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CHANGE

AC NO: 150/5100-9 CH 1

DATE: 6/11/75

ADVISORY CIRCULAR

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

SUBJECT: CHANGE 1 TO AC 150/5100-9, ENGINEERING SERVICES UNDER THE AIRPORT DEVELOPMENT AID PROGRAM (ADAP)

1. PURPOSE. This change transmits revised Chapter 5 incorporating the revisions cited in paragraph 2.

2. EXPLANATION OF CHANGES. Chapter 5 has been revised to prohibit cost-plus-a-percentage-of-cost (CPPC) methods of contracting for engineering services under ADAP as required by FAR Part 152. Paragraph 23, Salary Cost Times a Multiplier, Plus Direct Nonsalary Expense, and paragarph 26, Percentage of Contruction Costs, have been changed to prohibit these CPPC types of contracts. A definition of CPPC contracts has been added to paragraph 20, General. References in Chapter 5 to paragraphs 23 and 26 have been changed where appropriate. The use of asterisks denotes changed, added, or deleted portions of the text.

3. HOW TO OBTAIN ADDITIONAL COPIES OF THIS PUBLICATION. Additional copies of this Change 1 to AC 150/5100-9, Engineering Services Under the Airport Development Aid Program (ADAP), may be obtained from the Department of Transportation, Publications Section, TAD-443.1, Washington, D. C. 20590.

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Bascom N. Lockett

BASCOM N. LOCKETT, JR.
Acting Director, Airports Service

Initiated by: AAS-580

r. Allowable seasons for construction work.

s. Testing of materials and testing of compaction, mixes, density, surface smoothness, etc., to comply with plans and specifications.

18. ENGINEERING FOR REQUESTS FOR AID. Preparation of a request for aid and the estimate of construction cost and sketch to accompany it usually will require some engineering services. Such services should be accomplished under a contract and the usual process for selection of the engineer should be used. Airport sponsors may be somewhat reluctant, at this point in time, to enter into engineering contracts covering design or construction supervision and inspection as the possibility of doing such work may hinge on receiving federal aid. It is recommended that, under such circumstances, a contract be prepared covering only preparation of the request for aid and supporting sketch and estimate with an understanding that it does not imply that a follow on contract will be forthcoming. Because of the limited scope of the engineering services and for simplicity, a lump sum compensation is recommended.

19. DIVISION OF RESPONSIBILITY AND AUTHORITY. It is common to have one engineering firm providing the basic services and another doing the resident engineering or some other special service. In such cases, the basic services firm is the "primary engineer" or "principal consultant" as defined in paragraph 2b, and responsible for the acceptability of all engineering work and services in the project. The "primary engineer" represents the airport sponsor in coordinating and overseeing the work of other engineering firms. For example, the resident engineer and his inspectors will be responsible for arranging for, conducting, or witnessing field and laboratory or shop tests of construction materials as prescribed in the specifications. Similarly, the resident engineer determines the acceptability of compaction and the suitability of materials on the site and brought to the site to be used in the construction. The primary engineer would, on periodic visits to the site or upon receipt of copies, review the tests, reports, diaries, vendor reports, etc., produced or submitted by the resident engineer to insure that appropriate corrective action was taken as needed and to insure that sufficient and appropriate testing was being accomplished--in other words, to insure that the construction was being controlled properly. The resident engineer would necessarily be responsible and authorized to decide on the day to day acceptability of materials, compliance with the plans and specifications, and to order the contractor to take appropriate action. The division of responsibility and authority should be clearly specified in the engineering contracts. The primary engineer has, however, the overall responsibility for the acceptability and quality of the work.

CHAPTER 5. CHARGES FOR ENGINEERING SERVICES

20. GENERAL.

* a. The computation of charges for engineering services is dependent on the type of services required by the client. The types of services usually performed by engineers are outlined in Chapter 2. FAA approval of a contract will include review as to reasonableness of charges or reimbursement. If the client is to provide a portion of the engineering services, the facts should be stated in the contract both for completeness and to aid in the determination of reasonableness.

b. Cost-plus-a-percentage-of-cost (CPPC) methods of contracting are prohibited for engineering services under ADAP. CPPC contracts may be defined as a payment formula based on a fixed predetermined percentage rate of actual performance costs by which the sum of the contractor's entitlement, uncertain at the time of agreement, increases commensurately with increased performance costs. *

c. Engineering charges are usually computed on one of the following bases or by combining two or more of these methods with appropriate modifications applicable to specific cases.

21. PER DIEM.

a. Direct personal services are usually charged on a per diem basis. This method is particularly suited to court work or similar work involving intermittent personal service. For example, most of the types of services mentioned in paragraph 5 can require intermittent work and thus may indicate per diem compensation.

b. When such consulting or expert services are furnished, the engineer is compensated for all the time he devoted to the work including travel time. The per diem charge should be based on the complexity of the work involved and the breadth of experience of the engineer. In addition to the compensation based on per diem, the engineer is reimbursed for travel, subsistence, and other out-of-pocket expenses incurred while away from his home office.

c. For services in court or on other engagements in which the engineer is to appear as an expert, a per diem charge is considered to have been earned for each day of such appearance, although the engineer may not be called to testify or, if called, may finish his testimony in a fraction of the day.

d. On occasions, the urgency of the engagement requires the engineer to work longer than the normal day. In some instances, this requirement is a necessary feature of the services, and an understanding should be made with the client as to what constitutes a day. In such cases, the per diem rate may be based on the normal number of working hours per day, or the per diem rate may be increased to take into consideration the extended work day.

e. For certain kinds of work, compensation based on hourly rates is an equitable arrangement. Compensation for engineering service on an hourly basis demands a higher rate per hour than would be represented in a per diem rate. Also, the hourly rates should apply to time for travel involved plus reimbursement for travel costs, subsistence, and other out-of-pocket expenses. Depending on the duration of the services, compensation on an hourly basis may include an agreement on a preset minimum amount or retainer in addition to the payments based on the hourly rates.

* f. The state societies of professional engineers of the states listed below publish pamphlets on engineering services and fees and these may be consulted for more specific guidance on per diem rates. Such rates sometimes need to be adjusted to reflect the change in economic conditions since the publication was printed. The states issuing pamphlets include: Arkansas, Florida, Illinois, Iowa, Kansas, Kentucky, Louisiana, Massachusetts, Minnesota, Nebraska, New Jersey, North Carolina, Ohio, Oklahoma, Pennsylvania, South Dakota, Texas, Virginia, and Wisconsin. *

22. RETAINER.

a. The employment of engineers on a retainer basis is a common practice. This practice assures the client of always having the services of a certain individual engineer or organization available for future work. This method is used in cases of protracted litigation or for work over the years, when the calls on the engineer may be intermittent. It is also used in the development of undertakings for which the services of an engineering specialist are not required on a full-time basis. On large projects, this method enables the client to have the engineers who prepared the original plans and specifications on hand for maintenance or additions.

b. The amount of the retainer varies with the character and value of the services to the client and with the reputation and standing of the engineer in his profession.

c. The terms of agreements for services on a retainer basis vary widely. Compensation may be based on a fixed sum, paid monthly, or on some other mutually agreeable basis, with per diem or hourly rates in addition for time spent at the request of the client. In any case, the same principles, as explained previously for per diem or hourly charges, govern under retainer contracts.

d. This type of contract would rarely be used for airport engineering. If it were, detailed records would need to be kept to relate the work to a specific project.

* 23. SALARY COST TIMES A MULTIPLIER, PLUS DIRECT NONSALARY EXPENSE. This type of contract contains CPPC methods of contracting because the engineer's indirect cost and profit are not fixed at the time the contract is signed. Therefore, it is not to be used where the costs of engineering services are to be funded under ADAP.

24. COST PLUS A FIXED PAYMENT.

a. This type of contract is used frequently when the engineer is required to start work before the cost and scope of the project can be accurately determined. It does not permit compensation for indirect costs based on a predetermined percentage of actual direct costs. This would violate the CPPC prohibition whenever indirect costs include a profit factor and whenever no provision exists to adjust estimated indirect costs to actual indirect costs that have been verified by audit.

b. The cost-plus-a-fixed-payment contract should include a general description or statement of the work contemplated. The engineer is reimbursed for the direct costs of all services and supplies including salary costs, overhead, direct non-salary expense, and fixed payment.

(1) Salary cost is defined as the cost of salaries (including sick leave, vacation, and holiday pay applicable thereto) of engineers, draftsmen, surveyors, stenographers, clerks, etc.; for time directly chargeable to the project; plus unemployment, excise, and payroll taxes; and contributions for social security, employment compensation insurance, retirement benefits, and medical insurance benefits.

(2) Salaries or imputed salaries of partners or principals, to the extent that they perform technical or advisory services directly applicable to the project, are to be added to salary *

cost without additions for employee benefits. If the partners or principals are employees of the corporation and share in employee benefits, then the benefits should be added.

(3) The engineer's overhead includes the following "indirect" costs, which are not directly allocable to specific engagements:

(a) Provisions for office, light, heat, and similar items for working space, depreciation allowances or rental for furniture, drafting equipment and engineering instruments, and office and drafting supplies not identifiable to specific projects.

(b) Taxes and insurance other than those included as salary cost, but excluding state and Federal income taxes.

(c) Library and periodical expenses, and other means of keeping abreast of advances in engineering, such as attendance at technical and professional meetings.

(d) Executive, administrative, accounting, legal, stenographic, and clerical salaries and expenses, other than identifiable salaries included in salary costs and expenses included in reimbursable nonsalary expenses, plus salaries or imputed salaries of partners and principals, to the extent that they perform general executive and administrative services as distinguished from technical or advisory services directly applicable to particular projects. These services and expenses, essential to the conduct of the business, include preliminary arrangements for new projects or assignments and interest on borrowed capital.

(e) Business promotion expenses, including salaries of principals and salary costs of employees so engaged.

(f) Provision for loss of productive time of technical employees between assignments, and for time of principals and employees on public interest assignments.

(4) Direct nonsalary expenses usually incurred may include the following (detailed records must be kept to support charges and allow auditing): *

* (a) Living and traveling expenses of employees, partners, and principals when away from the home office on business connected with the project. (Records must include employee name, dates, points of travel, mileage rate, lodging, and meals.)

(b) Identifiable communication expense, such as long-distance telephone, telegraph, cable, express charges, and postage other than for general correspondence.

(c) Services directly applicable to the work, such as special legal and accounting expenses, computer rental and programming costs, special consultants, borings, laboratory charges, commercial printing and bindings, and similar costs that are not applicable to general overhead.

(d) Identifiable drafting supplies and stenographic supplies and expenses charged to the client's work as distinguished from such supplies and expenses as are applicable to two or more projects.

(e) Identifiable reproduction costs applicable to the work, such as blueprinting, photostating, mimeographing, printing, etc.

(5) Fixed payment is in addition to reimbursement for salary, direct costs, and overhead. The consulting engineer is paid a fixed amount for contingencies, interest on invested capital, readiness to serve, and profit. This may be an amount based on the estimated cost of the project at the time the engineer is engaged. The fixed payment usually ranges from four percent of the agreed-upon estimate of construction costs for projects of small or moderate size to as low as 3/4 of one percent on very large projects. The fixed payment also varies with the scope of the engineering services involved. The cost-plus-fixed-payment basis of compensation requires, as a prerequisite to equitable negotiation, that the scope of the project itself to be fairly well defined and that the services to be performed by the consulting engineer be fully set forth in the agreement. Such agreements should also provide for appropriate adjustments in the fixed payment in the event that the physical scope of the project, time for completion, or the services required are materially increased over that contemplated during the negotiations. *

25. FIXED LUMP-SUM PAYMENT.

a. This method of compensating engineers for basic services is used frequently. *

b. The fixed amount of compensation is developed by estimating the individual elements of the engineering cost outlined in the foregoing paragraph 24, plus a reasonable margin of profit, all expressed as a single lump sum. A lump-sum proposal should be accompanied by the engineer's detailed estimate. The estimate should detail the direct labor cost by categories of employee, manhours, and hourly rate; overhead on labor costs; general and administrative overhead; materials and supplies; travel; other costs; and profit or fee times complexity factor.

c. The lump-sum method of establishing the engineer's compensation is desirable when the scope of the assignment to be undertaken can be clearly and fully defined.

d. Where consultation is undertaken on a lump-sum basis, the agreement should contain a clearly stated time limit during which the services will be performed, and a provision for additional compensation for time in excess of that stated. In design assignments, there should be a provision for changes required after the approval of preliminary designs, with a clear understanding as to where the final approval authority lies.

e. Payments on this basis should be made to the consulting engineer at stated times (usually once a month) during the execution of the work.

26. PERCENTAGE OF CONSTRUCTION COSTS. Engineering contracts based on percentage of actual construction costs, and contracts based on percentage of estimated construction costs after design work has been completed, contain CPPC methods of contracting. They are considered to be CPPC contracts since the portion of the engineer's fee which does not reflect actual costs constitutes a profit which is not fixed at the time the contract with the engineer is executed. Therefore, contracts based on percentage of construction costs are prohibited where payments for engineering services are to be funded under ADAP. *

27. LEVEL OF ENGINEERING COMPENSATION.

a. Many design assignments are negotiated by means of two or more of the foregoing methods of compensation. Quite frequently, the preliminary phase of the assignment may be undertaken for a fixed lump sum, especially where the resultant report may be required to establish the project's feasibility or where the preliminary phase

will involve planning for deferred stages of construction. Following that, the design and construction phases may be accomplished under a cost-plus-fixed-payment type of compensation.

b. The curves presented in figures 1 and 2 represent median compensation, computed as a percentage of construction cost, developed from responses to questionnaries sent out by the ASCE. The original data was developed in 1963; the curves presented here are as revised in 1971 and published in 1972. Obviously, the appropriate compensation for a given assignment may vary well * above or below these curves, depending on the various factors which have been discussed in the foregoing paragraphs. The curves should be used only for rough approximations of engineering costs. Estimates used in the negotiation of contracts for engineering services should be based on detailed cost breakdowns of the factors described in paragraphs 24 and 25. The curves cover compensation only for the basic services outlined in paragraph 6.

c. The special services, described in paragraph 7, may add substantially to the local engineering cost of the project. These special services are furnished either directly by the client, by the primary engineering firm, or by a firm specializing in such work. *

d. Curve A in figure 1 is intended to apply to assignments of which the following are typical examples:

(1) Airports with extensive terminal facilities.

(2) Water, sewer, and industrial waste treatment plants.

(3) Bridges which are asymmetric or are otherwise complicated.

(4) Access roads.

(5) Highway and railway tunnels.

(6) Pumping stations.

(7) Large intercepting and relief sewers.

(8) Sanitary sewer lines under 24 inches in diameter.

(9) Water distribution lines under 16 inches in diameter.

(10) Foundations.

(11) Additions to or reconstruction of projects classified in Curve B on figure 2.

