive.org/details/americanairportd00lehi (2013-04-10)
Pic 7: First prize proposal by A.C. Zimmerman and William H. Harrison. Master Plan and ground floor plan of the Air Station and floorplans of the satellite building for boarding on the apron.
Pic 8: First prize proposal by Zimmerman and Harrison. Entrance facade, axonometric perspective of the air field and section showing the main building and the underground walkway to the apron satellite. Note protected telescoping passageways for passengers, from the satellite to the aircraft.
A selection of Architectural Competitions for airports 1929-38

There also occured a number of ordinary European architectural competitions for airports, focused on the design of construction projects. The table shows six such competitions, mentioned in the table at page 9. Since my study so far has been limited to the northern European countries and my review isn't comprehensive, it doesn't present a complete review of all possible European airport competitions from those years.

The table names the airports and the year of inauguration of the air stations that were the results of the particular competition\(^\text{16}\).

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<th>COMMENTS</th>
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As examples of what was achieved by those competitions, I have selected Berlin and Hamburg. Their air stations came to mean a lot as good examples of foresight solutions, for instance for the planners of the Stockholm-Bromma airport. Both represents future oriented air stations and became stepping stones for the development of other air stations during the 1930s.

**Berlin-Tempelhof Aerodrome 1923-29**

The former military training field at Tempelhof in Berlin was deposited as the new **Zentrallufthafen** in 1920. It replaced the old Johannisthal airfield, that mainly had been used for air meets and as an airship base. A plan for a new aerodrome at Tempelhof was set upp in the beginning of the 1920s. An architectural competition for the air station was organized 1926 and architects Paul and Klaus Engler recieved the first prize for a modernist air station proposal, designed for the growing air traffic. It was flanked by two large hangars and equipped with a station hall, restaurant and a large café terrace on the roof, an administrative department, hotel-rooms and a couple of separated courtyards for visitors/spectators in front of the station building. A covered walkway for passengers and a controltower was located in the buildings central axis towards the airfield.

\(^{16}\) The German competitions are discribed in *Der Baumeister nr 25, 1927, and nr 28 1930.*
Pic 9: The original Tempelhof field was slightly elliptic with a maximum dimension of 1200 m. The grassfield was surrounded by a paved taxi-way with adjoining start aprons in the field's periphery. Copy of part of a tourist map from the late 1920s.

The architectural character of the Tempelhof station was determined by horizontal bands of brick or windows. It was the largest air station built in Europe so far, a compact building with a strong horizontal character. The plan was slightly bent with the curvature of the elliptical field. Two high radiomasts and a control tower were visual markings for the air station.

This first Tempelhof Air Station and the two hangars were used until 1945. The first Tempelhof airport was considered having one of the the most modern air stations in Europe. Those responsible for the Stockholm-Bromma Airport e.g. visited Tempelhof several times to study the air station and the arrangements of the airfield. In 1935, architect Ernst Sagebiel was commissioned by the new Nazi government to draft a proposal for a new and even larger airport, which would better fit the planned city of Germania, the future capital of the Third Reich. The airfield was considerably enlarged and a new larger air station structure was designed in the northwestern part of the enlarged field. The construction started 1936 but the gigantic facility wasn't finished until 1945. The first air station was in operation until then. The airport served for many years and was finally closed in 2010.

The Hamburg-Fuhlsbüttel Aerodrome 1927-29

Another important example of new airport designs was the Hamburg-Fuhlsbüttel air station, inaugurated 1929. The airfield had served as a station for regular airship routes since 1909. It had also been a hot spot for local airshows.

The new air station was the result of an architectural competition 1926. The field itself had all the characteristics of the classic 1920s airfield, with a free circular operational surface with a 500 m radius. A novelty was the arrangement of the air station buildings and its good connection with the local road network and a light rail station.

