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Though many organizations have been studying the need for or emphasizing the need for a standard set of map symbols for large scale maps (1:240 to 1:4800), little to date has been done to develop a standardized legend. The main problems associated with producing a standard legend are: to provied a unique symbol for each feature, to be able to computer-program the symbols, to implement the standard once it is adopted, and the upkeep of the standard. These problems and their solutions are addressed in the presentation. The actual set

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of symbols and their development are presented in Chapter V of the forthcoming manual: "Manual on Map Uses, Scales, and Accuracies for Engineering and Associated Purposes". This manual is being prepared by the Committee on Cartographic Surveying, of the Surveying and Mapping Division, ASCE.

BIOGRAPHICAL SKETCH

Captain Robert Paul Jacober, Jr., is a Captain in the United States Air Force, presently stationed at the Defense Mapping Agency Aerospace Center, St. Louis, Missouri, as a Cartogra Staff Officer. Prior to being assigned to the Aerospace Center, Captain Jacober completed a Master's Degree at the Ohio State University's Department of Geodetic Sciences. He was sponsored through the Air Force Institute of Technology while he was at O.S.U. Before being selected for the Air Force Institute of Technology program, Captain Jacober flew B-52 heavy bomber aircraft for the Strategic Air Command. He has a B.S. Degree in Geography from Ball State University, Muncie, Indiana. He is a member of the American Congress on Surveying and Mapping, American Society of Photogrammetry, International Order of Navigation, and is currently an Advisor to the Committee on Cartographic Surveying, of the Surveying and Mapping Division, of the American Society of Civil Engineers.

OASD # 1173

ABSTRACT

Though many organizations have been studying the need for or emphasizing the need for a standard set of map symbols for large scale maps (1:240 to 1:4800), little to date has been done to develop a standardized legend. The main problems associated with producing a standard legend are: to provide a unique symbol for each feature, to be able to computer-program the symbols, to implement the standard once it is adopted, and the upkeep of the standard. These problems and their solutions are addressed in the presentation. The actual set of symbols and their development are presented in Chapter V of the forthcoming manual: "Manual on Map Uses, Scales, and Accuracies for Engineering and Associated Purposes". This manual is being prepared by the Committee on Cartographic Surveying, of the Surveying and Mapping Division, ASCE.

KEY WORDS: Design, Drawings, Mapping, Maps, Standards, Symbols.

A STANDARD FOR SYMBOLOGY ON ENGINEERING SCALE MAPS

by

Robert P. Jacober, Jr.[1]

Advisor to the Committee on Cartographic Surveying, ASCE

At the present time, a set of map symbols for large scale maps that is universally recognized as a national standard does not exist. Though many professional, governmental, and commercial organizations have symbols that are used internally, little has been done to consolidate the various lists into one standardized legend.

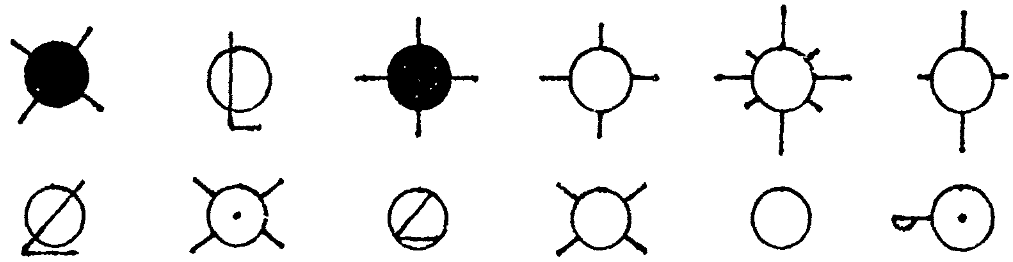
In 1978, Dean Merchant, the Chairman of the Cartographic Surveying Committee of the Surveying and Mapping Division, asked the author of this article to develop an appendix for the forthcoming ASCE manual, "Manual on Map Uses, Scales, and Accuracies for Engineering and Associated Purposes". The appendix would contain a legend of nationally accepted symbology for use by ASCE members as standard symbols on large scale maps (1:240 to 1:4800). It was found that many organizations have been studying the problem or emphasizing the need for such a standard, but no actual standard existed. The development of a set of symbols that could be acceptable as the nucleus for a national standard became the subject for the author's Master's thesis (1) and for Chapter V of the ASCE manual entitled, "Map Content and Symbology". Since Chapter V will be published for review and comment in the Journal of the Surveying and Mapping

[1]Cartographic Staff Officer, Defense Mapping Agency Aerospace Center, St. Louis, Missouri, 63118.