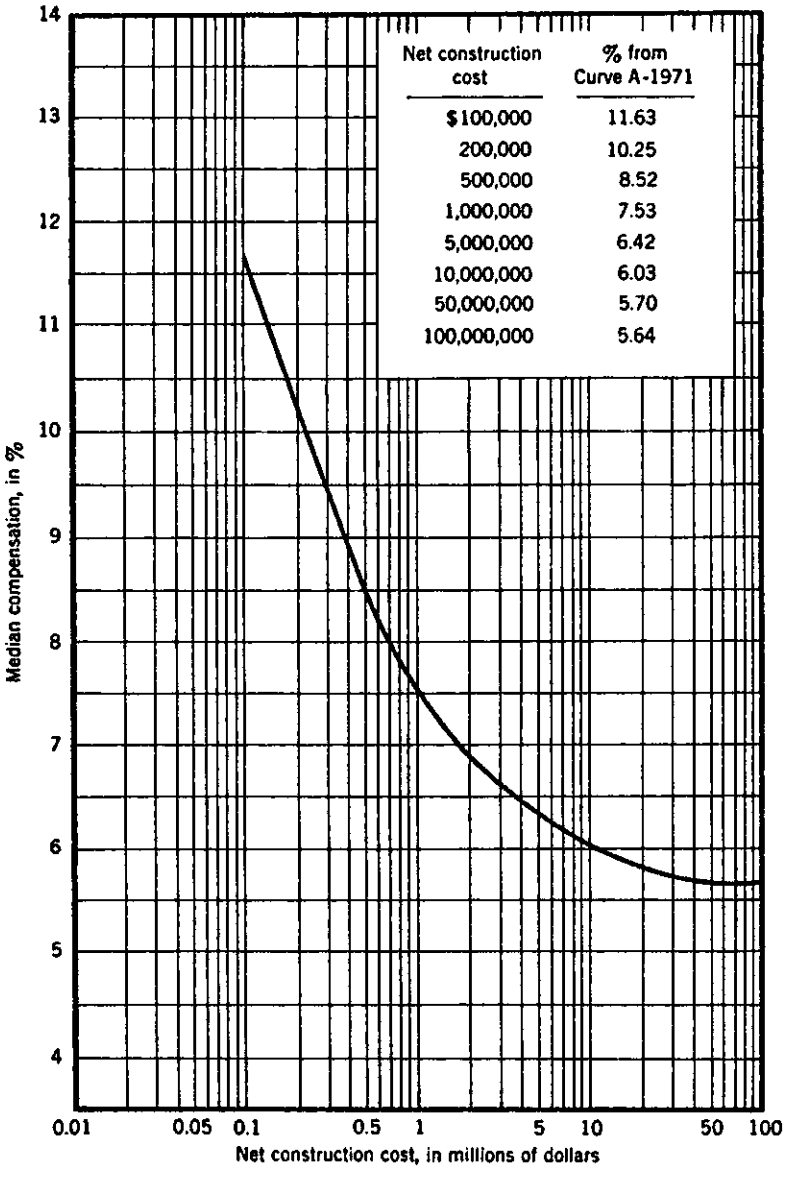

FIG. 1.—CURVE A, MEDIAN COMPENSATION FOR BASIC SERVICES EXPRESSED AS A PERCENTAGE OF CONSTRUCTION COST FOR PROJECTS OF ABOVE-AVERAGE COMPLEXITY (1971)

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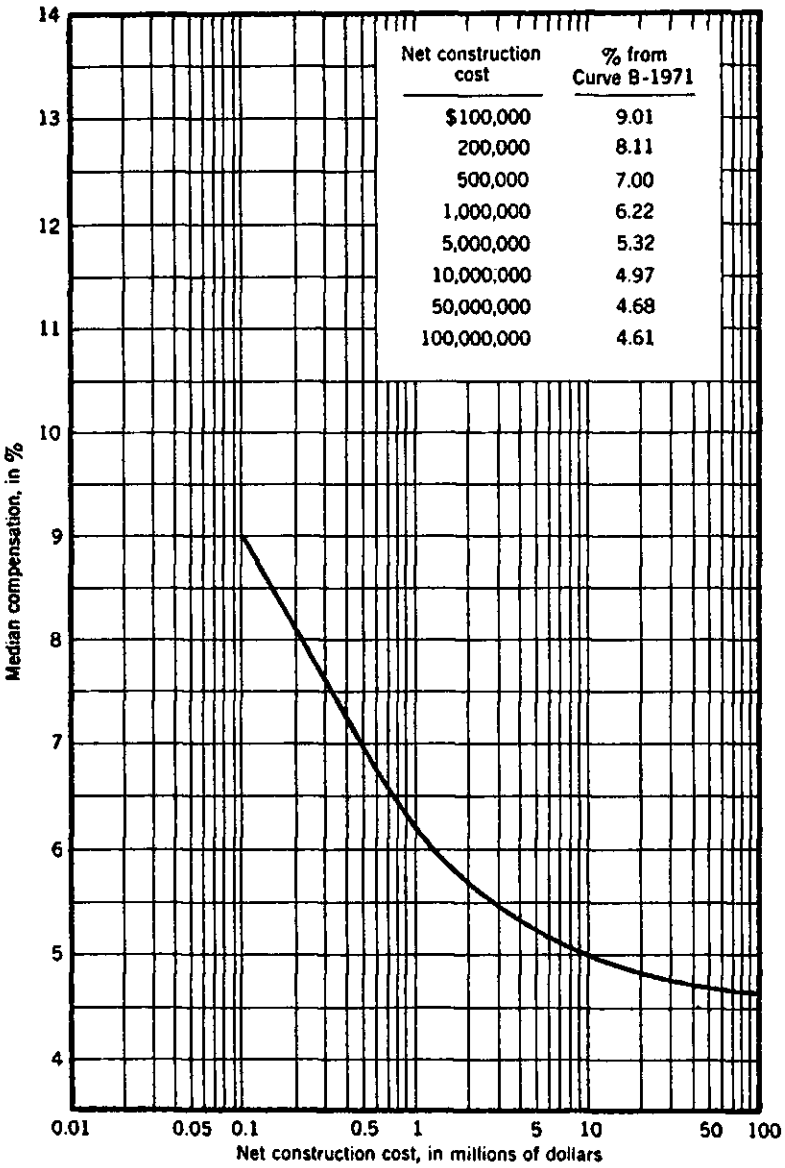

FIG. 2—CURVE B, MEDIAN COMPENSATION FOR BASIC SERVICES EXPRESSED AS A PERCENTAGE OF CONSTRUCTION COST FOR PROJECTS OF AVERAGE COMPLEXITY (1971)

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e. Curve B in figure 2 is intended to apply to less complex assignments of which the following are examples:

(1) Industrial buildings, warehouses, garages, hangars, and comparable engineering structures.

(2) Bridges and other structures of conventional design.

(3) Less complex access roads.

(4) Conventional levees, flood walls, and retaining walls.

(5) Sewer and water tunnels (free-air).

(6) Storm sewers and drains.

(7) Sanitary sewer lines 24 inches and larger.

(8) Water distribution lines 16 inches and larger.

(9) Airports except as classified for Curve A.

f. The curves in figures 1 and 2 represent median compensation for the three phases of the basic services described in paragraph 6. For the purpose of establishing charges for the separate phases, the following range of allocations is applicable:

(1) Preliminary Phase--up to 40 percent of basic compensation.

(2) Design Phase--up to 80 percent of basic compensation.

(3) Construction Phase--up to 20 percent of basic compensation.

Partial payments for the preliminary and design phases usually are made at monthly intervals based on monthly statements submitted by the engineer. Partial payments in the construction phase are made monthly, usually on the basis of contractor's monthly estimates. Charges for special services are usually billed on a monthly basis. On small projects, the engineer may prefer to bill upon completion of each phase or on some similar basis.

g. Some state societies of professional engineers have published ranges of compensation based on percentage of construction cost. These, like the ASCE curve data, should be used with extreme caution and with recognition of the date they were developed.

* h. Whether accomplished under "consultation and reports" or as a part of "special services," contracts for surveying should be negotiated for in the same manner as for other engineering services. If substantial knowledge of the scope of the work is available plus experience in similar projects, then the fixed lump sum method may be used. *

i. Because of high initial and maintenance costs, electronic distance-measuring devices are usually handled as a separate cost item. For example, a charge of $45 to $74 per day is usual for a piece of equipment costing about $6,000 (1968).

28. TIME OVERRUNS BEYOND CONTROL OF THE ENGINEER. Frequently the engineer is called upon to continue technical inspection services on construction contracts overrunning the program schedule contemplated at the time of negotiation of the engineer's compensation. In most instances, the time element is beyond the control of the engineer. To provide for the contingency of overrun of time, the agreement between the client and the engineer should state the period for which the * compensation shall apply and that the engineer shall be reimbursed for services in excess of the specified period of time at an agreed cost, as agreed on at the time the engineer's contract is negotiated. An * agreement for such reimbursement assumes that the construction contract includes liquidated damages to be paid by the construction contractor for overrunning the contract time. The amount of reimbursement should be related to the liquidated damages level.

29. OWNERSHIP OF DRAWINGS AND CONTRACT DOCUMENTS.

a. Original documents, such as tracings, plans, specifications and maps, prepared or obtained under the terms of the contract shall be delivered to and become the property of the client, and basic survey notes and sketches, charts, computations and other data shall be made available upon request to the client without restriction or limitation on their use. In the event any of the above documents are reused by the client, the nameplate will be removed and the consultant will be released and held harmless of subsequent liabilities.

b. When a contract is for preliminary plans only, no commitment should be stated or implied that would constitute a limitation on the subsequent use of the plans or ideas incorporated therein for preparation of construction plans.

30. TOTAL COST OF ENGINEERING VS. PROJECT COSTS. On new projects, before construction begins and before the engineer has been directed to proceed with detailed contract drawings and specifications, the client is concerned with the probable total cost of the project. He will request the engineer to make an engineering report on the project,

including a preliminary estimate of the project cost, fully realizing that because the engineer has no control over the cost of labor and materials or competitive bidding he cannot guarantee the estimate.

a. Information in the hands of the engineer after the completion of his report is not sufficient to enable him to make an estimate of construction cost which is equal in accuracy to the bid a contractor makes after his study of the detailed contract drawings and specifications. To the engineer's preliminary estimate, therefore, must be added an allowance for contingencies. These contingencies may include undisclosed conditions of foundations and construction, extra quantities of materials, larger and heavier equipment, inflation, and other items increasing the cost of construction.

b. The item of contingencies varies with the degree of completeness of the engineer's report. Usually, it should be included in preliminary estimates from 10 percent to 15 percent of the engineer's construction cost estimate.

c. To the estimated cost of construction plus contingencies should be added provision for engineering, legal, administrative costs, and land costs.

d. After contingencies and engineering, legal, administrative, and land expenses have been added to the estimated cost of construction, it may be necessary for the client and the engineer to consider the cost of financial advice, printing of bonds, discount of bonds, etc. Expenses incurred in raising project funds, including administrative expenses involved in bond referendums, the sale of bonds or premium or interest on bonds, or loans, are not eligible project expenses under ADAP.

AC NO: 150/5100-9

DATE: 1 JUL 72

ADVISORY CIRCULAR

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

SUBJECT: ENGINEERING SERVICES UNDER THE AIRPORT DEVELOPMENT AID PROGRAM (ADAP)

1. PURPOSE. This advisory circular provides guidance for airport sponsors and Federal Aviation Administration (FAA) offices in the definition, selection, review, and approval of engineering services used under the Airport Development Aid Program (ADAP).

2. REFERENCES. The publications listed in Appendix 1, Bibliography, provide further guidance and detailed information.

3. HOW TO OBTAIN THIS PUBLICATION. Obtain additional copies of this Advisory Circular (AC) 150/5100-9, Engineering Services Under the Airport Development Aid Program (ADAP), from the Department of Transportation, Distribution Unit, TAD-484.3, Washington, D.C. 20590.

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Acting Director, Airports Service

Initiated by: AS-580

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CHAPTER 1. INTRODUCTION

1. BACKGROUND. It is in the best interest of all concerned to obtain qualified engineering services. It is also essential to obtain such services at a fair and reasonable cost together with timely, complete, and acceptable performance. Federal Aviation Regulations (FAR) Part 152.51(f) includes requirements that:

   a. All contracts for engineering services and force account proposals for such services in connection with Federal grant airport projects be submitted to FAA for approval before execution of a new, or extension of an existing contract, or before performance of force account services.

   b. FAA approval applies to any project for airport development under ADAP.

2. DEFINITIONS.

   a. The term "engineers" refers to the individual, firm, or consultant engaged to do the engineering work. It is recognized that architectural services may be needed on some projects; the term "engineer" or "consultant" includes such services in the context of this advisory circular. Architectural fee information is, however, not included here but may be obtained from the source mentioned in the Bibliography as Item 8.

   b. The terms "primary engineer" and "principal consultant" refer to the individual or firm held responsible for the overall performance of the engineering work including that accomplished by others under special services type contracts or contracts with specialists.

   c. The term "client" refers to airport sponsors or airport owners.

   d. The term "force account" refers to accomplishment of engineering work by the sponsor's own personnel or by its agent.

3. INTENT. It is the intention of this advisory circular to:

   a. Provide guidance for attaining the objectives and requirements of paragraph 1.

   b. Include comprehensive guidance on engineering functions, types of services offered, acceptable bases for compensation, and procedure for selection of engineers.

   c. Realize that guidance should lead to proper conception and design of the work as well as appropriate, economic construction and supervision and inspection thereof.

d. Note that success is dependent upon complete understanding between the engineer and his employer and that appropriate consideration of the elements covered herein will help develop such understanding.

e. Recognize that some types of engineering common to airport engineering are unique and therefore should be specifically identified as a part of the required services.

f. Acknowledge that engineers should be engaged on the basis of their qualifications, experience, and availability.

g. Require that compensation be based on negotiations. Conversely, competitive bidding is considered unsuitable and unethical.

h. Note that FAA offices stand ready to advise and assist in the obtaining and development of engineering services under ADAP.

CHAPTER 2. TYPES OF ENGINEERING SERVICES.

4. GENERAL. There are three major categories of engineering: consultation and reports, basic services, and special services. Most airport engineering falls either in basic or special services; however, there is an occasional need for a feasibility investigation so we have included coverage on "consultation and reports" (for that exception and in the interest of completeness).

5. CONSULTATION AND REPORTS. These services generally involve collecting, interpreting, and reporting information, together with drawing conclusions and making recommendations.

   a. Direct Personal Service. Usually involves assisting in the preparation of legal proceedings, appearances before courts or commissions to state opinions and conclusions as an expert witness, and investigations of technical matters. This classification does not include preparation of working or construction drawings nor does it include responsible inspection of construction work.

   b. Preliminary and Feasibility Investigations, Site Selection, Cost Studies, and Economic Comparisons. These services may precede the authorization of a project and may involve extensive investigations, analysis of conditions, and comparisons of several possible plans. Such studies may include operating costs, financing considerations, and expected revenue as bases for conclusions and recommendations regarding the advisability of undertaking a project. May involve environmental or ecological studies.

   c. Appraisals, Valuations, and Rate Studies. These services may include investigations and analyses of conditions, capital and operating costs, overhead, financial costs, and revenues leading to property valuations or to recommendations for the establishment of prospective rates.

   d. Assistance in Financial Matters. The engineer may be asked to advise his client as to sources of capital and possible Federal aid. He may estimate operating costs, interest and debt retirement, and probable income from the project. He may also act as agent to certify that the terms and conditions of bond issues are carried out. This may include preparation of a request for aid and supporting estimates and sketches.

   e. Management and Production Engineering. These services comprise studies of management, production, labor relations, time studies, and similar activities that are carried out for the client.

   f. Inspection or Testing of Apparatus and Equipment.

g. Operational Services. Upon completion of construction, the engineer may be responsible for start-up of operations on the project. He may be required to establish an efficient operating staff, set up job classifications and salaries, etc.

h. Surveying and Mapping. There are four major categories; i.e., land, engineering, geodetic, and cartographic surveying. Although some coverage is given below to each category, airport engineering usually includes only land or engineering surveying.

(1) Land surveying includes the determination of the location of land boundaries and land boundary corners; the preparation of maps showing the plan figures formed by the boundaries; the determination of the areas of land contained therein; and the preparation and interpretation of land descriptions for incorporation in deeds, leases, and other related documents.

(2) Engineering surveying includes the development of design data, such as horizontal and vertical control, the plotting of culture and topography, and the development of profiles and cross sections for the study and selection of sites or alignment for engineering construction. It also includes the layout of facilities and structures, quantity and measurement determinations, and "as built" and utility surveys.

(3) Geodetic surveying includes the extension of high-order horizontal and vertical control surveys; the determination of astronomic latitudes, longitudes, and azimuths; and of the intensity of gravity.

(4) Cartographic surveying includes the establishment, computation, and adjustment of control surveys of the order required by the detail and scale of the map being made; the extension of control by aerotriangulation; the preparation of the manuscript by field and/or photogrammetric surveys; and the field inspection and field editing of the manuscript.

6. BASIC SERVICES.

a. General. These services cover engineering practice in which design and development work is done. They differ from "consultation and reports" in that engineering design, working drawings, specifications, and other similar documents are developed. These services, however, are usually based on a prior study of project requirements and feasibility.

THESE SERVICES DO NOT INCLUDE THE DETAILED RESIDENT INSPECTION OF CONSTRUCTION WHICH MAY BE FURNISHED SEPARATELY. The basic services usually required on airport development projects, and where both design and inspection of construction are required, are accomplished in three distinct and sequential phases as follows:

(1) The preliminary or "report phase".

(2) The design phase.

(3) The construction phase.

b. The Preliminary Phase. This phase of project development establishes the general size and scope of the project, and its location on the site. The basic services may include the following:

(1) Conferences with the client to review his wishes and requirements, inspection of the site, review of available material assembled by the client, and discussion of scheduling. Conferences also may be held with various approving and regulatory agencies including the FAA and with those utility companies affected.

(2) Planning for and assisting the client in procuring the necessary surveys and other field investigations.

(3) Preparation of preliminary engineering studies and designs. These will be submitted for review and approval by the client and others.

(4) Preparation of preliminary layouts, sketches, outline specifications and reports, where applicable, and the engineer's specific recommendations.

(5) Preparation of preliminary cost estimates of the project.

c. The Design Phase. This phase of project development is usually undertaken only after approval by the client of the preliminary design, report, and estimate. The basic services may include:

(1) Detailed conferences with the client and approval of regulatory authorities.

(2) Planning for and assisting the client in procuring the necessary field information for design. This information may include field surveys, photogrammetry, traffic studies, soils investigations, noise, land use, or other special studies. Such field information is normally furnished by the client or through the engineer for the client's account.

(3) Preparing engineering data, where necessary, for regulatory permit applications required by local, state, or Federal authorities.

(4) Preparation of engineering report.

(5) Preparation of plans and specifications, contract documents, and detailed estimates.

(6) Furnishing the client a specified number of copies of drawings, specifications, and other contract drawings for final review by client and approving authorities.

d. The Construction Phase.

(1) Office Engineering.

(a) Assistance to the client in securing bids, tabulation and analysis of bid results, and furnishing recommendations on the award of construction contracts.

(b) Assistance in the preparation of formal contract documents for the award of contracts.

(c) Consultation and advice to the client during construction.

(d) Preparation of elementary sketches and supplementary sketches required to resolve actual field conditions encountered.

(e) Checking detailed construction, shop, and erection drawings submitted by contractors for compliance with design concept.