The architectural character of the building was largely determined by horizontal bands of brick with intervening bands of windows or terraces, a popular design concept of the modernistic German air stations from this period. It is flanked by two hangars and with a common apron in front of the three buildings. The station building is gently curved, parallel with the operational circle of the field, as for to embrace the activities of the field. At the airside of the station building a protected walkway for the passengers leads to the aircraft stands. On both sides of the walkway there are fenced grassfields accessible from the street, used for airshow spectators. The solution principles are relatively similar to those at Tempelhof, the two competitions taking place almost in parallel during the same year.

The fronts of the two hangars on both sides of the air station are positioned with a 40° angle to a line between the center of the station building and the midpoint of the field. The arrangement strengthens the embracing effect of the buildings. The air station itself also functions as a kind of architectural variant of the classic Grand Stand at a Hippodrome, with space for up to 4500 spectators on the roofs and terraces, with an open restaurant terrace towards the field and dedicated yards for spectators in front. The grouping of

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Dittrich, E.; *Der Flughafen Tempelhof*; Lukas Verlag, Berlin 2006.
the three station buildings and their architecture is a notable piece of deliberate placemaking and geometrical elegance.

Pic 11: The Hamburg Air Station 1929, with its glazed control room top middle, restaurant-terrace and spectators stands towards the airfield. Architect: Dyrsen & Averhoff.

Pic 12: Hamburg Fuhlsbüttel Aerodrome map 1929. Architects: Dyrsen & Averhoff. Note the station building and its flanking hangars, the landside approach plaza with a light rail line and the two fenced spectator areas on both sides of the station building.
The lengthy process of establishing a first commercial airport in Stockholm was completed with the inauguration of Stockholm-Bromma Airport in May 1936. The rapid development of aviation was a challenge for those responsible for the planning of the new airport. It was desirable that it should keep the highest possible international standards. But which was the nature and details of such a standard? Consequently an important issue was what recommendations, knowledge and/or role models that should be chosen for the Bromma Airports design.

**Initial planning**

A joint state-municipal investigation was launched in 1919 to find a suitable location for a land airport in Stockholm. The Skarpnäck fields, about 8 km south of the city center, were proposed 1921. Doubt arose with respect to the suitability of the field. A decision was eventually made to change the location to the Riksby fields in Bromma, about 7 km west of the city centre, the main reason being that the preconditions for visual orientation were better and the surroundings somewhat less hilly than those in Skarpnäck. In 1929, the City Council finally stated the location and reserved the Bromma field. The area covered 175 hectares.

A municipal board for the airports of the city was appointed 1928, Flyghamnsstyrelsen (FHS, my abbreviation), to be responsible for the city's forthcoming airport and with the immediate task to control the planning and construction. A search for suitable models for the airport was initiated. Wide-ranging consultations with airport managers, international specialists and airline companies were carried out. A planning group made study-tours to airports in France, Belgium, the Netherlands, Germany and Denmark. A first, preliminary design program was formed. In 1933 a combined state-municipal *Airport Delegation* with two delegates from FHS and two from the Swedish CAA was appointed to finalize the planning of the new airport.

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18 Beckman, Mats T.; *Att planera Bromma flygplats. Om arkitektinsatserna i den ursprungliga planeringen*; TRITAMARKMForskningspublikationer 2013:2. A more detailed description of the planning process is given in this essay.
Pic. 13: The Riksby fields in Bromma 1929. The first airport map with the operative borders and eight runway directions marked. The hilly surroundings and the cramped airport field are clearly visible.

**Competition brief**

The Delegation chose to resolve the question of best solution for the Bromma air station through an *architectural competition*. The aim was to compile a master plan for the airport and to design the air station. The brief was substantially comparable to brief for a regular architectural competition. The Delegation wrote the brief, invited architects to compete, supervised the process, acted as a jury and delivered a final proposal to the prospective developer, the City of Stockholm.

