

TABLE OF CONTENTS

GENERAL DESIGN (E 100)

SECTION NO.	SUBJECT	DATE
E 110	STREET CLASSIFICATIONS	Sept., 1970
E 111	Master Plan of Highways and Freeways	"
E 112	Select System of Streets	"
E 113	For Design Purposes	"
E 120	FINANCING	"
E 121	Gas Tax Funds	"
E 122	Private Funds	"
E 123	Miscellaneous Funds	"
E 130	STREET IMPROVEMENT POLICIES	"
E 131	Private Development	"
E 131.1	Subdivision Ordinance	"
E 131.2	Parcel Map Ordinance	"
E 131.3	Highway Dedication and Improvement (R-3) Ordinance	"
E 131.4	Zone Changes and Conditional Uses	"
E 131.5	Permit	"
E 132	Select System Streets	"
E 132.1	Capital Improvement Projects	"
E 132.11	Payment with Gas Tax Funds	"
E 132.111	City Must Pay	"
132.112	City May Pay	"
E 132.12	Payment with Other Than Gas Tax Funds	"
E 132.121	By City	"
E 132.122	By Property Owner	"
E 132.13	Stage Construction	"
E 132.14	Resolution Projects	"
E 132.2	Assessment Projects	"
E 132.21	Payment	"
E 132.211	City Must Pay	"
E 132.212	City May Pay	"
E 132.213	By Property Owner	"
E 133	Local Streets	"
E 134	Improvements Abutting Railroad or Public Property	"
E 135	Assistance to Religious Institutions	"
E 136	Temporary Sidewalks	"
E 137	Requests for Immediate Financing	"
E 138	Design Office Responsibilities	"
E 138.1	Review of Capital Improvement Project Lists	"
E 138.2	Project Cost Estimates	"
E 140	CALCULATIONS AND PROBLEM SOLUTIONS	"
E 141	Cost Estimates	"

Sept., 1970

SECTION NO.	SUBJECT	DATED
		Sept., 1970
E 141.1	Tentative Estimate (Class "C")	"
E 141.11	Capital Improvement Projects	"
E 141.12	Assessment Act Projects	"
E 141.2	Appropriation Estimate (Class "B")	"
E 141.21	Capital Improvement Projects	"
E 141.22	Assessment Act Projects	"
E 141.23	Permits	"
E 141.3	Final Estimate (Class "A")	"
E 141.4	Average Engineering Costs	"
E 141.41	"B" Permit Projects	"
E 142	Earthwork Computations	"
E 142.1	Volume Calculations	"
E 142.2	Limit of Economical Haul	"
E 142.3	Volume Computation Factor	"
E 143	Electronic Computer Applications	"
E 143.1	Remote Access Terminals	"
E 143.2	Batch Processing	"

LIST OF FIGURES

NUMBER	TITLE	DATE
E 113	Standard Street Dimensions	Sept., 1970
E 141.4A	Engineering Cost Schedule (Street, Sewer, Storm Drain and Structural Projects A'11 and C.I.P.)	"
E 141.4B	Engineering Cost Schedule (Sewer Offsite and Bond Issue)	"
*E 141.41	"B" Permit Processing Costs	"

E 100 GENERAL DESIGN

In order to serve efficiently in the capacity of a street designer, the designer should have some knowledge of certain nondesign functions in addition to those covered in the previous section. The street designer may be called upon to help in the preparation of the list of street improvement projects to be included in the City budget. This involves a knowledge of the City's street improvement policies, including the desirable extent of the street improvement (full improvement vs. stage improvement) and the preparation of an accurate preliminary project cost estimate. Since the above

factors may influence the geometrics, right of way, and other related items of the design as well as the work load of the design office, a brief discussion of these items will follow. A more comprehensive treatment of the above aspects will be covered in Part C, *Operations and Control*, when this Part of the Manual is printed.

Also included here are some typical calculations that are generally applicable and usually encountered by the street design office in making cost and quantity estimates.

E 110 STREET CLASSIFICATIONS

Designation of a street or highway to a major, secondary, collector, or local classification is based on land use. In proposed streets and highways, the planned use of the land makes it necessary to consider the design peak-hour volume of traffic, the composition (percentage of trucks vs. passenger vehicles), and the design speed. In the case of an existing street or street pattern, accident records as well as other factors help determine highway planning and designation.