(f) Reviewing, analyzing, and approving laboratory, shop, and mill test reports of materials and equipment.

(g) Preparing "as built" drawings based on information provided by the resident engineer.

(2) Field Engineering.

(a) Making periodic inspections of work in progress, and providing appropriate reports to the client (does not include resident inspection).

(b) Inspecting initial operation of the project or of performance tests required by specifications.

(c) Making a final inspection and report of the completed project with the client or his representative.

(d) Preparation and negotiation of change orders and supplemental agreements.

(e) Represent the sponsor in the preconstruction conference.

(3) Office and Field Engineering. Reviews progress of contractor, acceptability of materials, construction methods, and resident inspection.

7. SPECIAL SERVICES. The development of some projects may involve studies outside the scope of the basic design services of the engineer. Many of these studies relate to decisions of management as to the feasibility, scope, and location of a project. The research, assembling of engineering data, and acquisition of property may involve many professional specialists other than the primary engineer or principal consultant. Because special services vary greatly in scope, complexity, and timing, they are normally negotiated when required as separate elements of service. These services are often negotiated by the primary engineer acting on behalf of his client. In any case, the relationship should be specified as to authority and responsibility of the primary engineer versus those providing special services. Included in special services may be:

a. Soils investigations--including test borings, related analyses, and recommendations.

b. Detailed mill, shop, and/or laboratory inspection of materials and equipment.

c. Land surveys, establishment of boundaries and monuments, and related office computations and drafting.1/

d. Field surveys, photogrammetry, and field layouts of construction. Construction layout control staking and pay-quantity surveys are to be done by engineers in the employ of the airport sponsor and should not be done by the construction contractor. Usually sufficient surveys shall be accomplished by the engineer to avoid requiring the construction contractor to do staking or surveying. Local practices may have the engineer establishing bench marks and base lines and the contractor doing the balance of the staking, however, the engineer should then spot check the contractor's stakes.

1/ Some primary engineering or principal consulting firms are not equipped to do surveying or the size of the surveying effort is beyond their capability. Accordingly, surveying is listed under "consultation and reports" as well as here, thus recognizing that "special services" or firms specializing in surveying may need to be engaged.

e. Technical inspection of construction by a full-time resident engineer or inspector and supporting staff, as required, who will also:

(1) Review and approve requests for monthly and final payments to contractors.

(2) Issue certificates of completion to the client or primary engineer on completed construction contracts.

(3) Provide "as built" information to the primary engineer for preparation of "as built" drawings of the completed project.

(4) Supervise testing and inspection. Arrange for, conduct, or witness field, laboratory, or shop tests of construction materials as required by the plans and specifications; determine the suitability of materials on the site and brought to the site to be used in the construction; interpret the contract plans and specifications and check the construction activities to assure compliance with the intent of the design; measure, compute, or check quantities of work performed and quantities of materials in-place for partial and final payments to the contractors; and maintain diaries and other project records to document the work.

f. Additional copies of reports, contract drawings, and documents above the specified number furnished in the basic services.

g. Extra travel and subsistence for the engineer and his staff beyond that normally required under basic circumstances when authorized by the client.

h. Assistance to the client as expert witness in litigation arising from the development or construction of the project.

i. Investigation involving detailed consideration of operation, maintenance, and overhead expenses; and the preparation of rate schedules, earnings, and expense statements; feasibility studies; appraisals; valuations; and material audits or inventories required for certification of force account construction performed by the client.

j. Preparation of applications and supporting documents for Government grants or advances for airport projects.

CHAPTER 3. PROCEDURE FOR SELECTION OF THE ENGINEER.

8. GENERAL.

a. Many governmental agencies, as well as private bodies and industries, have developed procedures for the selection of engineers. This chapter outlines the procedures as a general guide in this important decision.

b. No two engineering firms have equal training, experience, skills, capabilities, personnel, workloads, and particular abilities. Selection of the firm for a specific project can mean the difference between a well-planned, low cost, successful project or a mediocre and costly one.

c. Engineers should be engaged on the basis of their qualifications and experience and their compensation should be based on negotiations. Competitive bidding is not suitable for engineering work. The client that "buys" engineering services by competitive bids has no realistic basis on which to compare the value of what he will get.

9. SELECTING ORGANIZATION.

a. Within the sponsor's organization, an administrative policy should be established for designating persons authorized to select or recommend engineers for various assignments. The persons designated may include the administrator, or the department head, to be supplemented by others to make up a selection board. The person empowered to make the selection must be kept free of pressures, both internal and external.

b. In most cases, the most satisfactory procedure would be to utilize a board of three men, at least one of whom should be an engineer. The board should be appointed to investigate and make recommendations, holding such interviews and inquiries as they feel may be desirable. The final selection should be by the administrator or governing body of the sponsor based upon recommendation by the board.

10. POLICY FOR SELECTION. The sponsor should establish administrative policy for selection, in line with his own best interest and that of the public. For example, it may be desirable, where qualifications and other elements are satisfactory, for priority to be given to a local engineer. Other basic requirements which should be established as policy are:

a. The firm should be of high ethical and professional standing, its members being of good moral character, and it should be prepared to submit references from persons of known repute.

b. The firms being considered should be advised that they shall be required to comply with state/local requirements for registration as professional engineers and any other statutory requirements.

c. A principal member of the firm's staff must have recent experience in responsible charge of airport engineering work of the type involved in the project or similar engineering work. For the purpose of this chapter, "responsible charge" should be construed as having definite responsibility for engineering work of substantial importance.

11. DATA AS BASIS FOR SELECTION. Engineers interested in an engagement should disclose complete information on their qualifications. In addition to the specific data requested, they may wish to submit their own brochures with photographs and general background data. If airport lighting or other electrical work is contemplated, the engineer's qualifications should include qualifications for such work.

12. PROCEDURE. The sponsor should study the proposed project and its engineering needs so that his board knows what is required from and expected of the engineer. If the sponsor has previous experience with an engineer who has in the past rendered satisfactory services, he may consider it unnecessary to go through the procedure outlined herein. Otherwise, the board should proceed as follows:

a. Consider the qualifications of engineers who appear to be capable of meeting the requirements of the project. The names of engineering consultants may be obtained from the Professional Services Directory of the Civil Engineering Magazine published by ASCE, Directory of Engineers in Private Practice by NSPE, from the American Institute of Consulting Engineers; from the individual State Board of Registration; and from the telephone directory under Engineers-Civil or Engineers-Electric or Engineers-Consulting.

b. Consider at least three firms that appear to be best qualified for the particular project. Write separate letters to each of them describing briefly the proposed project and inquiring as to their interest. On receipt of an affirmative answer, request the firm to appear for a separate personal interview. In the case of design projects, give the engineer an opportunity to inspect the site explaining to him the proposed services required. At the interview, go over the qualifications and records of that firm, its capability to complete the work within the time allotted, and the specific key personnel assignable to the project, and the qualifications of personnel to be assigned.

c. Check carefully with recent clients of each firm and determine the quality of performance. Do not limit this check to references specified by the consulting firm. Ineptitude in designing, supervising, inspecting, testing, or recordkeeping may be grounds for considering the performance unacceptable. Similarly, delay in completion of the plans, specifications, or construction should be considered telling factors.

d. List the three firms in the order of their desirability, taking into account their location, reputation, experience, financial standing, size, personnel available, quality of references, workload, and any other factors peculiar to the project being considered.

e. Invite the firm that is considered to be the best qualified to appear for a second interview to discuss the project further and to negotiate the questions of compensation.

f. The compensation requested by the engineer may be checked against the guidelines outlined in this advisory circular as well as with other employers of engineering services. If agreement is not reached, the negotiations should be terminated and the engineer notified in writing to that effect. A similar interview should then follow with the second firm, and failing accord with the second firm, the third should be called in for negotiations. Such a procedure will usually result in a mutually satisfactory contract. All such negotiations should be on a strictly confidential basis, and in no case should the compensation discussed with one engineer be disclosed to another.

g. When all engineering matters, and the charges therefore, have been agreed upon:

(1) The selected firm may submit a proposal by correspondence for undertaking the project for acceptance.

(2) The parties should draft a formal contract, embodying all conditions and charges, for signature by both parties.

h. The proposal or draft contract should be submitted to the responsible FAA office for review and approval prior to its execution. AC 150/5000-3 is a list of FAA offices to which the proposal or draft contract should be submitted. These offices also stand ready to advise and assist at any other stage of the process.

i. Upon approval of the proposal or draft contract and execution of the contract, all other firms who have submitted qualifications should be notified that the selection has been completed.

j. Some contracts may have been executed between the time of passage of the Airport and Airway Development Act of 1970 and issuance of this advisory circular. Such contracts should be reviewed against the recommendations herein and supplemented or changed as necessary.

k. Just as steps are taken in the process of selection to assure that engineering to be accomplished by contract will be acceptable, timely and financially prudent; so should steps be taken to assure that engineering to be done by force account also meets such aims. Accordingly, the FAA will require that proposals to do the engineering work by force account be submitted in writing and FAA approval be obtained prior to start of any of the work. The proposal shall include, as a minimum:

(1) Names and engineering qualifications of personnel performing the work and reference to capability for design, supervision, inspection, testing, etc., as applicable.

(2) Details of experience with airport engineering of like or similar nature.

(3) Information on workload as it affects capacity to do the work with reference to date by which work will be complete or dates within which it will take place.

(4) Justification for doing the work by force account rather than by contract.

(5) Estimate of cost with details as to manhour rates and nonsalary expenses.

CHAPTER 4. CONTRACTS FOR ENGINEERING SERVICE.

13. ESSENTIALITY.

a. The relations of the engineer with his client should be clearly defined by a written instrument before commencement of actual work. All of the terms should be clearly defined in the agreement. It should state the parties to the contract and define the complete extent and character of the work to be performed, as well as conditions relating to any time limitations which may be involved. The terms and payments for various services should follow. The scope of the engineering effort should be described in complete enough detail to determine the sufficiency of supervisory and inspection staff and to determine whether some services will need to be otherwise contracted for or be provided by the client.

b. The right of either party to terminate the contract prior to its completion should be clearly stated. Otherwise, it should be stated that agreement will continue to completion. Engineering contracts frequently contain a unilateral termination clause whereby the client may terminate the agreement at any time he is dissatisfied with the services of the consulting engineer, subject, of course, to appropriate notification and payment for services already performed. The justification for such an arrangement is that the proper rendering of professional services demands an environment of mutual confidence between client and engineer.

c. Engineering contracts usually cover highly technical services. Therefore, to assure the soundness of a legal document, it is essential that someone who is thoroughly conversant with the practice of consulting engineering prepare the sections describing services to be performed, sequence of work, information to be furnished by the client, and terms of payment.

14. FORM OF CONTRACT.

a. Many government agencies, business firms, and engineering organizations have developed standardized forms for engineering contracts. The Consulting Engineers Council, the National Society of Professional Engineers, the American Society of Civil Engineers, and the American Road Builders' Association have developed such standardized forms. The American Institute of Architects has standardized forms for architectural contracts.

b. It is recommended that engineering contracts be written to apply to only one project, because continuing contracts do not provide the sponsor with the option to consider whether the services were completely satisfactory. Also, charges must be assigned to a specific project and continuing contracts usually make such assignment difficult. This is not to say that retainer contracts are not useful; however, retainer types are used for intermittent work over protracted periods and, thus somewhat inappropriate for the usual airport engineering work. If continuing type contracts were entered into prior to FAA review and approval, FAA will still require submission for review and may require that the contract be supplemented or changed. Some revenue bond issues require engineering services on a continuing basis and changing firms require formal action; consequently, a continuing contract or retainer type is used. When such types are required, the sponsor should stipulate: that each project or work assignment will require separate authorization; that separate records are to be maintained for each assignment for cost accounting purposes; and that the sponsor is not obligated to use the same consultant for services outside the terms of the bond issue resolution or trust indenture.

15. CONTRACT PROVISIONS. The following checklist contains the essential provisions to be considered in preparing any agreement for engineering services:

a. Effective date of agreement.

b. Names and descriptions of the parties to the agreement with their addresses and, in the case of a corporate body, the legal description of the corporation.

c. Acknowledgment of the engineer's visit to site of the project and interview with the client.

d. Nature, extent, and character of the project, the location thereof, and the time limitations.

e. Services to be rendered by the engineer. (Include here the applicable services required from Chapter 2, Types of Engineering Services.) Contracts shall be modified or supplemented whenever significant changes to the scope of the work are required. The engineer shall perform the required services with his own organization and those of his associates but may employ, with the consent of the client, specialized services for such items as surveying, boring, soil testing, aerial surveying, and such work or services normally provided to engineers by others.

f. Services to be rendered by the client. (Include here the applicable services required from Chapter 2, Types of Engineering Services).

g. Statement that design drawings and specifications become the property of the client.

h. Provisions for the termination of the engineer's services before final completion of his work.

i. Compensation for services rendered by the engineer, including times and methods of payments on account, interim payments, and final payment in full settlement (see Chapter 5). Conversely, renegotiation of compensation should be allowed if some services are not required because of changed conditions.

j. Emphasis on timeliness of requests for payment and payment itself.

k. Additional compensation for redesign, after approval of preliminary plans, for change in scope of project, for delays causing expense to the engineer, etc.

l. Time schedule for execution of engineering services.

16. CERTIFICATION OF ENGINEER. All contracts shall include a certification executed by the consultant and reading as follows:

AIRPORT DEVELOPMENT AID PROJECT _____

STATE _____

CERTIFICATION OF ENGINEER

I hereby certify that I am the ____(title)____ and duly authorized representative of the firm of _____, whose address is _____, and that neither I nor the above firm I here represent has:

(a) employed or retained for a commission, percentage, brokerage, contingent fee, or other consideration, any firm or person (other than a bona fide employee working solely for me or the above consultant) to solicit or secure this contract,

(b) agreed, as an express or implied condition for obtaining this contract, to employ or retain the services of any firm or person in connection with carrying out the contract, or

(c) paid or agreed to pay to any firm, organization, or person (other than a bona fide employee working solely for me or the above consultant) any fee, contribution, donation, or consideration of any kind for, or in connection with, procuring or carrying out the contract; except as here expressly stated (if any):

I acknowledge that this certificate is to be furnished to the Federal Aviation Administration of the United States' Department of Transportation, in connection with this contract involving participation of Airport Development Aid Program (ADAP) funds and is subject to applicable state and Federal laws, both criminal and civil.

_____(date)_____ _____(signature)_____

17. AIRPORT ENGINEERING. It should be realized that airport engineering may involve types of engineering or dimensions which are somewhat distinctive or peculiar to such engineering. Such recognition should result in a more complete description of the engineering involved in the project and thus enhance understanding between the engineer and client. Some of the rather distinctive features essential to many airport engineering situations are:

a. Site selection--analysis of alternate sites.

b. Progress reports to sponsor, FAA, etc.

c. Approach and obstruction survey.

d. Soil and drainage survey and analysis.

e. Topographic survey of comparatively large acreage.

f. Coordination of the safety of aircraft operations during construction.

g. Pavement survey, testing, and evaluation.

h. Detailed construction cost estimate.

i. Arrangement and participation in predesign and preconstruction conferences.

j. Engineer's report.

k. Airport lighting.

l. Recommendations for stage construction.

m. Obtaining FAA approval of design, plans and specifications, changes, etc.

n. Coordination of construction work with airport tenants.

o. Inclusion in contract documents of special provisions for labor requirements, equal employment opportunity, and wage rates.

p. Property surveys and description of needed land acquisition.

q. "As-built" plans.

r. Allowable seasons for construction work.

s. Testing of materials and testing of compaction, mixes, density, surface smoothness, etc., to comply with plans and specifications.

18. ENGINEERING FOR REQUESTS FOR AID. Preparation of a request for aid and the estimate of construction cost and sketch to accompany it usually will require some engineering services. Such services should be accomplished under a contract and the usual process for selection of the engineer should be used. Airport sponsors may be somewhat reluctant, at this point in time, to enter into engineering contracts covering design or construction supervision and inspection as the possibility of doing such work may hinge on receiving federal aid. It is recommended that, under such circumstances, a contract be prepared covering only preparation of the request for aid and supporting sketch and estimate with an understanding that it does not imply that a follow on contract will be forthcoming. Because of the limited scope of the engineering services and for simplicity, a lump sum compensation is recommended.

19. DIVISION OF RESPONSIBILITY AND AUTHORITY. It is common to have one engineering firm providing the basic services and another doing the resident engineering or some other special service. In such cases, the basic services firm is the "primary engineer" or "principal consultant" as defined in paragraph 2b, and responsible for the acceptability of all engineering work and services in the project. The "primary engineer" represents the airport sponsor in coordinating and overseeing the work of other engineering firms. For example, the resident engineer and his inspectors will be responsible for arranging for, conducting, or witnessing field and laboratory or shop tests of construction materials as prescribed in the specifications. Similarly, the resident engineer determines the acceptability of compaction and the suitability of materials on the site and brought to the site to be used in the construction. The primary engineer would, on periodic visits to the site or upon receipt of copies, review the tests, reports, diaries, vendor reports, etc., produced or submitted by the resident engineer to insure that appropriate corrective action was taken as needed and to insure that sufficient and appropriate testing was being accomplished--in other words, to insure that the construction was being controlled properly. The resident engineer would necessarily be responsible and authorized to decide on the day to day acceptability of materials, compliance with the plans and specifications, and to order the contractor to take appropriate action. The division of responsibility and authority should be clearly specified in the engineering contracts. The primary engineer has, however, the overall responsibility for the acceptability and quality of the work.