In 1932, the Swedish CAA published "Provisions concerning approval and classification of airports for land aircraft"\(^{19}\), the first complete Swedish airport regulations. The new airport should reach the requirements of a Class I-airport by the regulations. The brief recommended a siting of the air station towards a hill in the north-eastern part of the airport area (see map pic 13). The detailed space-requirements for the needed buildings were outlined in the brief. The architects were supposed to submit a master plan of the airport, a detailed plan for the air station area and design proposals for the buildings.

\(^{19}\) Notification nr 1 from the Swedish Aviation Authority 1932, *Bestämmelser rörande godkännande och klassificering av flygplatser för lantflygplan.*
The master plan should also include two hangars, approach road system, car-parking spaces and proposed siting of eventual complimentary buildings. Proposed principles for parking of aircraft, adjacent to the station building, were specified in an annex to the brief.

**Invited architects**

Four well-known younger Swedish architects were invited to undertake the parallel investigations: Gunnar Asplund, Paul Hedqvist, Sigurd Lewerentz and Sven Markelius. They were all below 50 years of age and considered belonging to the Swedish architectural elite of the early 1930s. They were professionally successful, held different public positions and had own architectural practices. Asplund, Lewerentz and Markelius had been active as architects in the implementation of the renowned Stockholm Exhibition 1930, which eventually established modernist architecture in Sweden. The Delegations choice of architects suggests that the modernist model of analytical planning and its unaffected design idiom were considered to be in accord with the imagined modernity of the new airport.

Apart from Markelius\(^{20}\), the architects had no experience of airports. The brief was, in addition, somewhat ambiguous. Many of the requirements were formulated as "shoulds".

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The only fixed prerequisite was the airports operational plan, with the position and size of the runway strips and the approach road from the city. The tasks that the architects were supposed to tackle didn't have any given role models in earlier swedish architectural practices. The time for the competition was short. The brief was presented March 13, 1934, and the submissions should be delivered May 15. The fee for carrying out the brief was set at 500 Swedish crowns per architect, a sum which today corresponds to 15,000 Swedish crowns, which can be claimed to be a meager fee for the work involved.

**Seven alternative submissions**

_Sigurd Lewerentz_ submits three proposals accompanied by written descriptions. He locates his air station in the recommended north-eastern situation, but doesn't submit the required master plan. He states that he has gathered basic information for his proposals from professional literature and from individuals within an airline company. The text acknowledges that he had access to information on contemporary American airports and also refers to examples from the Copenhagen and from Berlin Airports.

**Alternative A:** The concept is to locate the boarding part of the air station in a building very close to the hillside and connect it via a tunnel under the apron to a boarding pavilion, as illustrated in an annex to the brief. The two station buildings had car access either from the northern or the southern side. Two hangars are located north-west of the air station. This type of satellite solution occurs in several Lehigh-competition proposals.

![Pic 15: Sigurd Lewerentz Alternative A](image)

**Alternative B:** The brief generally underlines the importance of protecting the passengers from the harsh weather. This solution is a covered loading hangar for the passenger handling. Two aircraft could be positioned in the hangar at the same time. Closable hangar doors kept bad weather out. This kind of "drive-through"-hangars occurs in the 2nd prize proposal of the Lehigh-competition.
**Alternative C:** This proposal also focuses on the protected handling of passengers and a minimum of air field intrusion. All the handling facilities are located in an underground space, under the apron. The apron above accommodates six aircraft, parked beside six mechanically operable stairways leading up to each aircraft stand. An access road ends in a shaft in front of the underground handling hall.

Lewerentz’ three alternatives are interesting and interesting applications of many of the detailed requirements as set out in the brief. But, the applications are not presented in a master plan and many of the requested answers to the questions of the brief are missing. Different notes in his portfolio indicates that he took time to get acquainted with some results of architectural competitions for airports and with examples of appreciated air stations. Obviously,
his alternative A with its satellite pavilion is influenced by the proposal, annexed to the brief, alt. A. Alternative A is his likely primary solution.