E 111 MASTER PLAN OF HIGHWAYS AND FREEWAYS

The City Master Plan of Highways and Freeways classifies streets for City Planning purposes. The ultimate right of way widths of streets are determined in accordance with their classification. A major highway has a minimum right of way width of 100 feet; a secondary highway has a minimum right of way width of 80 feet; and divided major highways, as the name implies, have two roadways separated by a divider strip.

E 112 SELECT SYSTEM OF STREETS

The City's Select System of Streets comprises those streets which are eligible for expenditure of

gas tax funds allocated under the *Streets and Highways Code*. See Section E 020E. This includes all major and secondary highways on the City's Master Plan. Some traffic arteries not included on the Master Plan, and all State highways, are also included in the Select System. In general, only the streets in this system are eligible for improvements using gas tax funds.

All City streets other than Select System streets are defined as local streets. Each Division or District in the Bureau of Engineering has a copy of the Select System of Streets map. Copies of this map are distributed by the Coordinating Division of this Bureau.

E 113 FOR DESIGN PURPOSES

Figure E 113 shows the minimum standards used when designing streets. These standards may not necessarily meet the minimum standards required for Select System streets. Therefore, the minimum street widths indicated should be used only at the discretion of the office engineer when designing Select System streets.

E 120 FINANCING

Funds from various sources are used by the City for financing the construction of street improvements. The use of these funds is regulated by various codes and ordinances, and they may not be used indiscriminately. For purposes of this Part of the Manual, these funds may be classified as Gas Tax Funds, Private Funds, and Miscellaneous Funds.

E 121 GAS TAX FUNDS

Gas Tax Funds are received by the City from the State of California. The use of these funds is regulated by the California *Streets and Highways Code* and the specific applications as covered by the *City and County Projects Manual*. See Section E 020E and E 020F(5d). These documents limit the use of gas tax funds to the improvement of Select System streets, including certain rights of way and appurtenances necessary for their construction and maintenance. A list of these gas tax eligible items is presented under Section E 132.

E 122 PRIVATE FUNDS

Funds from private individuals or corporations for the purpose of street construction are referred to as private funds. Projects using these funds are usually initiated by the property owners by petition, by Council resolution under the Assessment Proceedings of the 1911 Act of the State's *Streets and Highways Code*, or by the 1941 *Los Angeles City Ordinance*. See Section E 020. Private funds are also used for construction of projects by permit and under the proceedings as outlined under various Los Angeles City Ordinances, such as the Subdivision, Parcel Map, Highway Dedication and Improvement (R-3), and Zone Changes and Con-

ditional Uses. See Section E 020. In making these improvements, the items designated for payment with private funds are indicated in the above regulations and under Section E 131 and Subsection E 132.2.

E 123 MISCELLANEOUS FUNDS

In addition to the above-mentioned funds, there are several miscellaneous funds, which are briefly discussed in the following paragraphs.

The Permanent Improvement (P.I.) Fund is used to finance the construction of portions of Select System streets that may not be eligible for gas tax funds. In addition, although local streets are generally improved with private capital, P.I. funds may be used to pay the cost of constructing portions of these streets. These portions may be considered to be of more than local benefit, and the extra cost should not necessarily be assumed by the property owner. See Section E 133. In any case, improvements made with the use of these funds must have a life expectancy of at least ten years.

The General Fund is used where improvements must be made and money from the sources mentioned in Sections E 121 and E 122 are not available or eligible.

Other miscellaneous funds are the Traffic Safety Fund, the Public Works Trust Fund, the Subventions and Grants Fund, funds from various Bond Issues, etc. These are used for certain types of facilities required to complete street improvement projects when these facilities are not eligible for gas tax funds and must be financed by other capital.

E 130 STREET IMPROVEMENT POLICIES

It is the intent of the City that whenever a Select System street or Local Street is to be improved, complete street improvements should be installed where feasible whether a project is initiated by a public agency or by a private party.

Complete street improvements should include the following:

1. Full-width right of way.
2. Full-width pavement.
3. Concrete curbs and gutters.
4. Concrete sidewalks.
5. Street lighting (including continuous underground conduit, cable, and electroliers).
6. Street trees.
7. Traffic control facilities (including traffic signals, warning devices, and channelization at intersections).
8. Storm drainage facilities.
9. Sanitary sewer facilities.
10. Fire hydrants.
11. Landscaping.
12. Guard rails, barricades, fences, and other items necessary for safety.
13. Retaining walls and other necessary structures.
14. Railroad crossing protective facilities.
15. Street name signs.
16. Water service.
17. Underground utilities.
18. Other necessary appurtenances (miscellaneous).