CHAPTER 5. CHARGES FOR ENGINEERING SERVICES

20. GENERAL.

a. The computation of charges for engineering services is dependent on the type of services required by the client. The types of services usually performed by engineers are outlined in Chapter 2. FAA review and approval of the contract will include a determination as to reasonableness (or extent thereof) or apparent reasonableness of charges or reimbursement. If the charges can only be computed after completion of the work (such as with contracts based on salary cost times a multiplier, etc.), then the determination of apparent reasonableness will require reconfirmation at that time. If the client will furnish some of the information or services, the facts should be stated in the contract both for completeness and to aid in the determination of reasonableness.

b. Engineering charges are usually computed on one of the following bases or by combining two or more of these methods, with appropriate modifications applicable to specific cases.

21. PER DIEM.

a. Direct personal services are usually charged on a per diem basis. This method is particularly suited to court work or similar work involving intermittent personal service. For example, most of the types of services mentioned in paragraph 5 can require intermittent work and thus may indicate per diem compensation.

b. When such consulting or expert services are furnished, the engineer is compensated for all the time he devoted to the work including travel time. The per diem charge should be based on the complexity of the work involved and the breadth of experience of the engineer. In addition to the compensation based on per diem, the engineer is reimbursed for travel, subsistence, and other out-of-pocket expenses incurred while away from his home office.

c. For services in court or on other engagements in which the engineer is to appear as an expert, a per diem charge is considered to have been earned for each day of such appearance, although the engineer may not be called to testify or, if called, may finish his testimony in a fraction of the day.

d. On occasions, the urgency of the engagement requires the engineer to work longer than the normal day. In some instances, this requirement is a necessary feature of the services, and an understanding should be made with the client as to what constitutes a day. In such cases, the per diem rate may be based on the normal number of working hours per day, or the per diem rate may be increased to take into consideration the extended work day.

e. For certain kinds of work, compensation based on hourly rates is an equitable arrangement. Compensation for engineering service on an hourly basis demands a higher rate per hour than would be represented in a per diem rate. Also, the hourly rates should apply to time for travel involved plus reimbursement for travel costs, subsistence, and other out-of-pocket expenses. Depending on the duration of the services, compensation on an hourly basis may include an agreement on a preset minimum amount or retainer in addition to the payments based on the hourly rates.

f. Per diem rates for the principal engineer will vary from $100 to $200 or more. The per diem rate for assistants will range from 2 to 3 times the "salary cost". "Salary cost" is defined in paragraph 23. The state societies of professional engineers of the states listed below publish pamphlets on engineering services and fees and these may be consulted for more specific guidance on per diem rates. Such rates sometimes need to be adjusted to reflect the change in economic conditions and salary rates since the publication was printed. The states issuing pamphlets include: Arkansas, Florida, Illinois, Iowa, Kansas, Kentucky, Louisiana, Massachusetts, Minnesota, Nebraska, New Jersey, North Carolina, Ohio, Oklahoma, Pennsylvania, South Dakota, Texas, Virginia, and Wisconsin.

22. RETAINER.

a. The employment of engineers on a retainer basis is a common practice. This practice assures the client of always having the services of a certain individual engineer or organization available for future work. This method is used in cases of protracted litigation or for work over the years, when the calls on the engineer may be intermittent. It is also used in the development of undertakings for which the services of an engineering specialist are not required on a full-time basis. On large projects, this method enables the client to have the engineers who prepared the original plans and specifications on hand for maintenance or additions.

b. The amount of the retainer varies with the character and value of the services to the client and with the reputation and standing of the engineer in his profession.

c. The terms of agreements for services on a retainer basis vary widely. Compensation may be based on a fixed sum, paid monthly, or on some other mutually agreeable basis, with per diem or hourly rates in addition for time spent at the request of the client. In any case, the same principles, as explained previously for per diem or hourly charges, govern under retainer contracts.

d. This type of contract would rarely be used for airport engineering. If it were, detailed records would need to be kept to relate the work to a specific project.

23. SALARY COST TIMES A MULTIPLIER, PLUS DIRECT NONSALARY EXPENSE. For many projects, it is not possible to state accurately the scope of work at the time the engineer is retained for the project. The preliminary engineering services, such as surveys, investigations, preparation of budget estimates, process studies, development of alternate layout plans, and other services needed to establish the final design, are usually so indeterminate in scope that a lump-sum would not be an equitable basis of compensation. Furthermore, on many projects during the design phase, it becomes necessary to undertake additional experimental or investigative work, the results of which may further alter the scope of the project. Compensation for services on the basis of the salary cost of the work, times an agreed multiplier is a satisfactory and equitable method for such assignments, when the time required is unduly difficult to predetermine. Direct nonsalary expenses are ordinarily considered as a separate item for reimbursement.

a. Salary cost is defined as the cost of salaries (including sick leave, vacation, and holiday pay applicable thereto) of engineers, draftsmen, surveyors, stenographers, clerks, etc.; for time directly chargeable to the project; plus unemployment, excise, and payroll taxes; and contributions for social security, employment compensation insurance, retirement benefits, and medical insurance benefits.

b. Salaries or imputed salaries of partners or principals, to the extent that they perform technical or advisory services directly applicable to the project, are to be added to salary cost without additions for employee benefits. If the partners or principals are employees of the corporation and share in employee benefits, then the benefits should be added.

c. The multiplier which is applied to salary cost is a factor which compensates the engineer for overhead, as hereinafter defined plus a reasonable margin for contingencies, interest on invested capital, readiness to serve, and profit. The size of the multiplier will vary with the types of work, the organization and experience of the engineering firm, and the geographic area in which its office is located. For average conditions in the United States, the multiplier will be within a range from 2.0 to 3.0 times salary cost.

d. A higher multiplier is ordinarily necessary on projects of short duration or small size. The rate will ordinarily be higher on consulting engagements providing recommendations based primarily on experience or special knowledge or for expert testimony in legal proceedings. It will also vary upward with the experience and special capabilities of the consulting engineering firm. For some services, however, the rate may be as low as 1.75 times salary cost, as in the case of a locally employed staff of the consulting engineer when engaged primarily in field work such as inspection or resident engineering service during construction.

e. Direct nonsalary expenses usually incurred may include the following (detailed records must be kept to support charges and allow auditing):

(1) Living and traveling expenses of employees, partners, and principals when away from the home office on business connected with the project. (Records must include employee name, dates, points of travel, mileage rate, lodging and meals).

(2) Identifiable communication expense, such as long-distance telephone, telegraph, cable, express charges, and postage other than for general correspondence.

(3) Services directly applicable to the work, such as special legal and accounting expenses, computer rental and programming costs, special consultants, borings, laboratory charges, commercial printing and bindings, and similar costs that are not applicable to general overhead.

(4) Identifiable drafting supplies and stenographic supplies and expenses charged to the client's work as distinguished from such supplies and expenses as are applicable to two or more projects.

(5) Identifiable reproduction costs applicable to the work, such as blueprinting, photostating, mimeographing, printing, etc.

f. The engineer's overhead, which comprises a major portion of the compensation generated by the multiplier on salary cost, includes the following "indirect" costs, which are not directly allowable to specific engagements:

(1) Provisions for office, light, heat, and similar items for working space, depreciation allowances or rental for furniture, drafting equipment and engineering instruments, and office and drafting supplies not identifiable to specific projects.

(2) Taxes and insurance other than those included as salary cost, but excluding state and Federal income taxes.

(3) Library and periodical expense, and other means of keeping abreast of advances in engineering, such as attendance at technical and professional meetings.

(4) Executive, administrative, accounting, legal, stenographic, and clerical salaries and expenses, other than identifiable salaries included in salary costs and expenses included in reimbursable nonsalary expenses, plus salaries or imputed salaries of partners and principals, to the extent that they perform general executive and administrative services as distinguished from technical or advisory services directly applicable to particular projects. These services and expenses, essential to the conduct of the business include preliminary arrangements for new projects or assignments and interest on borrowed capital.

(5) Business promotion expenses, including salaries of principals and salary costs of employees so engaged.

(6) Provision for loss of productive time of technical employees between assignments, and for time of principals and employees on public interest assignments.

g. The engineer who performs services under a cost-times-a-multiplier contract must make provision for the accounting work necessary to segregate and record the expenditures thereon. He must maintain detailed time records for all principals, partners, and technical employees who devote time to the work, and any part of whose salaries is included in direct cost. His applicable payroll records should be open for inspection or audit by the client or the FAA. The engineer should be prepared to support the basis for his overhead charges.

h. Payments on these bases should be made to the engineer at stated times during the execution of the work, within a reasonable period of billing.

24. COST PLUS A FIXED PAYMENT.

a. For many engineering projects, the engineer is required to start work before the cost and scope of the project can be accurately determined. Such indeterminate projects generally result from requirement for speed, special problems which require studies, research or experimental work, preparation of estimates for alternate types of construction, and other requirements. The contract, however, should carry a general description or statement of the scope of work contemplated; that is, the number, size, and character of airport facilities, the extent of related elements, and any other items.

b. For this type of project, the cost-plus-fixed-payment method offers a satisfactory basis for performing the service. Under the cost-plus-fixed-payment contracts, the engineer is reimbursed for the direct costs of all his services and supplies, including the following:

(1) Salary Cost. As previously defined.

(2) Overhead. As previously defined.

(3) Direct Nonsalary Expenses. As previously defined.

(4) Fixed Payment. In addition to reimbursement for salary, direct costs and overhead, the consulting engineer is paid a fixed amount for contingencies, interest on invested capital, readiness to serve, and profit. This may be an amount based on the estimated cost of the project at the time the engineer is engaged. The fixed payment usually ranges from four percent of the agreed-upon estimate of construction costs for projects of small or moderate size, to as low as 3/4 of one percent on very large projects. The fixed payment also varies with the scope of the engineering services involved. The cost-plus-fixed-payment basis of compensation requires, as a prerequisite to equitable negotiation, that the scope of the project itself to be fairly well defined and that the services to be performed by the consulting engineer be fully set forth in the agreement. Such agreements should also provide for appropriate adjustments in the fixed payment in the event that the physical scope of the project, time for completion, or the services required are materially increased over that contemplated during the negotiations.

25. FIXED LUMP-SUM PAYMENT.

a. This method of compensating engineers for basic services is frequently being used and is rapidly replacing the "percentage-of-cost" method, for reasons discussed in paragraph 26 below.

b. The fixed amount of compensation is developed by estimating the individual elements of the engineering cost outlined in the foregoing paragraph 23, plus a reasonable margin of profit, all expressed as a single lump sum. A lump-sum proposal should be accompanied by the engineer's detailed estimate. The estimate shall detail the direct labor cost by categories of employee, manhours, and hourly rate; overhead on labor costs; general and administrative overhead; materials and supplies; travel; other costs; and profit or fee times complexity factor.

c. The lump-sum method of establishing the engineer's compensation is suitable only when the scope of the assignment to be undertaken can be clearly and fully defined.

d. Where consultation is undertaken on a lump-sum basis, the agreement should contain a clearly stated time limit during which the services will be performed, and a provision for additional compensation for time in excess of that stated. In design assignments, there should be a provision for changes required after the approval of preliminary designs, with a clear understanding as to where the final approval authority lies.

e. Payments on this basis should be made to the consulting engineer at stated times (usually once a month) during the execution of the work.

26. PERCENTAGE OF CONSTRUCTION COSTS.

a. Contracts providing that the compensation is to be based on a prescribed percentage of estimated or actual construction cost should be subjected to extremely careful scrutiny. This method was commonly used in years past for determining the compensation of engineers on assignments where the principal responsibility was the design of various works and the preparation of drawings, specifications, and other contract documents necessary for the description of facilities to be constructed.

b. Over the years, it was said that engineering experience had established some approximate correlations between engineering costs and construction costs for certain types of engineering design, particularly where design procedures and materials of construction were more or less standardized. These correlations have resulted in publication of various curves and schedules which have been widely used--so much that they are sometimes regarded as fixed

bases of compensation for design projects of any kind. Such curves and schedules should be used only with extreme caution and then only for rough approximations and only when the user is otherwise professionally qualified to develop engineering cost estimates.

c. The validity of the percentage-of-construction-cost method rests upon the assumption that engineering costs vary in direct proportion to the cost of construction, irrespective of the location or type of construction undertaken. However, this is a questionable assumption for three reasons. First, engineering costs are largely technical "brain-power" costs. Today, engineering requires more manhours of highly paid talent for a given assignment than was required several years ago when many of the modern materials, methods, and automatic devices were not regarded as necessary to an average project. Second, the construction cost of many types of engineering projects, notably in the airport, highway, hydroelectric, and other heavy construction field, has not increased at the same rate as the cost of competent engineering, largely due to extensive mechanization of construction operations. Third, engineering efforts can vary widely as to time and effort involved in design or construction supervision and inspection yet have similar construction costs.

d. It is apparent, for example, that usually the design cost for a pavement overlay will be minimal as compared to the construction cost. In contrast, the design cost for a project involving soils investigation, grading, drainage, paving, and turfing would be more costly and have a ratio of design cost versus construction cost very different from that for the job limited to pavement overlay.

e. The modern tools of engineering, such as electronic computers, electronic surveying, photogrammetry, and the latest methods of reproduction, have made it possible for the consulting engineers to develop more efficient designs which result in lower overall construction costs to the client, but they have not reduced the cost per manhour of engineering work, nor have they offset the increasing number of manhours required for acceptable engineering work as measured by modern standards.

f. In view of this disparity, there is now a tendency to negotiate compensation on the basis of detailed manhour costs rather than by rigid adherence to published schedules and curves based solely on a percentage of construction cost. For similar reasons, some agencies of government now require contracts for consulting engineering services to be negotiated on a lump-sum basis as described above.

g. This is not to imply that these assumed relationships between engineering costs and construction costs are no longer of value. When judiciously and professionally applied, and with due consideration of the ranges within which engineering scope may vary, they remain as tools for general comparison with lump-sum or salary-plus-multiplier charges for basic services as described in paragraph 6.

27. LEVEL OF ENGINEERING COMPENSATION.

a. Many design assignments are negotiated by means of two or more of the foregoing methods of compensation. Quite frequently, the preliminary phase of the assignment may be undertaken for a fixed lump sum, especially where the resultant report may be required to establish the project's feasibility or where the preliminary phase will involve planning for deferred stages of construction. Following that, the design and construction phases may be accomplished under a cost-plus-fixed-payment type of compensation.

b. The curves presented in figures 1 and 2 represent median compensation, computed as a percentage of construction cost, developed from responses to questionnaires sent out by the ASCE. The original data was developed in 1963; the curves presented here are as revised in 1971 and published in 1972. Obviously, the appropriate compensation for a given assignment may vary well above or below these curves, depending on the various factors which have been discussed in the foregoing paragraphs. We repeat that curve data should be used only with caution and only under the circumstances noted above in paragraph 26. These curves afford compensation only for the basic services outlined in paragraph 6.

c. The special services, described in paragraph 7, may add substantially to the local engineering cost of the project. These special services are furnished either directly by the client, by the primary engineering firm, or by a firm specializing in such work usually on the basis of salary cost times a multiplier. For special services, the multiplier varies from 2.0 to 3.0, except for field staff employed for the purposes of the assignment, where the multiplier may be as low as 1.90. Direct nonsalary costs for special services are reimbursed at invoice cost.

d. Curve A in figure 1 is intended to apply to assignments of which the following are typical examples:

(1) Airports with extensive terminal facilities.

(2) Water, sewer, and industrial waste treatment plants.

(3) Bridges which are asymmetric or are otherwise complicated.