**Gunnar Asplund**'s written description is simple and easy to grasp and closely monitors the issues of the brief. He places the air station facilities adjacent to the hill in the recommended position. He gives a convincing account of the approach road in a loop around the hill and the arrangements for the car- and bustraffic to the station facility.

The air station is conceived as a concrete bridge with most of the handling facilities within the structure. Separate administration and restaurant buildings connect to the stations main entrance. Passengers arriving by car are protected by the overhanging upper floor of the bridge-structure, and walks through the main level of the covered bridge were check-in and other controls are located, having a splendid view over the airfield. The walk ends on apron-level at a refuge, from where aircraft may be boarded. The aircraft can taxi under the bridge's 50 m free span, free height 8 m, to three stands around the boarding platform. The station bridge ends with an operation control room on top of the tip of the bridge.

In the studied archives, in books about Asplund and in a special review\(^{21}\) of air stations built in Europe during the same period, no role models to his proposal are mentioned. It's tempting to understand Asplund's proposal as a precursor to modern aircraft piers.

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\(^{21}\) Mats T Beckman; *A review of 30 European Air Stations constructed between 1920–40*. Document not published yet.
Paul Hedqvist's proposal is very barely presented and his own written description gives no further explanation of how the air station operations are supposed to work. The master plan drawing is very simplified but seems to be adapted to the requirements of the brief. There are no specifics about eventual role models or other sources of inspiration in his portfolio.

The submitted drawings are neatly and clearly drawn and contains requested proposals to the station building, in the three requested construction phases. Hedqvist's proposal is compressed, simpel and has a very clear contemporary modernistic character.
Sven Markelius’ submission includes two different alternatives, both motivated in detail in the authors written descriptions.

In alternative 1 the air station facility is placed in the north-western part of the field. It connects to the public roads through a road-tunnel to an underground parking in front of the station building. The two hangars are placed parallel with the approach road tunnel. This location of the air station means that the distance from the city center increases with 1 km, in relation to the proposed location at the hill-side in north-eastern part of the field.
In alternative II a circular four-storey station building is located in the middle of the field, connected to the public road system with a road tunnel, that ends in an enlarged, partly open-air basement under the station building, with passenger entrance and cargo delivery, parking and a bus-stops. The aircraft park around the station building, which holds all the necessary functions under a control room on a fifth top floor. An apron
around the station building means, that the runway strips in the original airport plan must be moved and the airport area enlarged. The intended runways are separated for take-offs and landnings. The two hangars are located on the western and eastern sides of the field respectively, forming an inconvenient partition in two hangar areas.

*Pic 25: Sven Markelius; Proposed master plan for Bromma airport. Alternative II. Note the marking of separate runways for landings (red) and take off (blue).*

*Pic 26: Sven Markelius; Alternative II; Midfield Air Station for Bromma Airport.*
The jury's assessment

The Airport Delegation acted as a jury and made the evaluation of the proposals. The jury work began in June 1934 and finished with a statement dated Oct 4th. As the brief did not stipulate anything about aesthetic matters and there was no architect in the jury, it focused on avional aspects. Only Asplund and Hedqvist got any aesthetic credits.

The jury analyses and describes Asplund's proposal much more thoroughly than the others. Asplund is given credit for the beauty of his station building, the clever way that the structure takes advantage of the hill's slope and that the proposed air station fulfills most of the functional requirements. Ultimately, however, they stipulate that the proposal cannot be considered for execution, primarily due to the bridge being an obstacle for the free movement of aircraft. The proposal was put aside.

Both of Markelius' proposals were considered interesting and well worked out. However, as both alternatives required extensive changes of the airport layout they were unacceptable for the jury.

The jury dismisses Lewerentz' Alternative B and C without much comment, but finds Alternative A with a tunnel to a boarding pavilion on the apron, interesting. The jury made a cost-estimate of the tunnel and airline companies concerned were asked for their opinion. After positive answers from a majority of the companies, the proposal was recommended to be realized as a part of an air station solution.