Any item may be eliminated from an improvement project if the item would not contribute to the safety or welfare of the community, or if unusual conditions make its installation impractical or unnecessary. The additional cost of any facility desired by property owners in excess of normal City standards should be paid for by the property owners.

Select System streets will usually be improved by private development (see Section E 131) or as a capital improvement project (see Subsection E 132.1); however, project financing may be expedited by initiation of assessment proceedings (see Subsection E 132.2). Local streets are gener-

ally improved by private development (see Section E 131) or under assessment proceedings (see Section E 132).

E 131 PRIVATE DEVELOPMENT

Ordinances and other regulations requiring improvements in connection with private development shall take precedence over other methods of providing improvements. The developer generally provides the indicated improvements under one of the following procedures:

E 131.1 Subdivision Ordinance: Items which may be required for installation or construction by this ordinance are:

1. Dedication of right of way.
2. Pavement.
3. Curbs and gutters.
4. Sidewalks.
5. Street lighting.
6. Street trees.
7. Traffic warning and control devices (except traffic signals).
8. Storm drains, flood control channels and facilities.
9. Sanitary sewers.
10. Fire hydrants.
11. Guard rails, barricades, and safety devices.
12. Retaining walls and other necessary structures.
13. Street name signs.
14. Water service.
15. Underground utilities.
16. Other necessary improvements.

E 131.2 Parcel Map Ordinance: Items which may be required for installation or construction by this ordinance are:

1. Dedication of right of way.
2. Pavement.
3. Curbs and gutters.
4. Sidewalks.
5. Street lighting.
6. Street trees.
7. Traffic warning and control devices (except traffic signals).

8. Fire hydrants.
9. Street name signs.
10. Other incidental improvements.

E 131.3 Highway Dedication and Improvement (R-3) Ordinance: This ordinance applies to major and secondary highway frontages only. Items required for installation or construction by this ordinance are:

1. Dedication of right of way.
2. Pavement.
3. Curbs and gutters.
4. Sidewalk.

No additional improvements are required where complete roadway, curb, gutter, and sidewalk improvements exist.

E 131.4 Zone Changes and Conditional Uses: These are improvements required by tract map or determined by City departments. They generally include:

1. Dedication of right of way.
2. Pavement.
3. Curbs and gutters.
4. Sidewalks.
5. Street lighting.
6. Street trees.
7. Traffic warning and control devices (including relocation of traffic signals).
8. Fire hydrants.
9. Appurtenant improvements.

E 131.5 Permit: Improvements as may be desired by permittee and approved or as required by City departments.

E 132 SELECT SYSTEM STREETS

The City Council has designated certain streets to be included in a list called the *Select System of Streets and Highways*. See Section E 020I. This list has been approved by the California Highway Commission, pursuant to Sections 186.3 and 186.4 of the *Streets and Highways Code*. See Section E 020E. State Highways within the City are included in the Select System.

E 132.1 Capital Improvement Projects: A project financed wholly with public funds is called a capital improvement project. From the standpoint

of financing, resolution projects are considered as capital improvement projects. See Subsection E 132.14. Assessment projects normally initiated by property owners are not included in the capital improvement project designation. See Subsection E 132.2.

Capital projects are generally recommended by City officers and departments. The projects are then considered by the Technical Committee for Capital Programming and included in the Five Year Capital Program. Finally, projects are selected by the Public Works Priority Committee, the Mayor, and the Council for inclusion in the Capital Program Funds of the Budget. The projects recommended under this procedure are financed as follows:

E 132.11 Payment with Gas Tax Funds: Eligible items may be paid for with gas tax funds as described below.

E 132.111 City Must Pay: The following are always paid for by the City:

1. All right of way not already available.
2. Pavement.
3. Curbs and gutters.
4. Safety street lighting.
5. Traffic control devices (signals and conduit).
6. Drainage facilities required for the street improvement.
7. Guard rails and other safety items.
8. Retaining walls and other items required for the street improvement.

As a "rule of thumb," 60 percent of the estimated storm drain costs for those drains within the Select System street may be considered eligible for financing with Gas Tax Funds. For particulars in this regard, refer to *City and County Projects Manual* or Section G 031.1 of Part G of the Manual, *Storm Drain Design*. See Section E 020. The ineligible portions of the storm drain installation are then paid for with P.I. money for publicly financed improvements and with private capital for privately financed improvements.