Division, this paper will present the background to the chapter and describe the problems encountered in the development of the symbol system.

The need for standard symbology was stated as far back as 1938 by the National Resources Committee (2). In 1948, Walter Blucher, the Executive Director of the American Society of Planning Officials made the following statement: "Here in the United States it is almost impossible to compare drawings prepared by different draftsmen or offices, not only because they may be of different scales, but because the symbols used are often as far apart as the poles." (3). Joe Steakley reiterated this need in a letter to the American Cartographer in 1977 (4). And today, the need for a standardized set of symbols is more important with computer assisted mapping becoming the norm rather than the exception.

One example of the lack of standardization is all the features that are represented by a circle: manhole, light pole, chimney, oil tank, airport taxiway light, proposed location for a tree, utility pole, oil or gas well, sump, and mill. Confusion could result if one organization which used the circle to represent a manhole requested another organization's manuscript that used the circle to represent a light pole. If the manuscript did not contain a legend, the information represented would be meaningless to the requesting organization. A second example of the lack of standardization is demonstrated by the symbols used by various organizations to represent free standing light poles:



The problems in developing a standard symbology are several:

1. A unique symbol for each feature to be represented must be created.
2. The symbols must be easily computer programmable.
3. A method to differentiate between proposed, existing, and intermittent, destroyed, or abandoned features has to be included in the system.
4. A procedure must be established to phase in the symbols.
5. A procedure has to be initiated that will maintain the currency of the symbology file by adding symbols as new features need to be represented.

The crux of the entire issue is stated in the first problem, to insure that only one symbol exists for each feature. To solve the first problem, a folio of legends was assembled. Of 158 requests for information that were sent out, 103 samples of legends were received and compiled into one master file. This file included symbol lists from large and small private companies in the U.S. and abroad; national and international professional organizations; city, county, state, regional, national, international, and foreign governmental agencies; and from military and educational institutions both domestic and foreign. All of the features represented in the legends were listed. Next to each feature name were drawn all of the symbols used to represent that feature. An extract from that file is the set of symbols used to represent free standing light poles. The criteria used to select a unique symbol to represent each feature were as follows:

1. Popularity - This is an objective criterion. If a symbol is almost universally recognized as representing a feature, i.e., an X for a benchmark, that symbol/feature relationship should be retained.
2. Easily computer programmable - This criterion is subjective in that it is the author's conception of what is easily programmable in Fortran for use on the Versatec electrostatic plotter.
3. The symbol should visually resemble either the silhouette or the planimetric shape of the feature it represents.
4. The symbols should be as dissimilar as possible to avoid confusing one symbol with another in the interpretation of the map.

For some features the symbol selection is simple. For example, a horizontal control station, which is internationally represented as a triangle is also easily programmed. That symbol easily met the criteria. For other features, such as a free standing light pole, the choice is more difficult. The final list of features and the symbols which represent them is incorporated in Chapter V. This chapter will soon be published in the Journal of the Surveying and Mapping Division for ASCE member review and comment.

The selection of symbols based on how easily one may program them for computers is directed toward the increased use of computer driven plotters and CRT devices. The author programmed each symbol listed in Chapter V to insure that they could be displayed using the computer. An additional advantage to having unique symbols for each feature is that computer assisted map reading and reproduction becomes easier. Instead of storing a separate symbol software package for each map produced by a different organization, only on· ͻymbol software package need be stored.

The symbols are designed to be used in a monocolor production process; i.e., black or blue on white or clear, clear on red or black, etc. This does not preclude the use of color to help differentiate between classes of features. For example, on the same manuscript, use black to represent roads, red to show power distribution, blue for water distribution, etc. With the aid of computers and memory files, the overlay system could also be used in a monochrome or multicolor display. Each feature layer is printed on a separate sheet of transparent or translucent material. With the monochrome system, each layer would be printed in the same color. With the multicolor system, each feature class could be printed in a different color on the separates. The overlay method could be used to help solve the third problem, how to represent existing, proposed, and destroyed, abandoned, or intermittent features.