Hedqvist's proposal is considered aesthetically attractive, developable and to have a practical master plan and a good, developable station building proposal. Reading the assessment, Hedqvist appears as "the winner".

The summarized result of the competition is, that Hedqvist's project is proposed to be carried out and supplemented with Lewerentz' alternative A-tunnel, to be built as a preparation for an eventual future pavilion at the apron in front of the station building. This decision is submitted to the airport owner, the City of Stockholm, together with a total cost estimate.

After the competition FHS consults with the CAA and decides to adjust the design program for the buildings. The developer finally decides to choose Hedqvist as architect for the new airport. But his original proposal for the station building was revised, the air stations size considerably reduced and a decision made to pave the runways.

Even at the airport's completion many realized that the place chosen was far from ideal for an airport. The development of aviation had gone so fast that already during 1937 it became necessary to plan prolonged runways and an enlarged station building.
Comments to the submissions

Stockholm-Bromma Airport opened in 1936 with the first purpose-built air station in Sweden. When WWII broke out in 1939, the main part of Europe's countries had a capital city airport equipped with a modern air station. With today's airport dimensions, most of them were small, simple and easily oriented buildings. Many of them were destroyed or severely damaged during the war, only a few exists today.

After reviewing the proposals for Bromma Airport, one can conclude that the four architects had managed to acquire the elementary skills necessary to cope with the competition task. They all should have had access to documentation about modern airports and their buildings and used with their basic professionality. A difficulty for them seems to have been that they didn't get time enough to complete the brief with any systematic study of contemporary airport knowledge.

Lewerentz seem to have been working so intense with his three proposals that he simply did not get the time to finalize one proposal and illustrate it in the required master plan. The lack of plan drawings of the station buildings and presentation perspectives makes it hard to assess his proposals.

Markelius motivates his two proposals skillfully and convincingly. His proposals are fully feasible but has significant disadvantages on the basis of the program conditions. Both proposals require significant changes in the approved layout of the air field. The proposals are interesting and well worked but a bit complicatedly conceived and should have meant difficulties to finalize the airport according to plan. around 1930 Markelius had active contacts with American colleagues and should have known about the Lehigh Competition and acquired information from it. E.g. his alternative II-proposal with a round mid-field air station, occurs in different forms in several proposals from that competition.

Asplund took a strong and clear grip on the matters outlined in the brief and presented a well worked solution for an air station, which took into account most of the requests formulated. His proposal is well adapted to the preconditions of the place itself, the proximity of a steep hill. It was a new and untried way to secure the passenger flows through the necessary control procedures. Disadvantages were that the solution didn't provide sufficient flexibility.

Asplund's structure for the passenger's way to and from the aircraft is architecturally powerful and expresses its traffic engineering purposes. If Asplund's proposal had materialized, Bromma would have constructed a unique contemporary airport building. The so-
olution is a fine example of an architectural work, characterized by skilful management of the requirements and of good adaption to conditions on site.

Hedqvist's proposal can be described as thoughtful and sober, with a good adaption of most of the brief's fundamental requirements. It is a simple and buildable solution in a functionalist spirit. The intended runway system works well with the station building, hangars and apron. The station building is given a slightly curved plan figure that follows the curvature of the hills edge against the field. The disposition of the requested spaces are about the same as in many new air stations published in contemporary professional magazines. It is easy to accept that the jury felt comfortable with his proposal.

Comments to the jury's conclusions

To put the assessments of the jury into more perspective comments and evaluations of the proposals overall character are added. The comments are based on my previous acquaintance with Bromma airport, the image material available in the archives, literature and professional journals and the brief's requirements. Given these conditions an evaluation table and a SWAT chart were compiled. The aim is to give a more graspable presentation of the proposals. Since Lewerentz and Markelius each submitted several, I have chosen to assess Lewerentz' alternative A and Markelius alternative I as their main proposals.