Permanent Improvement (P.I.) funds up to \$5,000 should be requested on all new street projects even though the project is apparently 100 percent eligible for Gas Tax expenditures. This

will eliminate many late requests to Council for P.I. funds due to a small change in eligibility.

E 132.112 City May Pay: The following are sometimes paid for by the City:

1. Permanent concrete sidewalks on structures, medians, and where determined by the City to be of no benefit to owners of abutting property.

2. Landscaping of medians to basic City standards, functional planting for erosion or weed control purposes, and street trees where determined by the City to be of no benefit to owners of abutting property. Landscaping shall include lawn, specimen trees, and automatic electrically controlled sprinkler system as may be determined by the City to be appropriate to the use of the facility.

3. Pedestrian, equestrian, or vehicular underpasses or overhead crossings.

4. Any replacement or reconstruction necessitated by the street improvement, including street trees.

E 132.12 Payment with Other Than Gas Tax Funds: Items not eligible for gas tax funds may be paid for as described below.

E 132.121 By City: City will provide funds to complete the following:

1. Additional street lighting as may be necessary to provide for a continuous underground system of conduit, cable, and foundations, plus electroliers at intersections and other points of hazard. See Subsection E 132.111 (4).

2. Additional traffic control devices as may be necessary in conjunction with the street improvement. See Subsection E 132.111 (5).

3. Drainage facilities and betterments incidental to the street improvements. See Subsection E 132.111 (6).

E 132.122 By Property Owner: Property owners pay for other improvements, including the following:

1. Sidewalks, except those which may be financed by City. See Subsection E 132.112 (1) and (4).

2. Electroliers necessary to complete the street lighting system. See Subsections E 132.111

- (4), E 132.112 (4), and E 132.121 (1).

3. Street trees, except those which may be financed by City. See Subsection E 132.112 (2) and (4).

4. Landscaping as may be desired over and above that set forth in Subsection E 132.112 (2). These improvements should be installed under assessment proceedings initiated by property owners or by Council resolution, but not necessarily concurrent with the construction of pavement or other facilities.

E 132.13 Stage Construction: This refers to the construction of part of an improvement (usually in an undeveloped area) that will handle traffic in an interim period until traffic density warrants the completion of the improvement to its ultimate development. The portion in the initial stage should be designed so that it may be used in its entirety with little or no modification as part of the ultimate development. Where stage construction is being used on Select System streets, the City will provide pavement for two lanes of traffic in each direction, plus channelization at intersections, and such other facilities as may be needed for drainage control, traffic control, and safety, including rights of way for utility and pedestrian needs.

E 132.14 Resolution Projects: These projects are improvements processed under assessment proceedings, but for programming and financing purposes they are considered capital improvement projects. Authority to proceed with design or other processing is contingent upon availability of public funds.

Capital improvement projects may be advanced in priority consideration for financing through property owners providing or paying for acquisition or improvements. This would be accomplished by adoption of a Council resolution which would initiate assessment proceedings for right of way acquisition and complete improvements. Public funds may be provided as follows:

1. City may pay for all right of way not already available when property owners pay for complete street improvements except traffic control facilities and portions of street lighting, for which other public funds would normally be provided.

OR

2. City may pay for "curb to curb" improvements when property owners provide the remaining complete street improvements. Examples of "curb to curb" improvements are full pavement for which other public funds are not already available, curb and gutter, drainage facilities, traffic control devices, and portions of street lighting.

OR

3. City may provide or pay for the right of way except severance and improvement damage to major improvements, for which other public funds may be provided.

E 132.2 Assessment Projects: Select System street improvements may be included in assessment proceedings. These projects, which are normally initiated by property owners, are not to be considered as capital improvement projects for programming and financing purposes.

E 132.21 Payment: Select System street improvements are paid for as described below.

E 132.211 City Must Pay: The following are always paid for by the City:

1. Pavement in excess of local street width. See Section E 134.
2. Street lighting underground system plus electroliers at intersections and other points of hazard.
3. Traffic control devices.
4. Severance and improvement portion of requisition costs.

E 132.212 City May Pay: Storm drains which are included in an assessment district where the drainage facilities required are more than the normal minimum catch basins and connector laterals necessary to make the street improvements functional may be paid for by the City. See Part G of the Manual, *Storm Drain Design*, Section G 031, Financing.