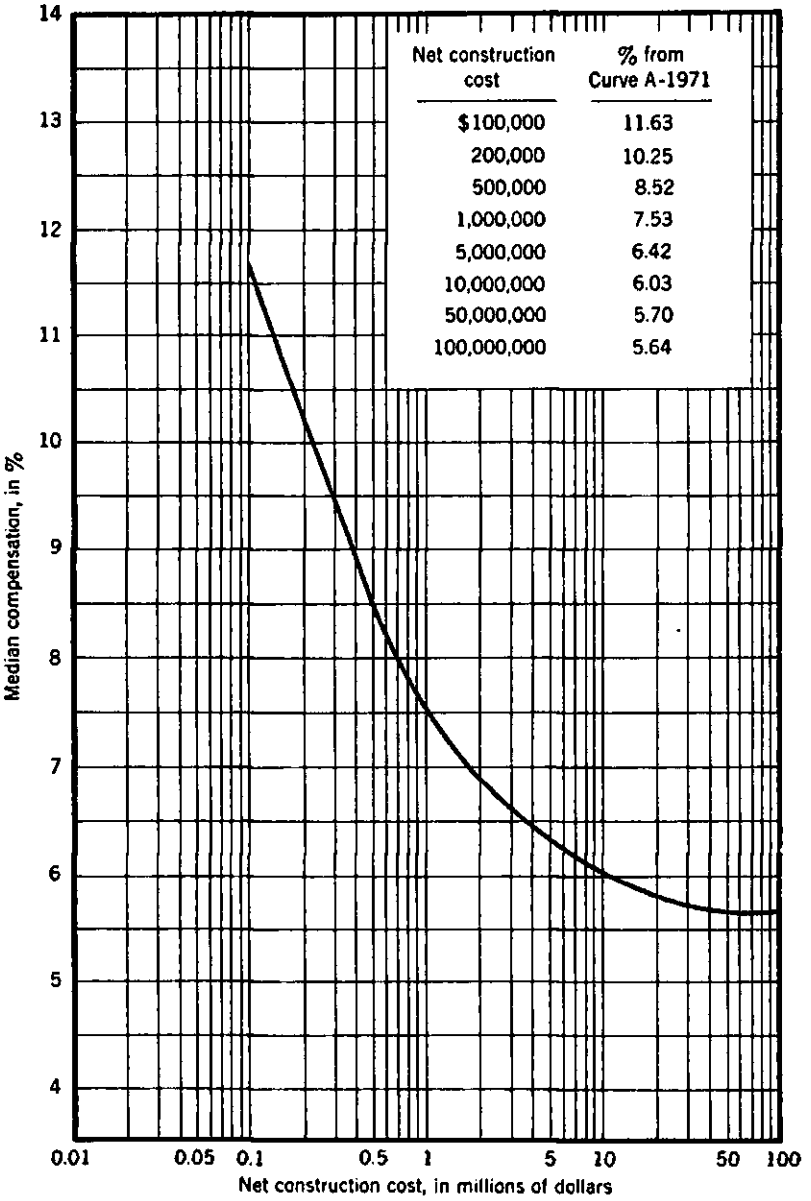

FIG. 1.—CURVE A, MEDIAN COMPENSATION FOR BASIC SERVICES EXPRESSED AS A PERCENTAGE OF CONSTRUCTION COST FOR PROJECTS OF ABOVE-AVERAGE COMPLEXITY (1971)

ASCE Manual No. 45 (1972)

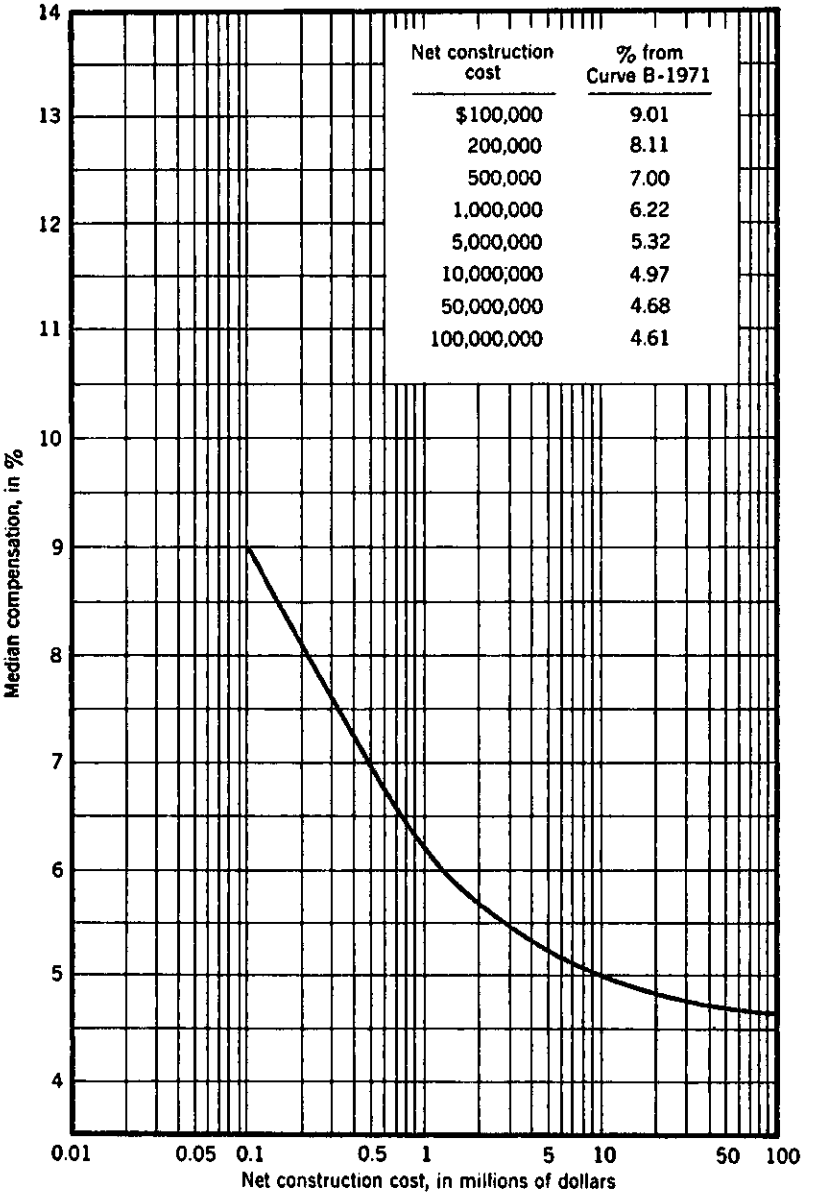

FIG. 2—CURVE B, MEDIAN COMPENSATION FOR BASIC SERVICES EXPRESSED AS A PERCENTAGE OF CONSTRUCTION COST FOR PROJECTS OF AVERAGE COMPLEXITY (1971)

ASCE Manual No. 45 (1972)

(4) Access roads.

(5) Highway and railway tunnels.

(6) Pumping stations.

(7) Large intercepting and relief sewers.

(8) Sanitary sewer lines under 24 inches in diameter.

(9) Water distribution lines under 16 inches in diameter.

(10) Foundations.

(11) Additions to or reconstruction of projects classified in Curve B on figure 2.

e. Curve B in figure 2 is intended to apply to less complex assignments of which the following are examples:

(1) Industrial buildings, warehouses, garages, hangars, and comparable engineering structures.

(2) Bridges and other structures of conventional design.

(3) Less complex access roads.

(4) Conventional levees, flood walls, and retaining walls.

(5) Sewer and water tunnels (free-air).

(6) Storm sewers and drains.

(7) Sanitary sewer lines 24 inches and larger.

(8) Water distribution lines 16 inches and larger.

(9) Airports except as classified for Curve A.

f. The curves in figures 1 and 2 represent median compensation for the three phases of the basic services described in paragraph 6. For the purpose of establishing charges for the separate phases, the following range of allocations is applicable:

(1) Preliminary Phase--up to 40 percent of basic compensation.

(2) Design Phase--up to 80 percent of basic compensation.

(3) Construction Phase--up to 20 percent of basic compensation.

Partial payments for the preliminary and design phases usually are made at monthly intervals based on monthly statements submitted by the engineer. Partial payments in the construction phase are made monthly,usually on the basis of contractor's monthly estimates. Charges for special services are usually billed on a monthly basis. On small projects, the engineer may prefer to bill upon completion of each phase or on some similar basis.

g. Some state societies of professional engineers have published ranges of compensation based on percentage of construction cost. These, like the ASCE curve data, should be used with extreme caution and with recognition of the date they were developed.

h. Whether accomplished under "consultation and reports" or as a part of "special services," contracts for surveying should be negotiated for in the same manner as for other engineering services. The most satisfactory method for compensation is salary cost times a multiplier plus direct nonsalary expense. The multiplier may vary between 2.0 and 3.0. If substantial knowledge of the scope of the work is available plus experience in similar projects, then the fixed lump sum method may be used.

i. Because of high initial and maintenance costs, electronic distance-measuring devices are usually handled as a separate cost item. For example, a charge of $45 to $75 per day is usual for a piece of equipment costing about $6,000 (1968).

28. TIME OVERRUNS BEYOND CONTROL OF THE ENGINEER. Frequently the engineer is called upon to continue technical inspection services on construction contracts overrunning the program schedule contemplated at the time of negotiation of the engineer's compensation. In most instances, the time element is beyond the control of the engineer. To provide for the contingency of overrun of time, the agreement between the client and the engineer should state the period for which the percentage or fixed compensation shall apply and that the engineer shall be reimbursed for services in excess of the specified period of time at an agreed cost or at salary cost times a multiplier plus expenses, as agreed on at the time the engineer's contract is negotiated. An agreement for such reimbursement assumes that the construction contract includes liquidated damages to be paid by the construction contractor for overrunning the contract time. The amount of reimbursement should be related to the liquidated damages level.

29. OWNERSHIP OF DRAWINGS AND CONTRACT DOCUMENTS.

a. Original documents, such as tracings, plans, specifications and maps prepared or obtained under the terms of the contract shall be delivered to and become the property of the client and basic survey notes and sketches, charts, computations and other data shall be made available upon request to the client without restriction or limitation on their use. In the event any of the above documents are reused by the client, the name plates will be removed and the consultant will be released and held harmless of subsequent liabilities.

b. When a contract is for preliminary plans only, no commitment should be stated or implied that would constitute a limitation on the subsequent use of the plans or ideas incorporated therein for preparation of construction plans.

30. TOTAL COST OF ENGINEERING VS. PROJECT COSTS. On new projects, before construction begins and before the engineer has been directed to proceed with detailed contract drawings and specifications, the client is concerned with the probable total cost of the project. He will request the engineer to make an engineering report on the project, including a preliminary estimate of the project cost, fully realizing that because the engineer has no control over the cost of labor and materials or competitive bidding he cannot guarantee the estimate.

a. Information in the hands of the engineer after the completion of his report is not sufficient to enable him to make an estimate of construction cost which is equal in accuracy to the bid a contractor makes after his study of the detailed contract drawings and specifications. To the engineer's preliminary estimate, therefore, must be added an allowance for contingencies. These contingencies may include undisclosed conditions of foundations and construction, extra quantities of materials, larger and heavier equipment, inflation, and other items increasing the cost of construction.

b. The item of contingencies varies with the degree of completeness of the engineer's report. Usually, it should be included in preliminary estimates from 10 percent to 15 percent of the engineer's construction cost estimate.

c. To the estimated cost of construction plus contingencies should be added provision for engineering, legal, administrative costs, and land costs.

d. After contingencies and engineering, legal, administrative, and land expenses have been added to the estimated cost of construction,

it may be necessary for the client and the engineer to consider the cost of financial advice, printing of bonds, discount of bonds, etc. Expenses incurred in raising project funds, including administrative expenses involved in bond referendums, the sale of bonds or premium or interest on bonds, or loans, are not eligible project expenses under ADAP.

APPENDIX 1. BIBLIOGRAPHY

1. Federal Aviation Regulations (FAR) Part 152, Airport Aid Program, (FAR Volume X) for sale by the U.S. Government Printing Office, Washington, D.C. 20402, price $4.50. Make check or money order payable to the Superintendent of Documents; no c.o.d. orders are accepted.

2. Airport and Airway Development Act of 1970, Public Law 91-258, 91st Congress, H.R. 14465, 21 May 1970; Amendment to the Airport and Airway Development Act, Public Law 92-174, 92nd Congress, H.R. 7072, 27 November 1971, price $0.20 and $0.05 respectively, available from the U.S. Government Printing Office (address as shown in paragraph 1 above).

3. Consulting Engineering, A Guide for the Engagement of Engineering Services, American Society of Civil Engineers (ASCE), available from Headquarters of ASCE, United Engineering Center, 345 East 47th Street, New York, New York 10017, price $1.00.

4. Guide for Professional Engineer's Services, by Professional Engineers in Private Practice, National Society of Professional Engineers (NSPE), available from NSPE, 2029 K Street, N.W., Washington, D.C. 20026, at no cost.

5. Several State Societies of Professional Engineers publish guides for the engagement and reimbursement of consulting engineering services (available from the individual state societies at modest cost).

6. AC 150/5300-3, Address List for Regional Airports Divisions and Airports District Offices, available free of charge from the Department of Transportation, Distribution Unit, TAD-484.3, Washington, D.C. 20590.

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ADVISORY CIRCULAR

ENGINEERING SERVICES UNDER THE AIRPORT DEVELOPMENT AID PROGRAM (ADAP)

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

Initiated by: AS-580

AC NO: 150/5100-9

DATE: 1 JUL 72

ADVISORY CIRCULAR

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

SUBJECT: ENGINEERING SERVICES UNDER THE AIRPORT DEVELOPMENT AID PROGRAM (ADAP)

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1. PURPOSE. This advisory circular provides guidance for airport sponsors and Federal Aviation Administration (FAA) offices in the definition, selection, review, and approval of engineering services used under the Airport Development Aid Program (ADAP).

2. REFERENCES. The publications listed in Appendix 1, Bibliography, provide further guidance and detailed information.

3. HOW TO OBTAIN THIS PUBLICATION. Obtain additional copies of this Advisory Circular (AC) 150/5100-9, Engineering Services Under the Airport Development Aid Program (ADAP), from the Department of Transportation, Distribution Unit, TAD-484.3, Washington, D.C. 20590.

Clyde W. Pace, Jr.

CLYDE W. PACE, JR.
Acting Director, Airports Service

Initiated by: AS-580

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CHAPTER 1. INTRODUCTION

1. BACKGROUND. It is in the best interest of all concerned to obtain qualified engineering services. It is also essential to obtain such services at a fair and reasonable cost together with timely, complete, and acceptable performance. Federal Aviation Regulations (FAR) Part 152.51(f) includes requirements that:

   a. All contracts for engineering services and force account proposals for such services in connection with Federal grant airport projects be submitted to FAA for approval before execution of a new, or extension of an existing contract, or before performance of force account services.

   b. FAA approval applies to any project for airport development under ADAP.

2. DEFINITIONS.

   a. The term "engineers" refers to the individual, firm, or consultant engaged to do the engineering work. It is recognized that architectural services may be needed on some projects; the term "engineer" or "consultant" includes such services in the context of this advisory circular. Architectural fee information is, however, not included here but may be obtained from the source mentioned in the Bibliography as Item 8.

   b. The terms "primary engineer" and "principal consultant" refer to the individual or firm held responsible for the overall performance of the engineering work including that accomplished by others under special services type contracts or contracts with specialists.

   c. The term "client" refers to airport sponsors or airport owners.

   d. The term "force account" refers to accomplishment of engineering work by the sponsor's own personnel or by its agent.

3. INTENT. It is the intention of this advisory circular to:

   a. Provide guidance for attaining the objectives and requirements of paragraph 1.

   b. Include comprehensive guidance on engineering functions, types of services offered, acceptable bases for compensation, and procedure for selection of engineers.

   c. Realize that guidance should lead to proper conception and design of the work as well as appropriate, economic construction and supervision and inspection thereof.

d. Note that success is dependent upon complete understanding between the engineer and his employer and that appropriate consideration of the elements covered herein will help develop such understanding.

e. Recognize that some types of engineering common to airport engineering are unique and therefore should be specifically identified as a part of the required services.

f. Acknowledge that engineers should be engaged on the basis of their qualifications, experience, and availability.

g. Require that compensation be based on negotiations. Conversely, competitive bidding is considered unsuitable and unethical.

h. Note that FAA offices stand ready to advise and assist in the obtaining and development of engineering services under ADAP.

CHAPTER 2. TYPES OF ENGINEERING SERVICES.

4. GENERAL. There are three major categories of engineering: consultation and reports, basic services, and special services. Most airport engineering falls either in basic or special services; however, there is an occasional need for a feasibility investigation so we have included coverage on "consultation and reports" (for that exception and in the interest of completeness).

5. CONSULTATION AND REPORTS. These services generally involve collecting, interpreting, and reporting information, together with drawing conclusions and making recommendations.

   a. Direct Personal Service. Usually involves assisting in the preparation of legal proceedings, appearances before courts or commissions to state opinions and conclusions as an expert witness, and investigations of technical matters. This classification does not include preparation of working or construction drawings nor does it include responsible inspection of construction work.

   b. Preliminary and Feasibility Investigations, Site Selection, Cost Studies, and Economic Comparisons. These services may precede the authorization of a project and may involve extensive investigations, analysis of conditions, and comparisons of several possible plans. Such studies may include operating costs, financing considerations, and expected revenue as bases for conclusions and recommendations regarding the advisability of undertaking a project. May involve environmental or ecological studies.

   c. Appraisals, Valuations, and Rate Studies. These services may include investigations and analyses of conditions, capital and operating costs, overhead, financial costs, and revenues leading to property valuations or to recommendations for the establishment of prospective rates.

   d. Assistance in Financial Matters. The engineer may be asked to advise his client as to sources of capital and possible Federal aid. He may estimate operating costs, interest and debt retirement, and probable income from the project. He may also act as agent to certify that the terms and conditions of bond issues are carried out. This may include preparation of a request for aid and supporting estimates and sketches.

   e. Management and Production Engineering. These services comprise studies of management, production, labor relations, time studies, and similar activities that are carried out for the client.

   f. Inspection or Testing of Apparatus and Equipment.

g. Operational Services. Upon completion of construction, the engineer may be responsible for start-up of operations on the project. He may be required to establish an efficient operating staff, set up job classifications and salaries, etc.

h. Surveying and Mapping. There are four major categories; i.e., land, engineering, geodetic, and cartographic surveying. Although some coverage is given below to each category, airport engineering usually includes only land or engineering surveying.