A direct interpretation of the text of the jury's final assessment, could well have resulted in Asplund declared the winner. Facing the uncertainties of the mid 1930s, they chose Hedqvist's proposal as a safer card and from practical reasons. Hedqvist's solution is an example of best practice of the 1930s.

The figures in the following chart represents my evaluation of six selected areas of qualifications. I have scored them on a scale from 1-5, where 1 = poor and 5 = very good.

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<thead>
<tr>
<th>Quality</th>
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<th>Comment</th>
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<tr>
<td>Adaption to the site's conditions.</td>
<td>2</td>
<td>5</td>
<td>4</td>
<td>4</td>
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<tr>
<td>Compliance with program requirements</td>
<td>2</td>
<td>4</td>
<td>3</td>
<td>5</td>
<td>Lewerentz' proposals difficult to assess because of incomplete reporting.</td>
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<tr>
<td>Originality, Innovation</td>
<td>4</td>
<td>5</td>
<td>3</td>
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<tr>
<td>Construction Technology and -Economy</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>Lewerentz' proposals difficult to assess.</td>
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<tr>
<td>Expandability, Flexibility</td>
<td>2</td>
<td>1</td>
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<tr>
<td>Architectonic expression in relation to the purpose</td>
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My summarized assessments of the proposals have been interposed into two scales: simple-complicated and untested-well proven. With the requirements of the brief as a basis, the SWAT-table positions show my overall interpretation of the average qualities of the four proposals.
Answers to the initial questions

My purpose is to try to clarify what influences and role models which may have been important for the solutions proposed in the 1934 architectural competition for Stockholm-Bromma airport. In the previous text I have made some remarks on the actual situation of aviation between the two world-wars, how firm knowledge of airport planning was lacking, how architectural competitions became a way to improve knowledge and how the Bromma competition was carried through. Three questions were initially presented:

1. Did there exist any internationally accepted recommendations or role models for the design of commercial airports and their buildings during the actual period?

   From the end of the 1920s national recommendations or standards for the design of airfields existed or were in preparation in many European countries, but there was still uncertainty about the use of these recommendations.

   A common model for a modern air station during the 1930s is a station building in close grouping with a couple of hangars, interconnected with a common apron towards the field, the ensamble forming the Air Station Area. Based on printed sources it can be concluded that a frequent model for the station building itself, exposed through several professional magazines, was a two-level building with an expedition hall in the center. The building was topped with a glazed control room, had a landside entrance to the hall, where the control procedures occurred, and an exit to the aircraft at the apron. The winning proposal in the Bromma competition is an example of such an air station, but with an unsymmetric composition.

2. Did the submitted proposals for the Bromma Airport buildings represent best practice or did they represent a new, inovative way of designing a civil airport for the future?

   Hedqvist’s winning proposal and the built air station definitely represents best practice, as it could be defined in the early years of the 1930s. Markelius' two solutions also represents practice, but in a more complex manner. Lewerentz’ proposals are experimental and unfinished and Asplund’s is original.
3. Were architectural competitions an appropriate method to obtain acceptable solutions for an uncertain future of aviation and airports?

Architectural competitions in general can be defined as idea competitions. Viewed in retrospect, most competitions described in this paper have a strong sense of idea competitions, although some were focused on solving construction projects. It’s my belief that the airport competitions in a fundamental way contributed to the development of airports, which were critical for the development of aviation. The competitions resulted in solutions to a variety of problems that originated in the first-generation airports. New radical ideas to integrate airports into urban environments were presented. Architectural competitions were a learning process for all engaged in airport construction, not at least the architects.

CONCLUSION

My work is about the historical development of aviation and how it has affected airport construction and airport architecture. The Delft conference 2014 is headed Conditions for Architect-Client Interactions. The clients of early airport construction were of a mixed origin. During the actual period they often were local politicians in cooperation with representatives for air carrier companies or aircraft manufacturers and sometimes also representatives for local military authorities. Often the State was a partial financer of airport projects and, through it’s aviation authority, also directly involved in the implementation.