E 132.213 By Property Owner: Property owners should provide or pay for all other improvements, which should include the following except where specifically excluded by Council:

1. Land cost of right of way.
2. Pavement of local street width and character.
3. Curb and gutter.

4. Sidewalk.
5. Remaining street lighting electroliers.
6. Street trees.
7. Traffic signal interconnect conduit.
8. Local drainage facilities.
9. Local sewer.
10. Fire hydrant initial installation.
11. Water service initial installation.

Reference: Council File No. 85,446.

E 133 LOCAL STREETS

Property owners should provide all necessary right of way and should pay for all improvements except traffic control devices, which will be provided by the City. The City will advance funds to pay the cost of right of way acquisition to be assessed against the district in accordance with the *Streets and Highways Code*. See Section E 020E.

The improvement of local streets for local benefit should be at the expense of the property owners; however, the Council may find by resolution that certain specified unusual conditions or circumstances of broad public interest prevail, and may determine that these unusual conditions warrant the expenditure of City funds. The unusual conditions or circumstances may include an undue financial burden on the property owner without commensurate benefit, a local street improvement that is of more than local benefit, or an improvement of essential benefit to the City to relieve traffic congestion.

For example, Major or Secondary Highways improved under assessment proceedings usually require heavy-duty pavement. However, the cost of improvements to be assessed against property abutting the highway, where the property is zoned for multiple dwelling or commercial or industrial use, should normally include the cost of sidewalk, curb, and only 18 feet of width of heavy duty pavement (gutter included). The cost of pavement required in excess of 18 feet of width on each side of the centerline of the roadway should be paid for from public funds.

Similarly, property zoned R-1 should normally include the cost of sidewalk, curb, and 18 feet of width of pavement (gutter included). However, 10 feet of heavy duty paving (six inches or more

in thickness) is considered to satisfy the local width requirement for R-1 zone owners. The excess of 10 feet of width required on each side of the centerline should be paid for from public funds. Reference: Council File No. 118,341.

E 134 IMPROVEMENTS ABUTTING RAILROAD OR PUBLIC PROPERTY

Complete street improvements abutting land owned by a railroad or a governmental agency, when provided, are financed as follows:

1. Operative Railroad Right of Way:
 - a. Capital Improvement Projects—City may pay for pavement, street lighting, and curb and gutter.
 - b. Assessment Projects—City may pay for pavement, street lighting, and a portion of curb and gutter. Railroads should pay for improvements according to benefit received. Reference: Council File No. 90,947.
2. Developed Federal and State property, or County property used in the public service—City will pay for all improvement costs but will seek reimbursement for betterments installed at request of agency.
3. Developed City property under the jurisdiction of the Departments of Library or Recreation and Parks—Departments are expected to provide all necessary right of way insofar as legally possible. Capital Program Funds should be used for all improvements.
4. Developed property under the jurisdiction of the Departments of Water and Power, Harbor, or Airports—Departmental funds should be used for all improvements insofar as legally possible.
5. Property being acquired and developed under new bond funds programs or operating department funds—Full street improvements as may be necessary for the operation of the facilities should be provided for in connection with all City operating plant construction projects. Future bond funds or departmental funds will be used to pay for all local street improvement costs; gas tax funds may be used for Select System street improvements. Where current bond funds can be used and are available, they should be used to finance street improvements needed in conjunction with the

facilities. Where such funds are not available, Capital Improvement Program Funds may be used.

E 135 ASSISTANCE TO RELIGIOUS INSTITUTIONS

The City may assist religious institutions by paying the cost of street paving and incidental expenses required for dedications adjacent to their properties, subject to the following conditions:

1. Dedication and construction must be within a Select System street.
2. A permanent building used primarily as a house of worship must exist on the property or be substantially under construction.
3. The institution should submit appropriate sets of plans for processing under "B" Permit requirements of the *Municipal Code* (Section E 020A) showing the curb, gutter, sidewalk, street lighting, and incidentals to be constructed by the permittee and the paving to be constructed by the City. The construction should be coordinated with the City. Reference: Council File No. 110,606.

Under a tract map proceeding or conditional use approval, the City may stipulate that public funds should be provided to pay for street paving. Under 1911 Act assessment proceedings, no public allocation can be made to relieve the assessments against religious institutions.

E 136 TEMPORARY SIDEWALKS

Temporary asphalt sidewalks may be installed in locations where sidewalks are necessary for the safety of school children. Temporary sidewalk installation normally will be requested by the Board of Education safety officials. The Board of Public Works will review the sidewalk request for feasibility. The Council will be responsible for ordering installation of these temporary sidewalks. Wherever feasible, permanent sidewalks will be ordered by the Council in traffic danger areas. Reference: Council File Nos. 93,062 and 93,665.