Depiction of existing features and proposed features on the same manuscript is tied to the purpose of that manuscript. And the purpose of the map dictates what features belong on the map, and how they will be portrayed. For example, the maps produced by a state highway department will probably depict the roads as parallel lines. If the map is used by the planning division, the proposed roads will usually appear as solid lines and the existing roads as broken lines. For the highway maintenance division, the existing roads will appear as solid lines, while the proposed roads will appear as dashed lines. Though the two divisions work for the same agency, if a person from the maintenance division saw an unlabelled map produced for the planning division, he would probably interpret the map erroneously.

This problem can be greatly reduced or eliminated by the use of appropriate titles and legends on all maps and by the use of overlays.

Once the standard symbol system is accepted, the question of how to implement the system must be addressed. With many years accumulation of irreplacable manuscripts in files across the United States, to recompile all of those maps with a standard symbol system would be an unnecessary and impossible task. As long as legends are available for the filed maps, they will remain valuable documents. But as new maps are produced or old maps revised, the standard symbols should be used, especially on maps that are being digitized. Thus over a period of years, all maps will be produced using the standard symbols.

A major problem with the proposed list of symbols contained in Chapter V, is that it is not comprehensive. The features represented are those most often used on the engineering scale maps that the author had accessible to him. Special use symbology, infrequently used symbols, or symbols that were not on the maps used by the author are not included in the chapter.

As new symbols need to be added to represent new features that advancing technology develops or to represent features that were not included in the original list, a method must be available to update the list. As a map producer designs a new symbol that symbol should be sent to the Committee on Cartographic Surveying, Surveying and Mapping Division, ASCE, for inclusion in the symbol list. The symbol should also be sent to the Committee for publication in the Journal for comment and review.

Though Chapter V is aimed at solving the problem of symbol standardization for large scale maps, the chapter also recommends cartographic guidelines that should be used by all within ASCE who produce maps or plots. The Manual on Map Uses, Scales, and Accuracies for Engineering and Associated Purposes is being published to provide information to enable the map designer or user to select the proper type, scale, accuracy, and quality maps suitable for the map's intended purpose, which will promote standardization within the American Society of Civil Engineers.(5)

APPENDIX I - REFERENCES

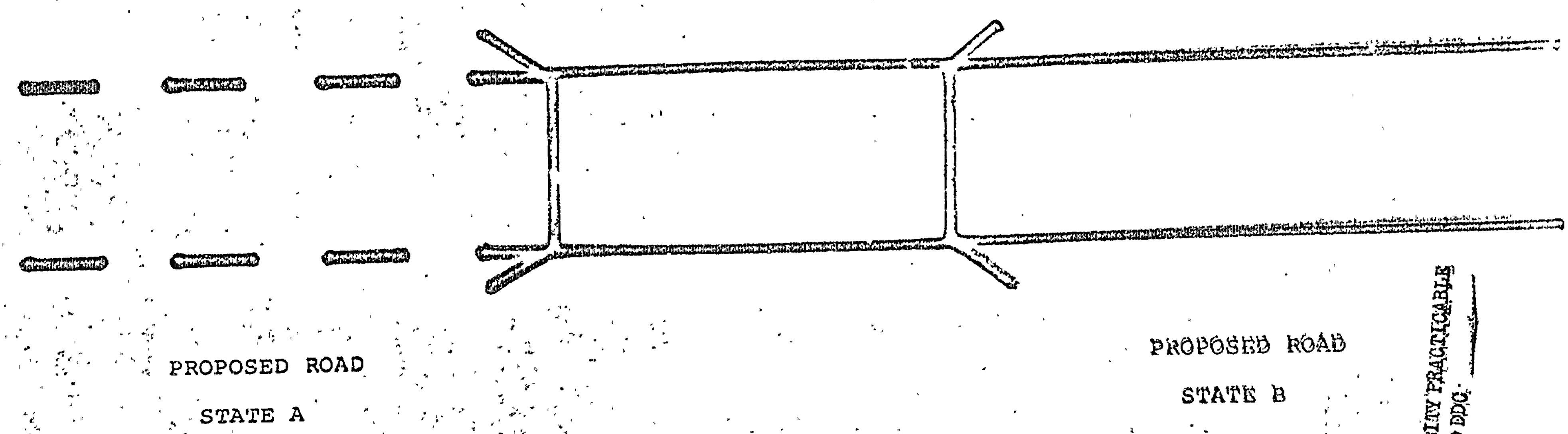
1. Jacober, Robert P., Jr., "Standardization of Map Symbology for Large Scale Maps", thesis presented to the Ohio State University, at Columbus, Ohio, in 1979, in partial fulfillment of the requirements for the degree of Master of Science in Geodetic Science.