It’s interesting to note that the people preparing the airport competition briefs and the juries of the RIBA Competition and the Lehigh Competition consists of both architects and engineers as well as specialists from all fields of aviation. There seem to have been a serious wish to get the guidelines for the competitions as well as the results well entrenched by those who would become dependent on the results.

Such a mixed responsible body was partly the result of aviation being such a new phenomenon. Sometimes the complex situation ended with disagreement on how to proceed. In such a situation an architectural competition also could function as an instrument to solve conflicts within a client-group or to publicly test different solutions. When the airport was completed and regular air traffic began, the most common solution was that the municipality took operational responsibility, for example through a newly established airport company.

Architectural competitions for airports were accepted as a progressive instrument to achieve a foundation for best practice in airport construction during the 1920s and 1930s. Another motif was that the air station building had become as architecturally important, as the new central railway stations once were. There seem to have been a broad consensus that the Air Station building should be given a dignified architectural expression.

Competitions brought professional competence to a new area of expertise, Airport Construction. The results of architectural competitions for airports formed a basis for standardization and contributed to an expansion of general knowledge of airport design among several professions and among the public.

Despite comprehensive Swedish airport construction during the period 1950-1975, only a few architectural competitions for airports were conducted. My experience is that airport managers and owners distrust today’s architects in a way that I think was alien to the airport clients of the 1930s. Airport planning seems no longer perceived as an elemen-
tary task for architects. Today brand new airports are rarely constructed in Europe, but existing airports are subject to constant changes. In Sweden architects are mostly hired only for the design of terminal buildings, not as master planners of airports.

PICTURE CREDITS

Pictures are either scanned images of original from archives or scanned from printed pictures in journals or literature.

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<td>Archives of the Swedish Architecture Museum, Stockholm</td>
</tr>
</tbody>
</table>
REFERENCES (partially in swedish)


Allpere, Christina; Paul Hedqvist; Arkitekt och Stockholmsgestalter; Stockholmia Förlag, Värnamo 2009; ISBN 978-91-7031-209-0.


Dittrich, Elke; Der Flughafen Tempelhof in Entwurfzeichnungen und Modellen 1935-1944; Lukas Verlag, Berlin 2006. ISBN 3-931836-52-X.

Holmdahl, Gustav m fl (red); Gunnar Asplund arkitekt 1885-1940 A Ritningar, skisser och fotografier; Ursprungligen utgiven av tidningen Byggmästaren 1943; Faksimiltryck, Byggförlaget, 1981; ISBN 91MB60519422M.


Zukowsky, John, editor; Building for Air Travel; Prestel and the Art Institute of Chicago, USA, Chicago 1996; ISBN 3-7913-1684-2.


Meddelanden från Luftfartsmyndigheten nr 1 1932; Kungörelse med bestämmelser rörande godkännande och klassificering av flygplatser för lantflygplan, utgiven i Stockholm 2 januari 1932.


Professional periodicals:
- Architect's Journal, 69 (Jan 30, 1929); RIBA aerodrome Competition.
- Journal of the RIBA, 36, no 8 (Febr 1929); RIBA Competition for a design of an Aerodrome.
- Journal of the RIBA 39, no 13 (April 30, 1932); John Dover; aerodromes.
- The architectural Association Journal 48, no 555 (May 1933); Aerodrome Design.
- Der Baumeister 25.1927, H.1, sid 1-31; Wettbewerb für Lufthafen Tempelhof und Lufthafen München.
- Der Baumeister 28.1930, sid 367-373; Wettbewerb für Lufthafen Hamburg-Fuhlsbüttel.
- Byggnästaren No 32, 1934, Arkitektupplagan; Arkitektävlingen om Bromma flygplats.