E 137 REQUESTS FOR IMMEDIATE FINANCING

Capital Improvement Project Requests should normally be referred to the Technical Committee for Capital Programming. A project request may

be considered for immediate financing solely on its own merits under one or more of the following circumstances:

1. The project is partially financed or otherwise previously authorized.
2. There is an agreement, commitment, or coordination required with other agencies or projects.
3. City financing is recommended in accordance with established policies or practices (such as City contributions to assessment projects, assistance to religious institutions, etc.).
4. There are contemplated substantial cost savings.
5. The project is relatively small (currently under \$5,000) or of a nature that is not normally considered in the capital program.
6. The project is of an emergency nature involving:
 - a. the protection of life or health,
 - b. the provision of safety measures, or
 - c. the prevention of property damage.

E 138 DESIGN OFFICE RESPONSIBILITIES

As a result of the adoption of the street improvement policies as presented in the foregoing discussion, the street design office has been assigned various responsibilities. Some of these duties are reviewing the annual list of capital improvement projects, making preliminary project cost estimates, and considering the possible effects of these policies on street design standards. The design office must prepare the required information promptly and accurately, since the data obtained are used in preparing the City budget, as well as for assigning and more equitably distributing the work loads to the various design offices and the Survey Division. Some of these responsibilities are briefly outlined below.

E 138.1 Review of Capital Improvement Project Lists: The list of capital improvement projects and those assessment projects for which public fund appropriations are or will be provided is reviewed by the street design office. This list is examined annually for any changes in scope or for changes in the project cost estimate of 10 percent or more. Also, any projects which are to be split, added, or deleted from the list are noted and a new Form CAO-39 is prepared. For a further outline of the street design office function in regard to completing the capital improvement project review and the Form CAO-39, refer to Part C, *Operations and Control*, when this part of the Manual is printed.

E 138.2 Project Cost Estimates: The cost estimate on all capital improvement projects must be reviewed in order that they may be included in the CAO's Five Year Capital Program. See E 141. The design office should request cost estimates as soon as possible from the Bureaus of Street Lighting and Right of Way and Land, the Traffic Department, and any other offices that may be involved. It is important that the preliminary cost estimate for a project be accurate, since it is used to determine the priority rating. The priority rating shows the relative benefit gained by constructing one job after another. If the preliminary cost estimate has been underestimated, the job is given a higher priority rating than it deserves and does not fall into its proper place on the priority list. As previously mentioned, each Council District has a limited amount of funds allocated for these improvements. Where subsequent estimates show the costs to have doubled or tripled, this results in the project being underfinanced. This means unnecessary delay in construction of projects that are deserving of a higher priority and is unfair to residents of the other Councilmanic Districts in which these other projects may be located.

E 140 CALCULATIONS AND PROBLEM SOLUTIONS

Included under the above title are various calculations and criteria used in making engineering cost estimates, in earthwork computations, and in electronic computer applications for typical problems in street design.

E 141 COST ESTIMATES

Engineering cost estimates are necessary steps made at various stages of proposed projects. These cost estimates are made for the purpose of defining and classifying right of way acquisition, plan preparation, and the construction of public improvements. A discussion of the type of estimate, the scope, and the degree of accuracy required will follow.

Class "C" and "B" estimates are made by the engineering design offices involved. The quantities, location, and nature of the project may be submitted informally by telephone to the Utility and Estimating Division. Other prices are available from the design divisions, bureaus, or other agencies directly concerned. The Utility and Estimating Division then determines the appropriate unit or lump sum bid prices and returns this information to the design office requesting these prices.

Class "A" estimates are usually made by the Utility and Estimating Division. The various classes of estimates are defined as follows:

E 141.1 Tentative Estimate (Class "C"): The purpose of the Class "C" estimate is to provide a tentative estimate which is intended to show the order of magnitude only and is subject to major revision. This estimate is to be based on general knowledge of the project with regard to location, limits, width of improvement, width of right of way, and other known physical characteristics, due regard being given to previous experience with similar projects in the same area.

E 141.11 Capital Improvement Projects: Class "C" estimates are *not* to be used for preliminary project cost estimates for capital improvement projects. Because of the importance of accuracy, estimates for these projects should be at least Class "B". See Subsections E 138.2 and E 141.2.