(1) Land surveying includes the determination of the location of land boundaries and land boundary corners; the preparation of maps showing the plan figures formed by the boundaries; the determination of the areas of land contained therein; and the preparation and interpretation of land descriptions for incorporation in deeds, leases, and other related documents.

(2) Engineering surveying includes the development of design data, such as horizontal and vertical control, the plotting of culture and topography, and the development of profiles and cross sections for the study and selection of sites or alignment for engineering construction. It also includes the layout of facilities and structures, quantity and measurement determinations, and "as built" and utility surveys.

(3) Geodetic surveying includes the extension of high-order horizontal and vertical control surveys; the determination of astronomic latitudes, longitudes, and azimuths; and of the intensity of gravity.

(4) Cartographic surveying includes the establishment, computation, and adjustment of control surveys of the order required by the detail and scale of the map being made; the extension of control by aerotriangulation; the preparation of the manuscript by field and/or photogrammetric surveys; and the field inspection and field editing of the manuscript.

6. BASIC SERVICES.

a. General. These services cover engineering practice in which design and development work is done. They differ from "consultation and reports" in that engineering design, working drawings, specifications, and other similar documents are developed. These services, however, are usually based on a prior study of project requirements and feasibility.

THESE SERVICES DO NOT INCLUDE THE DETAILED RESIDENT INSPECTION OF CONSTRUCTION WHICH MAY BE FURNISHED SEPARATELY. The basic services usually required on airport development projects, and where both design and inspection of construction are required, are accomplished in three distinct and sequential phases as follows:

(1) The preliminary or "report phase".

(2) The design phase.

(3) The construction phase.

b. The Preliminary Phase. This phase of project development establishes the general size and scope of the project, and its location on the site. The basic services may include the following:

(1) Conferences with the client to review his wishes and requirements, inspection of the site, review of available material assembled by the client, and discussion of scheduling. Conferences also may be held with various approving and regulatory agencies including the FAA and with those utility companies affected.

(2) Planning for and assisting the client in procuring the necessary surveys and other field investigations.

(3) Preparation of preliminary engineering studies and designs. These will be submitted for review and approval by the client and others.

(4) Preparation of preliminary layouts, sketches, outline specifications and reports, where applicable, and the engineer's specific recommendations.

(5) Preparation of preliminary cost estimates of the project.

c. The Design Phase. This phase of project development is usually undertaken only after approval by the client of the preliminary design, report, and estimate. The basic services may include:

(1) Detailed conferences with the client and approval of regulatory authorities.

(2) Planning for and assisting the client in procuring the necessary field information for design. This information may include field surveys, photogrammetry, traffic studies, soils investigations, noise, land use, or other special studies. Such field information is normally furnished by the client or through the engineer for the client's account.

(3) Preparing engineering data, where necessary, for regulatory permit applications required by local, state, or Federal authorities.

(4) Preparation of engineering report.

(5) Preparation of plans and specifications, contract documents, and detailed estimates.

(6) Furnishing the client a specified number of copies of drawings, specifications, and other contract drawings for final review by client and approving authorities.

d. The Construction Phase.

(1) Office Engineering.

(a) Assistance to the client in securing bids, tabulation and analysis of bid results, and furnishing recommendations on the award of construction contracts.

(b) Assistance in the preparation of formal contract documents for the award of contracts.

(c) Consultation and advice to the client during construction.

(d) Preparation of elementary sketches and supplementary sketches required to resolve actual field conditions encountered.

(e) Checking detailed construction, shop, and erection drawings submitted by contractors for compliance with design concept.

(f) Reviewing, analyzing, and approving laboratory, shop, and mill test reports of materials and equipment.

(g) Preparing "as built" drawings based on information provided by the resident engineer.

(2) Field Engineering.

(a) Making periodic inspections of work in progress, and providing appropriate reports to the client (does not include resident inspection).

(b) Inspecting initial operation of the project or of performance tests required by specifications.

(c) Making a final inspection and report of the completed project with the client or his representative.

(d) Preparation and negotiation of change orders and supplemental agreements.

(e) Represent the sponsor in the preconstruction conference.

(3) Office and Field Engineering. Reviews progress of contractor, acceptability of materials, construction methods, and resident inspection.

7. SPECIAL SERVICES. The development of some projects may involve studies outside the scope of the basic design services of the engineer. Many of these studies relate to decisions of management as to the feasibility, scope, and location of a project. The research, assembling of engineering data, and acquisition of property may involve many professional specialists other than the primary engineer or principal consultant. Because special services vary greatly in scope, complexity, and timing, they are normally negotiated when required as separate elements of service. These services are often negotiated by the primary engineer acting on behalf of his client. In any case, the relationship should be specified as to authority and responsibility of the primary engineer versus those providing special services. Included in special services may be:

a. Soils investigations--including test borings, related analyses, and recommendations.

b. Detailed mill, shop, and/or laboratory inspection of materials and equipment.

c. Land surveys, establishment of boundaries and monuments, and related office computations and drafting.1/

d. Field surveys, photogrammetry, and field layouts of construction. Construction layout control staking and pay-quantity surveys are to be done by engineers in the employ of the airport sponsor and should not be done by the construction contractor. Usually sufficient surveys shall be accomplished by the engineer to avoid requiring the construction contractor to do staking or surveying. Local practices may have the engineer establishing bench marks and base lines and the contractor doing the balance of the staking, however, the engineer should then spot check the contractor's stakes.

1/ Some primary engineering or principal consulting firms are not equipped to do surveying or the size of the surveying effort is beyond their capability. Accordingly, surveying is listed under "consultation and reports" as well as here, thus recognizing that "special services" or firms specializing in surveying may need to be engaged.

e. Technical inspection of construction by a full-time resident engineer or inspector and supporting staff, as required, who will also:

(1) Review and approve requests for monthly and final payments to contractors.

(2) Issue certificates of completion to the client or primary engineer on completed construction contracts.

(3) Provide "as built" information to the primary engineer for preparation of "as built" drawings of the completed project.

(4) Supervise testing and inspection. Arrange for, conduct, or witness field, laboratory, or shop tests of construction materials as required by the plans and specifications; determine the suitability of materials on the site and brought to the site to be used in the construction; interpret the contract plans and specifications and check the construction activities to assure compliance with the intent of the design; measure, compute, or check quantities of work performed and quantities of materials in-place for partial and final payments to the contractors; and maintain diaries and other project records to document the work.

f. Additional copies of reports, contract drawings, and documents above the specified number furnished in the basic services.

g. Extra travel and subsistence for the engineer and his staff beyond that normally required under basic circumstances when authorized by the client.

h. Assistance to the client as expert witness in litigation arising from the development or construction of the project.

i. Investigation involving detailed consideration of operation, maintenance, and overhead expenses; and the preparation of rate schedules, earnings, and expense statements; feasibility studies; appraisals; valuations; and material audits or inventories required for certification of force account construction performed by the client.

j. Preparation of applications and supporting documents for Government grants or advances for airport projects.

CHAPTER 3. PROCEDURE FOR SELECTION OF THE ENGINEER.

8. GENERAL.

a. Many governmental agencies, as well as private bodies and industries, have developed procedures for the selection of engineers. This chapter outlines the procedures as a general guide in this important decision.

b. No two engineering firms have equal training, experience, skills, capabilities, personnel, workloads, and particular abilities. Selection of the firm for a specific project can mean the difference between a well-planned, low cost, successful project or a mediocre and costly one.

c. Engineers should be engaged on the basis of their qualifications and experience and their compensation should be based on negotiations. Competitive bidding is not suitable for engineering work. The client that "buys" engineering services by competitive bids has no realistic basis on which to compare the value of what he will get.

9. SELECTING ORGANIZATION.

a. Within the sponsor's organization, an administrative policy should be established for designating persons authorized to select or recommend engineers for various assignments. The persons designated may include the administrator, or the department head, to be supplemented by others to make up a selection board. The person empowered to make the selection must be kept free of pressures, both internal and external.

b. In most cases, the most satisfactory procedure would be to utilize a board of three men, at least one of whom should be an engineer. The board should be appointed to investigate and make recommendations, holding such interviews and inquiries as they feel may be desirable. The final selection should be by the administrator or governing body of the sponsor based upon recommendation by the board.

10. POLICY FOR SELECTION. The sponsor should establish administrative policy for selection, in line with his own best interest and that of the public. For example, it may be desirable, where qualifications and other elements are satisfactory, for priority to be given to a local engineer. Other basic requirements which should be established as policy are:

a. The firm should be of high ethical and professional standing, its members being of good moral character, and it should be prepared to submit references from persons of known repute.

b. The firms being considered should be advised that they shall be required to comply with state/local requirements for registration as professional engineers and any other statutory requirements.

c. A principal member of the firm's staff must have recent experience in responsible charge of airport engineering work of the type involved in the project or similar engineering work. For the purpose of this chapter, "responsible charge" should be construed as having definite responsibility for engineering work of substantial importance.

11. DATA AS BASIS FOR SELECTION. Engineers interested in an engagement should disclose complete information on their qualifications. In addition to the specific data requested, they may wish to submit their own brochures with photographs and general background data. If airport lighting or other electrical work is contemplated, the engineer's qualifications should include qualifications for such work.

12. PROCEDURE. The sponsor should study the proposed project and its engineering needs so that his board knows what is required from and expected of the engineer. If the sponsor has previous experience with an engineer who has in the past rendered satisfactory services, he may consider it unnecessary to go through the procedure outlined herein. Otherwise, the board should proceed as follows:

a. Consider the qualifications of engineers who appear to be capable of meeting the requirements of the project. The names of engineering consultants may be obtained from the Professional Services Directory of the Civil Engineering Magazine published by ASCE, Directory of Engineers in Private Practice by NSPE, from the American Institute of Consulting Engineers; from the individual State Board of Registration; and from the telephone directory under Engineers-Civil or Engineers-Electric or Engineers-Consulting.

b. Consider at least three firms that appear to be best qualified for the particular project. Write separate letters to each of them describing briefly the proposed project and inquiring as to their interest. On receipt of an affirmative answer, request the firm to appear for a separate personal interview. In the case of design projects, give the engineer an opportunity to inspect the site explaining to him the proposed services required. At the interview, go over the qualifications and records of that firm, its capability to complete the work within the time allotted, and the specific key personnel assignable to the project, and the qualifications of personnel to be assigned.

c. Check carefully with recent clients of each firm and determine the quality of performance. Do not limit this check to references specified by the consulting firm. Ineptitude in designing, supervising, inspecting, testing, or recordkeeping may be grounds for considering the performance unacceptable. Similarly, delay in completion of the plans, specifications, or construction should be considered telling factors.

d. List the three firms in the order of their desirability, taking into account their location, reputation, experience, financial standing, size, personnel available, quality of references, workload, and any other factors peculiar to the project being considered.

e. Invite the firm that is considered to be the best qualified to appear for a second interview to discuss the project further and to negotiate the questions of compensation.

f. The compensation requested by the engineer may be checked against the guidelines outlined in this advisory circular as well as with other employers of engineering services. If agreement is not reached, the negotiations should be terminated and the engineer notified in writing to that effect. A similar interview should then follow with the second firm, and failing accord with the second firm, the third should be called in for negotiations. Such a procedure will usually result in a mutually satisfactory contract. All such negotiations should be on a strictly confidential basis, and in no case should the compensation discussed with one engineer be disclosed to another.

g. When all engineering matters, and the charges therefore, have been agreed upon:

   (1) The selected firm may submit a proposal by correspondence for undertaking the project for acceptance.

   (2) The parties should draft a formal contract, embodying all conditions and charges, for signature by both parties.

h. The proposal or draft contract should be submitted to the responsible FAA office for review and approval prior to its execution. AC 150/5000-3 is a list of FAA offices to which the proposal or draft contract should be submitted. These offices also stand ready to advise and assist at any other stage of the process.

i. Upon approval of the proposal or draft contract and execution of the contract, all other firms who have submitted qualifications should be notified that the selection has been completed.

j. Some contracts may have been executed between the time of passage of the Airport and Airway Development Act of 1970 and issuance of this advisory circular. Such contracts should be reviewed against the recommendations herein and supplemented or changed as necessary.

k. Just as steps are taken in the process of selection to assure that engineering to be accomplished by contract will be acceptable, timely and financially prudent; so should steps be taken to assure that engineering to be done by force account also meets such aims. Accordingly, the FAA will require that proposals to do the engineering work by force account be submitted in writing and FAA approval be obtained prior to start of any of the work. The proposal shall include, as a minimum:

(1) Names and engineering qualifications of personnel performing the work and reference to capability for design, supervision, inspection, testing, etc., as applicable.

(2) Details of experience with airport engineering of like or similar nature.

(3) Information on workload as it affects capacity to do the work with reference to date by which work will be complete or dates within which it will take place.

(4) Justification for doing the work by force account rather than by contract.

(5) Estimate of cost with details as to manhour rates and nonsalary expenses.

CHAPTER 4. CONTRACTS FOR ENGINEERING SERVICE.

13. ESSENTIALITY.

a. The relations of the engineer with his client should be clearly defined by a written instrument before commencement of actual work. All of the terms should be clearly defined in the agreement. It should state the parties to the contract and define the complete extent and character of the work to be performed, as well as conditions relating to any time limitations which may be involved. The terms and payments for various services should follow. The scope of the engineering effort should be described in complete enough detail to determine the sufficiency of supervisory and inspection staff and to determine whether some services will need to be otherwise contracted for or be provided by the client.

b. The right of either party to terminate the contract prior to its completion should be clearly stated. Otherwise, it should be stated that agreement will continue to completion. Engineering contracts frequently contain a unilateral termination clause whereby the client may terminate the agreement at any time he is dissatisfied with the services of the consulting engineer, subject, of course, to appropriate notification and payment for services already performed. The justification for such an arrangement is that the proper rendering of professional services demands an environment of mutual confidence between client and engineer.

c. Engineering contracts usually cover highly technical services. Therefore, to assure the soundness of a legal document, it is essential that someone who is thoroughly conversant with the practice of consulting engineering prepare the sections describing services to be performed, sequence of work, information to be furnished by the client, and terms of payment.

14. FORM OF CONTRACT.

a. Many government agencies, business firms, and engineering organizations have developed standardized forms for engineering contracts. The Consulting Engineers Council, the National Society of Professional Engineers, the American Society of Civil Engineers, and the American Road Builders' Association have developed such standardized forms. The American Institute of Architects has standardized forms for architectural contracts.

b. It is recommended that engineering contracts be written to apply to only one project, because continuing contracts do not provide the sponsor with the option to consider whether the services were completely satisfactory. Also, charges must be assigned to a specific project and continuing contracts usually make such assignment difficult. This is not to say that retainer contracts are not useful; however, retainer types are used for intermittent work over protracted periods and, thus somewhat inappropriate for the usual airport engineering work. If continuing type contracts were entered into prior to FAA review and approval, FAA will still require submission for review and may require that the contract be supplemented or changed. Some revenue bond issues require engineering services on a continuing basis and changing firms require formal action; consequently, a continuing contract or retainer type is used. When such types are required, the sponsor should stipulate: that each project or work assignment will require separate authorization; that separate records are to be maintained for each assignment for cost accounting purposes; and that the sponsor is not obligated to use the same consultant for services outside the terms of the bond issue resolution or trust indenture.

15. CONTRACT PROVISIONS. The following checklist contains the essential provisions to be considered in preparing any agreement for engineering services:

a. Effective date of agreement.

b. Names and descriptions of the parties to the agreement with their addresses and, in the case of a corporate body, the legal description of the corporation.

c. Acknowledgment of the engineer's visit to site of the project and interview with the client.

d. Nature, extent, and character of the project, the location thereof, and the time limitations.

e. Services to be rendered by the engineer. (Include here the applicable services required from Chapter 2, Types of Engineering Services.) Contracts shall be modified or supplemented whenever significant changes to the scope of the work are required. The engineer shall perform the required services with his own organization and those of his associates but may employ, with the consent of the client, specialized services for such items as surveying, boring, soil testing, aerial surveying, and such work or services normally provided to engineers by others.

f. Services to be rendered by the client. (Include here the applicable services required from Chapter 2, Types of Engineering Services).

g. Statement that design drawings and specifications become the property of the client.

h. Provisions for the termination of the engineer's services before final completion of his work.

i. Compensation for services rendered by the engineer, including times and methods of payments on account, interim payments, and final payment in full settlement (see Chapter 5). Conversely, renegotiation of compensation should be allowed if some services are not required because of changed conditions.

j. Emphasis on timeliness of requests for payment and payment itself.

k. Additional compensation for redesign, after approval of preliminary plans, for change in scope of project, for delays causing expense to the engineer, etc.

l. Time schedule for execution of engineering services.