E 141.12 Assessment Act Projects: Preliminary estimates used for processing petitions, work order requests, preliminary engineering reports, etc., on

relatively simple projects will require Class "C" estimates. The more complex projects may require some investigation and preparation to the same degree required for Class "B" estimates. See Subsections E 141.22 and E 811.2, Project Report and Council Action.

E 141.2 Appropriation Estimate (Class "B"): The Class "B" estimate is intended to be used as the basis for fund appropriation, for other specific projects as directed by the Board of Public Works, and for urgent projects recommended for immediate financing. This estimate is to be based on specific, detailed knowledge of the project obtained by field investigations and preliminary planning. When requesting Class "B" estimates from the other offices concerned, the Bureau of Engineering should furnish a sketch showing all basic information, including information as to additional right of way requirements, change of grade, location of private improvements which may interfere with the work, and anticipated requirements for storm drain, sewer, and slope easements. Bureau of Right of Way and Land estimates shall include cost of clearing right of way acquired. However, cost of relocating public utility facilities is to be estimated by the Bureau of Engineering.

E 141.21 Capital Improvement Projects: A Class "B" estimate is required for all preliminary cost estimates that will be made for projects to be included in the Bureau's Annual Tentative Capital Program.

E 141.22 Assessment Act Projects: A Class "B" estimate should be made for any project to be improved under Assessment Act proceedings where public funds will be appropriated. Gross errors in the preliminary project cost estimates may result in the rejection of the proposed project, either by the Council or by the property owners, and the consequent unnecessary expenditure of City funds. Therefore, a Class "B" estimate is suggested for any projects of a complex nature.

E 141.23 Permits: In compliance with the *Municipal Code*, projects done under permit, whether designed by the City or by a private engineer and checked by the City, require an estimate to be made by the City Engineer. The estimate should

cover the cost of the portion of the design and/or plan checking to be done by the City. Also, estimates of the total construction cost including grading, streets, sewers, storm drains, etc., are required. The purpose of these estimates is to determine the amount of the plan checking fee and construction bond to be paid by the permittee. The fees should be realistically estimated to cover anticipated actual costs. Similarly, bond estimates should be high enough to ensure complete recovery in case of default.

The quantities and costs are arrived at from a preliminary project investigation and a thorough study of the preliminary construction plans. The accuracy of these types of estimates should at least approach the Class "B" level.

E 141.3 Final Estimate (Class "A"): The Class "A" estimate is the final summation of estimated costs after completion of final plans by the Bureau of Engineering. The Class "A" estimate for construction is the final estimate based on completed plans. If this estimate indicates that additional funds are required, a report should be made promptly to the Board of Public Works by the Bureau concerned. See Chapter E 800, Procedural Steps for Proposed Improvement, and Part C, *Operations and Control*, when this Part of the Manual is printed.

E 141.4 Average Engineering Costs: Figures E 141.4A and E 141.4B show the construction cost estimates and the corresponding percentage costs of engineering and inspection for capital improvement, assessment act, and sewer offsite and bond issue projects. Figure E 141.4A shows storm drain, and structural pipe, and structural pipe improvement and assessment act, which are located in both flat and hilly areas. Figure E 141.4B is for sewer projects constructed under bond issue funding, and for offsite tract improvements constructed by City contracts.

Both figures give the median engineering cost of various sized projects and reflect data collected on those projects that were completed and accepted in 1966-67, 1967-68, and 1968-69 fiscal years. "B" Permits are not included. See Subsection E 141.41. No data were available for combination capital improvement and assessment act projects. These projects are treated as assessment act projects.

Design Costs include those charges made by the design Division or design section of the District for all design functions. *Processing Costs* include those charges made to a project by the non-design Divisions (Utility and Estimating, Opening and Widening, Administration, Coordinating, etc.). *Survey Costs* include all of the charges made by the Survey Division to a project. *Total Engineering Costs* are the sum of the three previous costs. *Inspection Costs* include those charges made to a project by the Bureau of Contract Administration and are not included in the total engineering costs.

It should be emphasized that the information in these figures is statistically derived, and is not intended to supplant professional judgment on projects considered individually. They are primarily for use in financing and budgeting when many projects are being considered.

E 141.41 "B" Permit Projects: Figure E 141.41, below, shows the charges in dollar amounts made by the City for processing permit projects. They give the median processing costs of various sized projects and reflect data collected on projects that were completed and accepted in the 1969-70 fiscal year. They include the average total of the survey, the administration, and the engineering costs for checking the plans, construction of the project, and acceptance of the project.