16. CERTIFICATION OF ENGINEER. All contracts shall include a certification executed by the consultant and reading as follows:

AIRPORT DEVELOPMENT AID PROJECT _____

STATE _____

CERTIFICATION OF ENGINEER

I hereby certify that I am the ____(title)____ and duly authorized representative of the firm of _____, whose address is _____, and that neither I nor the above firm I here represent has:

(a) employed or retained for a commission, percentage, brokerage, contingent fee, or other consideration, any firm or person (other than a bona fide employee working solely for me or the above consultant) to solicit or secure this contract,

(b) agreed, as an express or implied condition for obtaining this contract, to employ or retain the services of any firm or person in connection with carrying out the contract, or

(c) paid or agreed to pay to any firm, organization, or person (other than a bona fide employee working solely for me or the above consultant) any fee, contribution, donation, or consideration of any kind for, or in connection with, procuring or carrying out the contract; except as here expressly stated (if any):

I acknowledge that this certificate is to be furnished to the Federal Aviation Administration of the United States' Department of Transportation, in connection with this contract involving participation of Airport Development Aid Program (ADAP) funds and is subject to applicable state and Federal laws, both criminal and civil.

_____(date)_____ _____(signature)_____

17. AIRPORT ENGINEERING. It should be realized that airport engineering may involve types of engineering or dimensions which are somewhat distinctive or peculiar to such engineering. Such recognition should result in a more complete description of the engineering involved in the project and thus enhance understanding between the engineer and client. Some of the rather distinctive features essential to many airport engineering situations are:

a. Site selection--analysis of alternate sites.

b. Progress reports to sponsor, FAA, etc.

c. Approach and obstruction survey.

d. Soil and drainage survey and analysis.

e. Topographic survey of comparatively large acreage.

f. Coordination of the safety of aircraft operations during construction.

g. Pavement survey, testing, and evaluation.

h. Detailed construction cost estimate.

i. Arrangement and participation in predesign and preconstruction conferences.

j. Engineer's report.

k. Airport lighting.

l. Recommendations for stage construction.

m. Obtaining FAA approval of design, plans and specifications, changes, etc.

n. Coordination of construction work with airport tenants.

o. Inclusion in contract documents of special provisions for labor requirements, equal employment opportunity, and wage rates.

p. Property surveys and description of needed land acquisition.

q. "As-built" plans.

r. Allowable seasons for construction work.

s. Testing of materials and testing of compaction, mixes, density, surface smoothness, etc., to comply with plans and specifications.

18. ENGINEERING FOR REQUESTS FOR AID. Preparation of a request for aid and the estimate of construction cost and sketch to accompany it usually will require some engineering services. Such services should be accomplished under a contract and the usual process for selection of the engineer should be used. Airport sponsors may be somewhat reluctant, at this point in time, to enter into engineering contracts covering design or construction supervision and inspection as the possibility of doing such work may hinge on receiving federal aid. It is recommended that, under such circumstances, a contract be prepared covering only preparation of the request for aid and supporting sketch and estimate with an understanding that it does not imply that a follow on contract will be forthcoming. Because of the limited scope of the engineering services and for simplicity, a lump sum compensation is recommended.

19. DIVISION OF RESPONSIBILITY AND AUTHORITY. It is common to have one engineering firm providing the basic services and another doing the resident engineering or some other special service. In such cases, the basic services firm is the "primary engineer" or "principal consultant" as defined in paragraph 2b, and responsible for the acceptability of all engineering work and services in the project. The "primary engineer" represents the airport sponsor in coordinating and overseeing the work of other engineering firms. For example, the resident engineer and his inspectors will be responsible for arranging for, conducting, or witnessing field and laboratory or shop tests of construction materials as prescribed in the specifications. Similarly, the resident engineer determines the acceptability of compaction and the suitability of materials on the site and brought to the site to be used in the construction. The primary engineer would, on periodic visits to the site or upon receipt of copies, review the tests, reports, diaries, vendor reports, etc., produced or submitted by the resident engineer to insure that appropriate corrective action was taken as needed and to insure that sufficient and appropriate testing was being accomplished--in other words, to insure that the construction was being controlled properly. The resident engineer would necessarily be responsible and authorized to decide on the day to day acceptability of materials, compliance with the plans and specifications, and to order the contractor to take appropriate action. The division of responsibility and authority should be clearly specified in the engineering contracts. The primary engineer has, however, the overall responsibility for the acceptability and quality of the work.

CHAPTER 5. CHARGES FOR ENGINEERING SERVICES

20. GENERAL.

* a. The computation of charges for engineering services is dependent on the type of services required by the client. The types of services usually performed by engineers are outlined in Chapter 2. FAA approval of a contract will include review as to reasonableness of charges or reimbursement. If the client is to provide a portion of the engineering services, the facts should be stated in the contract both for completeness and to aid in the determination of reasonableness.

b. Cost-plus-a-percentage-of-cost (CPPC) methods of contracting are prohibited for engineering services under ADAP. CPPC contracts may be defined as a payment formula based on a fixed predetermined percentage rate of actual performance costs by which the sum of the contractor's entitlement, uncertain at the time of agreement, increases commensurately with increased performance costs. *

c. Engineering charges are usually computed on one of the following bases or by combining two or more of these methods with appropriate modifications applicable to specific cases.

21. PER DIEM.

a. Direct personal services are usually charged on a per diem basis. This method is particularly suited to court work or similar work involving intermittent personal service. For example, most of the types of services mentioned in paragraph 5 can require intermittent work and thus may indicate per diem compensation.

b. When such consulting or expert services are furnished, the engineer is compensated for all the time he devoted to the work including travel time. The per diem charge should be based on the complexity of the work involved and the breadth of experience of the engineer. In addition to the compensation based on per diem, the engineer is reimbursed for travel, subsistence, and other out-of-pocket expenses incurred while away from his home office.

c. For services in court or on other engagements in which the engineer is to appear as an expert, a per diem charge is considered to have been earned for each day of such appearance, although the engineer may not be called to testify or, if called, may finish his testimony in a fraction of the day.

d. On occasions, the urgency of the engagement requires the engineer to work longer than the normal day. In some instances, this requirement is a necessary feature of the services, and an understanding should be made with the client as to what constitutes a day. In such cases, the per diem rate may be based on the normal number of working hours per day, or the per diem rate may be increased to take into consideration the extended work day.

e. For certain kinds of work, compensation based on hourly rates is an equitable arrangement. Compensation for engineering service on an hourly basis demands a higher rate per hour than would be represented in a per diem rate. Also, the hourly rates should apply to time for travel involved plus reimbursement for travel costs, subsistence, and other out-of-pocket expenses. Depending on the duration of the services, compensation on an hourly basis may include an agreement on a preset minimum amount or retainer in addition to the payments based on the hourly rates.

f. The state societies of professional engineers of the states listed below publish pamphlets on engineering services and fees and these may be consulted for more specific guidance on per diem rates. Such rates sometimes need to be adjusted to reflect the change in economic conditions since the publication was printed. The states issuing pamphlets include: Arkansas, Florida, Illinois, Iowa, Kansas, Kentucky, Louisiana, Massachusetts, Minnesota, Nebraska, New Jersey, North Carolina, Ohio, Oklahoma, Pennsylvania, South Dakota, Texas, Virginia, and Wisconsin. *

22. RETAINER.

a. The employment of engineers on a retainer basis is a common practice. This practice assures the client of always having the services of a certain individual engineer or organization available for future work. This method is used in cases of protracted litigation or for work over the years, when the calls on the engineer may be intermittent. It is also used in the development of undertakings for which the services of an engineering specialist are not required on a full-time basis. On large projects, this method enables the client to have the engineers who prepared the original plans and specifications on hand for maintenance or additions.

b. The amount of the retainer varies with the character and value of the services to the client and with the reputation and standing of the engineer in his profession.

c. The terms of agreements for services on a retainer basis vary widely. Compensation may be based on a fixed sum, paid monthly, or on some other mutually agreeable basis, with per diem or hourly rates in addition for time spent at the request of the client. In any case, the same principles, as explained previously for per diem or hourly charges, govern under retainer contracts.

d. This type of contract would rarely be used for airport engineering. If it were, detailed records would need to be kept to relate the work to a specific project.

* 23. SALARY COST TIMES A MULTIPLIER, PLUS DIRECT NONSALARY EXPENSE. This type of contract contains CPPC methods of contracting because the engineer's indirect cost and profit are not fixed at the time the contract is signed. Therefore, it is not to be used where the costs of engineering services are to be funded under ADAP.

24. COST PLUS A FIXED PAYMENT.

a. This type of contract is used frequently when the engineer is required to start work before the cost and scope of the project can be accurately determined. It does not permit compensation for indirect costs based on a predetermined percentage of actual direct costs. This would violate the CPPC prohibition whenever indirect costs include a profit factor and whenever no provision exists to adjust estimated indirect costs to actual indirect costs that have been verified by audit.

b. The cost-plus-a-fixed-payment contract should include a general description or statement of the work contemplated. The engineer is reimbursed for the direct costs of all services and supplies including salary costs, overhead, direct non-salary expense, and fixed payment.

(1) Salary cost is defined as the cost of salaries (including sick leave, vacation, and holiday pay applicable thereto) of engineers, draftsmen, surveyors, stenographers, clerks, etc.; for time directly chargeable to the project; plus unemployment, excise, and payroll taxes; and contributions for social security, employment compensation insurance, retirement benefits, and medical insurance benefits.

(2) Salaries or imputed salaries of partners or principals, to the extent that they perform technical or advisory services directly applicable to the project, are to be added to salary *

cost without additions for employee benefits. If the partners or principals are employees of the corporation and share in employee benefits, then the benefits should be added.

(3) The engineer's overhead includes the following "indirect" costs, which are not directly allocable to specific engagements:

(a) Provisions for office, light, heat, and similar items for working space, depreciation allowances or rental for furniture, drafting equipment and engineering instruments, and office and drafting supplies not identifiable to specific projects.

(b) Taxes and insurance other than those included as salary cost, but excluding state and Federal income taxes.

(c) Library and periodical expenses, and other means of keeping abreast of advances in engineering, such as attendance at technical and professional meetings.

(d) Executive, administrative, accounting, legal, stenographic, and clerical salaries and expenses, other than identifiable salaries included in salary costs and expenses included in reimbursable nonsalary expenses, plus salaries or imputed salaries of partners and principals, to the extent that they perform general executive and administrative services as distinguished from technical or advisory services directly applicable to particular projects. These services and expenses, essential to the conduct of the business, include preliminary arrangements for new projects or assignments and interest on borrowed capital.

(e) Business promotion expenses, including salaries of principals and salary costs of employees so engaged.

(f) Provision for loss of productive time of technical employees between assignments, and for time of principals and employees on public interest assignments.

(4) Direct nonsalary expenses usually incurred may include the following (detailed records must be kept to support charges and allow auditing):

* (a) Living and traveling expenses of employees, partners, and principals when away from the home office on business connected with the project. (Records must include employee name, dates, points of travel, mileage rate, lodging, and meals.)

(b) Identifiable communication expense, such as long-distance telephone, telegraph, cable, express charges, and postage other than for general correspondence.

(c) Services directly applicable to the work, such as special legal and accounting expenses, computer rental and programming costs, special consultants, borings, laboratory charges, commercial printing and bindings, and similar costs that are not applicable to general overhead.

(d) Identifiable drafting supplies and stenographic supplies and expenses charged to the client's work as distinguished from such supplies and expenses as are applicable to two or more projects.

(e) Identifiable reproduction costs applicable to the work, such as blueprinting, photostating, mimeographing, printing, etc.

(5) Fixed payment is in addition to reimbursement for salary, direct costs, and overhead. The consulting engineer is paid a fixed amount for contingencies, interest on invested capital, readiness to serve, and profit. This may be an amount based on the estimated cost of the project at the time the engineer is engaged. The fixed payment usually ranges from four percent of the agreed-upon estimate of construction costs for projects of small or moderate size to as low as 3/4 of one percent on very large projects. The fixed payment also varies with the scope of the engineering services involved. The cost-plus-fixed-payment basis of compensation requires, as a prerequisite to equitable negotiation, that the scope of the project itself to be fairly well defined and that the services to be performed by the consulting engineer be fully set forth in the agreement. Such agreements should also provide for appropriate adjustments in the fixed payment in the event that the physical scope of the project, time for completion, or the services required are materially increased over that contemplated during the negotiations. *

25. FIXED LUMP-SUM PAYMENT.

a. This method of compensating engineers for basic services is used frequently. *

b. The fixed amount of compensation is developed by estimating the individual elements of the engineering cost outlined in the foregoing paragraph 24, plus a reasonable margin of profit, all expressed as a single lump sum. A lump-sum proposal should be accompanied by the engineer's detailed estimate. The estimate should detail the direct labor cost by categories of employee, manhours, and hourly rate; overhead on labor costs; general and administrative overhead; materials and supplies; travel; other costs; and profit or fee times complexity factor.

c. The lump-sum method of establishing the engineer's compensation is desirable when the scope of the assignment to be undertaken can be clearly and fully defined.

d. Where consultation is undertaken on a lump-sum basis, the agreement should contain a clearly stated time limit during which the services will be performed, and a provision for additional compensation for time in excess of that stated. In design assignments, there should be a provision for changes required after the approval of preliminary designs, with a clear understanding as to where the final approval authority lies.

e. Payments on this basis should be made to the consulting engineer at stated times (usually once a month) during the execution of the work.

26. PERCENTAGE OF CONSTRUCTION COSTS. Engineering contracts based on percentage of actual construction costs, and contracts based on percentage of estimated construction costs after design work has been completed, contain CPPC methods of contracting. They are considered to be CPPC contracts since the portion of the engineer's fee which does not reflect actual costs constitutes a profit which is not fixed at the time the contract with the engineer is executed. Therefore, contracts based on percentage of construction costs are prohibited where payments for engineering services are to be funded under ADAP. *

27. LEVEL OF ENGINEERING COMPENSATION.

a. Many design assignments are negotiated by means of two or more of the foregoing methods of compensation. Quite frequently, the preliminary phase of the assignment may be undertaken for a fixed lump sum, especially where the resultant report may be required to establish the project's feasibility or where the preliminary phase

will involve planning for deferred stages of construction. Following that, the design and construction phases may be accomplished under a cost-plus-fixed-payment type of compensation.

b. The curves presented in figures 1 and 2 represent median compensation, computed as a percentage of construction cost, developed from responses to questionnaries sent out by the ASCE. The original data was developed in 1963; the curves presented here are as revised in 1971 and published in 1972. Obviously, the appropriate compensation for a given assignment may vary well above or below these curves, depending on the various factors which have been discussed in the foregoing paragraphs. The curves should be used only for rough approximations of engineering costs. Estimates used in the negotiation of contracts for engineering services should be based on detailed cost breakdowns of the factors described in paragraphs 24 and 25. The curves cover compensation only for the basic services outlined in paragraph 6.

c. The special services, described in paragraph 7, may add substantially to the local engineering cost of the project. These special services are furnished either directly by the client, by the primary engineering firm, or by a firm specializing in such work.

d. Curve A in figure 1 is intended to apply to assignments of which the following are typical examples:

(1) Airports with extensive terminal facilities.

(2) Water, sewer, and industrial waste treatment plants.

(3) Bridges which are asymmetric or are otherwise complicated.

(4) Access roads.

(5) Highway and railway tunnels.

(6) Pumping stations.

(7) Large intercepting and relief sewers.

(8) Sanitary sewer lines under 24 inches in diameter.

(9) Water distribution lines under 16 inches in diameter.

(10) Foundations.

(11) Additions to or reconstruction of projects classified in Curve B on figure 2.

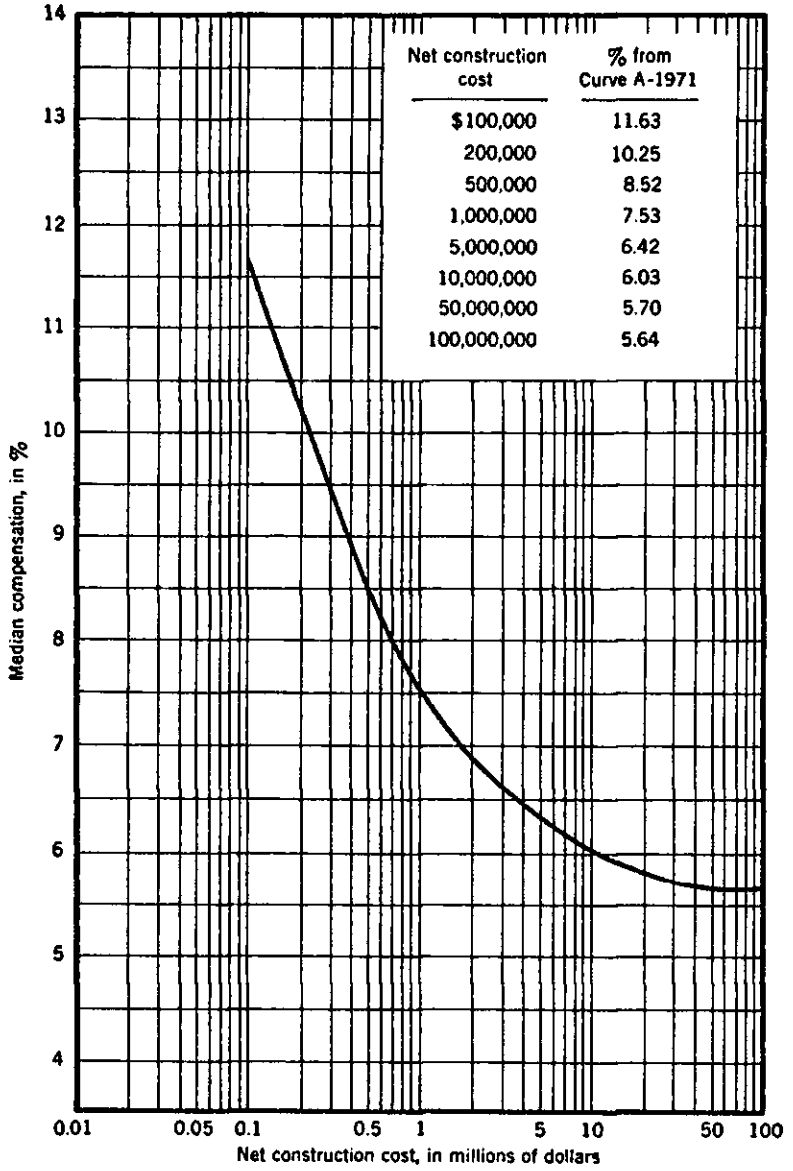

FIG. 1.—CURVE A, MEDIAN COMPENSATION FOR BASIC SERVICES EXPRESSED AS A PERCENTAGE OF CONSTRUCTION COST FOR PROJECTS OF ABOVE-AVERAGE COMPLEXITY (1971)

ASCE Manual No. 45 (1972)

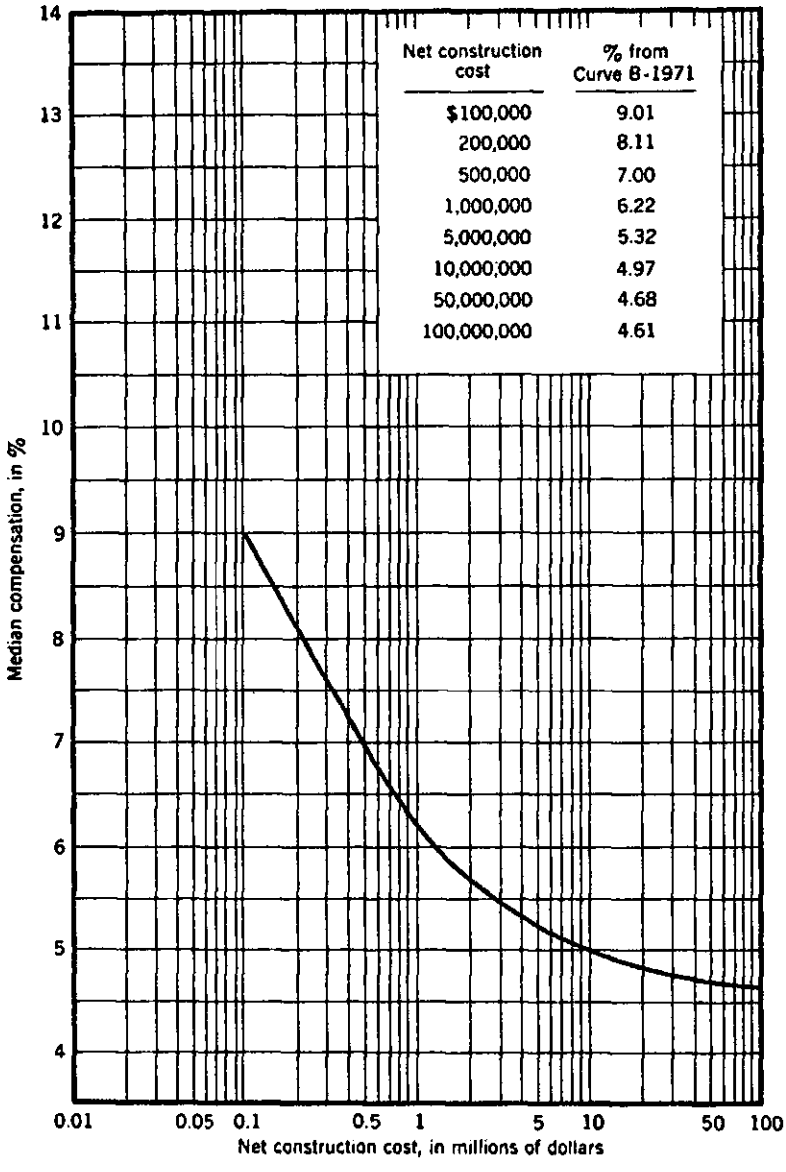

FIG. 2—CURVE B. MEDIAN COMPENSATION FOR BASIC SERVICES EXPRESSED AS A PERCENTAGE OF CONSTRUCTION COST FOR PROJECTS OF AVERAGE COMPLEXITY (1971)

ASCE Manual No. 45 (1972)

e. Curve B in figure 2 is intended to apply to less complex assignments of which the following are examples:

(1) Industrial buildings, warehouses, garages, hangars, and comparable engineering structures.

(2) Bridges and other structures of conventional design.

(3) Less complex access roads.

(4) Conventional levees, flood walls, and retaining walls.

(5) Sewer and water tunnels (free-air).

(6) Storm sewers and drains.

(7) Sanitary sewer lines 24 inches and larger.

(8) Water distribution lines 16 inches and larger.

(9) Airports except as classified for Curve A.

f. The curves in figures 1 and 2 represent median compensation for the three phases of the basic services described in paragraph 6. For the purpose of establishing charges for the separate phases, the following range of allocations is applicable:

(1) Preliminary Phase--up to 40 percent of basic compensation.

(2) Design Phase--up to 80 percent of basic compensation.

(3) Construction Phase--up to 20 percent of basic compensation.

Partial payments for the preliminary and design phases usually are made at monthly intervals based on monthly statements submitted by the engineer. Partial payments in the construction phase are made monthly, usually on the basis of contractor's monthly estimates. Charges for special services are usually billed on a monthly basis. On small projects, the engineer may prefer to bill upon completion of each phase or on some similar basis.

g. Some state societies of professional engineers have published ranges of compensation based on percentage of construction cost. These, like the ASCE curve data, should be used with extreme caution and with recognition of the date they were developed.

* h. Whether accomplished under "consultation and reports" or as a part of "special services," contracts for surveying should be negotiated for in the same manner as for other engineering services. If substantial knowledge of the scope of the work is available plus experience in similar projects, then the fixed lump sum method may be used. *

i. Because of high initial and maintenance costs, electronic distance-measuring devices are usually handled as a separate cost item. For example, a charge of $45 to $74 per day is usual for a piece of equipment costing about $6,000 (1968).

28. TIME OVERRUNS BEYOND CONTROL OF THE ENGINEER. Frequently the engineer is called upon to continue technical inspection services on construction contracts overrunning the program schedule contemplated at the time of negotiation of the engineer's compensation. In most instances, the time element is beyond the control of the engineer. To provide for the contingency of overrun of time, the agreement between the client and the engineer should state the period for which the * compensation shall apply and that the engineer shall be reimbursed for services in excess of the specified period of time at an agreed cost, as agreed on at the time the engineer's contract is negotiated. An agreement for such reimbursement assumes that the construction contract includes liquidated damages to be paid by the construction contractor for overrunning the contract time. The amount of reimbursement should be related to the liquidated damages level.

29. OWNERSHIP OF DRAWINGS AND CONTRACT DOCUMENTS.

a. Original documents, such as tracings, plans, specifications and maps, prepared or obtained under the terms of the contract shall be delivered to and become the property of the client, and basic survey notes and sketches, charts, computations and other data shall be made available upon request to the client without restriction or limitation on their use. In the event any of the above documents are reused by the client, the nameplate will be removed and the consultant will be released and held harmless of subsequent liabilities.

b. When a contract is for preliminary plans only, no commitment should be stated or implied that would constitute a limitation on the subsequent use of the plans or ideas incorporated therein for preparation of construction plans.

30. TOTAL COST OF ENGINEERING VS. PROJECT COSTS. On new projects, before construction begins and before the engineer has been directed to proceed with detailed contract drawings and specifications, the client is concerned with the probable total cost of the project. He will request the engineer to make an engineering report on the project,

including a preliminary estimate of the project cost, fully realizing that because the engineer has no control over the cost of labor and materials or competitive bidding he cannot guarantee the estimate.

a. Information in the hands of the engineer after the completion of his report is not sufficient to enable him to make an estimate of construction cost which is equal in accuracy to the bid a contractor makes after his study of the detailed contract drawings and specifications. To the engineer's preliminary estimate, therefore, must be added an allowance for contingencies. These contingencies may include undisclosed conditions of foundations and construction, extra quantities of materials, larger and heavier equipment, inflation, and other items increasing the cost of construction.

b. The item of contingencies varies with the degree of completeness of the engineer's report. Usually, it should be included in preliminary estimates from 10 percent to 15 percent of the engineer's construction cost estimate.

c. To the estimated cost of construction plus contingencies should be added provision for engineering, legal, administrative costs, and land costs.

d. After contingencies and engineering, legal, administrative, and land expenses have been added to the estimated cost of construction, it may be necessary for the client and the engineer to consider the cost of financial advice, printing of bonds, discount of bonds, etc. Expenses incurred in raising project funds, including administrative expenses involved in bond referendums, the sale of bonds or premium or interest on bonds, or loans, are not eligible project expenses under ADAP.

APPENDIX 1. BIBLIOGRAPHY

1. Federal Aviation Regulations (FAR) Part 152, Airport Aid Program, (FAR Volume X) for sale by the U.S. Government Printing Office, Washington, D.C. 20402, price $4.50. Make check or money order payable to the Superintendent of Documents; no c.o.d. orders are accepted.

2. Airport and Airway Development Act of 1970, Public Law 91-258, 91st Congress, H.R. 14465, 21 May 1970; Amendment to the Airport and Airway Development Act, Public Law 92-174, 92nd Congress, H.R. 7072, 27 November 1971, price $0.20 and $0.05 respectively, available from the U.S. Government Printing Office (address as shown in paragraph 1 above).

3. Consulting Engineering, A Guide for the Engagement of Engineering Services, American Society of Civil Engineers (ASCE), available from Headquarters of ASCE, United Engineering Center, 345 East 47th Street, New York, New York 10017, price $1.00.

4. Guide for Professional Engineer's Services, by Professional Engineers in Private Practice, National Society of Professional Engineers (NSPE), available from NSPE, 2029 K Street, N.W., Washington, D.C. 20026, at no cost.

5. Several State Societies of Professional Engineers publish guides for the engagement and reimbursement of consulting engineering services (available from the individual state societies at modest cost).

6. AC 150/5300-3, Address List for Regional Airports Divisions and Airports District Offices, available free of charge from the Department of Transportation, Distribution Unit, TAD-484.3, Washington, D.C. 20590.

Chapter 12. ECONOMIC FEASIBILITY

81. General. As stated in the introduction to this advisory circular, the technical and economic feasibility of master plan considerations must be analyzed throughout the development of the plan. In the establishment of airport requirements, the planner must decide whether it is feasible to expand the existing airport or look for a new airpoort site. In the site selection process, the feasibility of constructing an airport at each possible location must be considered. After site selection, the feasibility of various airport concepts must be tested before the final airfield/terminal area/access plan is adopted. In each case, preliminary estimates must be made of capital investment, anticipated revenues, and the ability of users to pay costs attributable to proposed improvements. Methods such as determination of facility cost per enplaned passenger, as is used by some airlines, may be helpful in establishing feasibility during the various stages of the plan's development.

After these steps have been taken during the development of the plan, a final evaluation of economic feasibility should be made to establish what the financial prospectus of the airport will be when the plan is implemented and to establish a financial plan for the implementation of the proposed improvements. The terms of economic feasibility should be based on short, intermediate, and long-range forecasts (approximately 5, 10, and 20 years).

In simple terms the practicality of the master plan will depend on whether the users of the airport improvements programmed under the plan can produce the revenues (as may be supplemented by Federal, State, or local subsidies) required to cover annual costs attributable to capital investment plus the annual cost for administration, operation, and maintenance. This must be determined for each stage of development scheduled in the master plan. This consideration should include the cost of capital to be employed in the improvement, the annual costs of facilities, and prospective annual revenues.

82. Capital Investment. The schedule of improvements proposed in the master plan, as well as the cost estimates of those improvements, should be developed as prescribed in Chapter 11. They should schedule construction by phases and break down the costs of proposed improvements by elements such as the passenger terminal area, cargo area, landing area, airport administration, and operations and maintenance areas. This will provide the basic capital investment information needed for evaluating the feasibility of individual facilities. Estimated construction costs should be adjusted to include allowance for architect and engineer fees for preparation of detailed plans and specifications, overhead for construction administration, allowance for contingencies, and allowance for interest during construction. Estimated costs of land acquisition, as well as the costs of easements required to protect approach and departure areas, should be included. If the master plan provides for the expansion of an existing airport, the cost of the existing capital investment may be required to be added to the new capital costs.

83. Break-Even Need. The annual amount which is required to cover cost of capital investment and costs of administration, operation, and maintenance can be called the break-even need. The revenues required to produce the break-even need are derived from user charges, lease rentals, and concession revenues produced by the airport as a whole. To be assured, however, that individual components of the airport are generating a proper share of the required annual revenues, the airport can be divided into cost areas to allow allocation of costs to such areas following generally accepted cost accounting principles. Carrying charges on invested capital will include depreciable and nondepreciable items.

84. Nondepreciable Investment. Nondepreciable items are those which will have a permanent value even if the airport site is converted to other uses. Nondepreciable items include the cost of land acquisiton, excavation and fill operations, and road relocations which enhance the value of the airport site. The annual cost of capital invested in nondepreciable assets depends in the first instance on the source of the capital used. If revenue or general obligation bonds have been issued to acquire the asset,

the total of the principal and interest payments and required reserves or coverage payments called for by the bonds is used. Assets acquired with airport operating surpluses of prior years, general tax revenues, or gifts do not ordinarily impose a cash operating requirement and the treatment of these investments will require a decision by the operator based upon legal considerations and financial operating objectives of the airport. Interest or depreciation charges are not required to be recovered on amounts secured by the airport under the Federal Aviation Act of 1958 as grants-in-aid or under the Airport and Airway Development Act of 1970. Treatment of funds acquired under State grants-in-aid programs should be governed by the terms of the act involved.

85. Depreciable Investment. The annual cost of capital invested in plant and equipment (as distinguished from land) can be regarded as depreciation. The annual charge for depreciation depends on the useful life of the asset and the source of capital used in acquiring the asset. If payments of principal and interest on bonds issued to pay for the asset are required over a shorter period than the useful life of the asset, this schedule would govern and form the basis for depreciation charges unless other revenues are available to service the debt. Depreciation charges for capital assets acquired with operating surpluses of prior years, general tax revenues, or gifts do not ordinarily impose a cash operating requirement on the operator and the treatment of this investment will require a policy decision by the operator. Interest or depreciation charges are not required to be recovered on amounts secured under the Federal Aviation Act of 1958 or the Airport and Airway Development Act of 1970. Funds secured under State grants-in-aid will be governed by the terms of the act involved.

86. Expenses for Administration, Operation, and Maintenance. Prospective expenses for administration, operation, and maintenance should be developed for each airport cost area based on unit costs for direct expenses. For nonrevenue areas, these expenses should be forecasted separately and distributed to various airport operations. For utility expenses, the net amount expected to be owed from utility purchase, after sale of utility services, should be forecast.

87. Potential Airport Revenue. From the above, the sum of the prospective annual carrying charges on invested capital and the prospective average annual expenses of administration, operation, and maintenance should establish the break-even need for each revenue-producing facility and for the airport as a whole. The next step in establishing economic feasibility is to determine if sufficient revenues (which may be supplemented by Federal, State, and local subsidies) can be expected at the airport to cover the break-even needs. Therefore, forecasts should be prepared for revenue-producing areas. These areas will include:

a. Landing Area. This area should include runways and related taxiways and circulation taxiways. Flight fee revenue determination should be distributed between scheduled airlines, other air carrier users, and general aviation. Flight fee amounts should provide sufficient revenues to cover the landing area break-even need.

b. Aircraft Aprons and Parking Areas. Revenues to obtain the break-even need for airline terminal aprons and cargo aprons should be assigned to the scheduled airlines. Those for general aviation ramps should be assigned to private aircraft. Apron and parking area fees should provide sufficient revenues to cover the break-even needs for specific aircraft aprons and parking areas.

c. Airline Terminal Buildings. Revenues for concessionaires and ground transportation services are usually based on a percentage of gross income with a fixed rate minimum for each type of service. Space for scheduled airlines and other users is payed for on a fixed rental. In order to establish rental rates, forecasts of potential revenue from concessions and ground transportation must be established. Rental rates should be based on the break-even need of the terminal building after giving credit for forecasted revenues from concessions and ground transportation.

d. Public Parking Areas. Public parking is usually operated on a concessionaire basis with revenues obtained from rentals based on a percentage of gross income with a fixed-rate minimum. The revenue amount required to meet break-even needs will depend on whether parking facilities are constructed by the airport owner or under provisions of the concessionaire contract. These revenues apply to public parking for both airline and general aviation terminals. Revenues in excess of the break-even need for public parking should be allocated to the break-even need for the airport as a whole.

e. Cargo Buildings. Rentals are usually charged on a rate per square foot and should cover investments in employee parking, truck unloading