"B" PERMIT PROCESSING COSTS

Revised July 1, 1970

Estimate in Dollars	Total Processing Costs in Dollars
1,000	590
5,000	756
10,000	967
20,000	1,392
30,000	1,822
40,000	2,256
50,000	2,696
60,000	3,140
70,000	3,590
80,000	4,044
90,000	4,504
100,000	4,968

Figure E 141.41

E 142 EARTHWORK COMPUTATIONS

The Geology and Soils Engineering Section of the Street Opening and Widening Division should be consulted when any appreciable amount of earthwork is involved. This Section can determine the earthwork volume factor (swell or shrinkage), the type of soil, the amount of compaction required, the maximum slope of cut and fill permitted, and other factors that may be needed to determine earth volumes and stability. Reference is also made to *Standard Specifications—1970 Edition* and the Hillside Grading Ordinance, No. 123,970, which cover earthwork and grading construction practices, and the discussions of related practices in this Part of the Manual. See Subsection E 422.11, Flexible Pavement Design, and Sections E 480, Side Slopes, and E 020B.

E 142.1 Volume Calculations: Three methods are used in determining earthwork quantities:

1. *Prismoidal formula*—This is the most accurate method, since it takes into account the area in the middle of the prismoidal section.

2. *Average end area*—This is not as accurate as the prismoidal formula, but it is acceptable for most purposes. The City generally uses this method, not making any corrections for alignment curvature.

3. *Contour interval*—This is generally acceptable for quick preliminary studies. It may also be used for odd-shaped construction, such as grade separations or complex intersections. It is much more rapid than the other two methods. The earthwork volume is computed by getting the product of the area bounded by a closed contour and the contour interval.

E 142.2 Limit of Economical Haul: The limiting distance beyond which it is not economical to overhaul yardage is a distance usually designated as the limit of economical haul. For hauls beyond this limit, it is cheaper to waste the excess excavation and haul from a borrow pit for supply of fill material, provided a borrow pit with suitable material is available within a reasonable distance. The limit of economical haul may be determined by the formula:

$$L = \frac{B}{O} + F$$

Where L = Limit of economical haul in stations

B = Cost of borrow per cubic yard

O = Cost of overhaul per station in yards

F = Free-haul distance in stations

The City presently uses 1000 feet (10 stations) as the free-haul distance.

E 142.3 Volume Computation Factor: Allowance must be made for the change in volume of excavated materials from the original volume in cut to the final volume in fill after shrinkage and settlement have taken place. Since most soils shrink as a result of this process, a shrinkage correction factor must be applied for earth volume computations. The percentage allowed for this shrinkage varies with different soils; as an average it is 10%. Occasionally, rock formations are encountered which expand rather than shrink and an average figure that may be used is 10%. However, since certain soils or rock may shrink or expand as much as 50%, it is advisable to contact the Geology and Soils Section of the Street Opening and Widening Division and request the shrinkage or expansion factor to be used for a specific project.

E 143 ELECTRONIC COMPUTER APPLICATIONS

There are two types of electronic computer systems available for use: the Remote Access Terminal System and the Batch Processing System. Either system is recommended.

E 143.1 Remote Access Terminals: The Remote Access Terminal System uses remote terminals (located in the various design offices and connected to an IBM 360 Computer via telephone) and uses the "time-sharing principle." The results are obtained at once.

The most useful programs available are:

1. *Traverse, engineering* (trav, engr)—Solving traverse-survey type problems.

2. *Vertical curve, engineering* (vcurve, engr)—Solving vertical curves.

3. *Intersection, engineering* (inter, engr)—Solving station intersection problems.

4. *Horizontal curve, engineering* (hcurve, engr)—Calculating horizontal curve information.

Detailed information on the operation of the remote terminals is given in the IBM Terminal User's Manual. A Catalog of Program Abstracts that will list all available programs is being prepared. Each office has, or will be furnished, the latest copies of the Manual and the Catalog.

E 143.2 Batch Processing: The Batch Processing System utilizes punched cards and the Data

Service Bureau's computer. From one to two days are required to obtain results. The chief advantage of this system is in making extensive, repetitive calculations. Programs similar to those listed in Subsection E 143.1 are available.

Detailed information concerning the use of either system may be obtained from the Systems Engineering Section of the Executive Division.