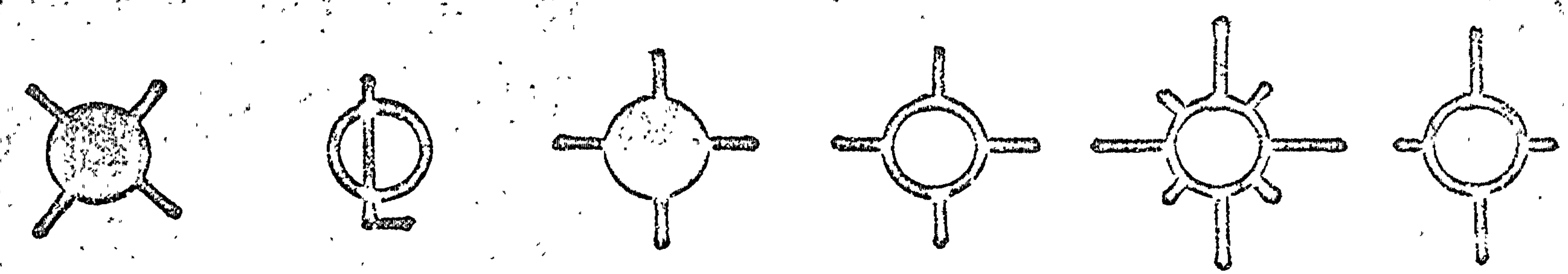
2. National Resources Committee, Suggested Symbols for Plans, Maps, and Charts, U.S. Government Printing Office, Washington, D.C., 1938.

3. Wilkins, E.B., "Maps for Planning", Public Administration Service, Chicago, Ill., 1948.

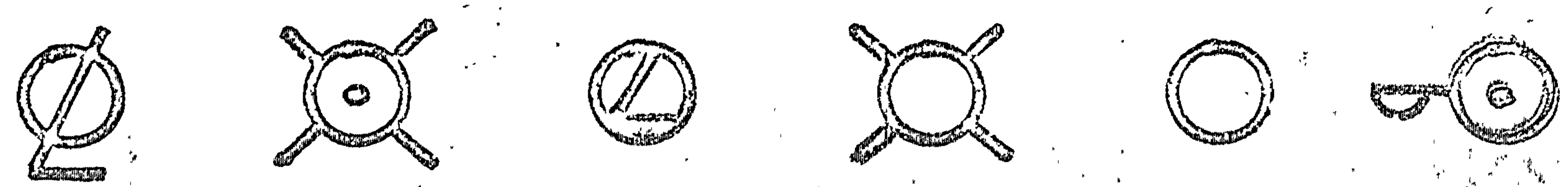
4. Steakley, Joe E., "Large Scale Mapping, Communication from Readers", American Cartographer, Vol. 4, No. 1, April, 1977, p. 96.

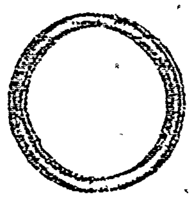
5. Feldscher, Car B., "A New Manual on Map Uses, Scales, and Accuracies", presented at the April 2-6, 1979, ASCE Convention and Exposition, held at Boston, Mass. (Preprint 3489).


PROPOSED ROAD
STATE A
PROPOSED ROAD
STATE B



FREE STANDING LIGHT POLES





MANHOLE, LIGHT POLE, CHIMNEY, OIL TANK, SUMP, AIRPORT TAXIWAY LIGHT, PROPOSED LOCATION FOR A TREE, UTILITY POLE, OIL/GAS WELL, MILL.

CULTURAL FEATURES, MINING

Bore or test hole

Open pit mine or quarry, operational

Open pit mine or quarry, abandoned, filled in, or no longer used

Mine. underground vertical shaft

Mine, underground horizontal shaft

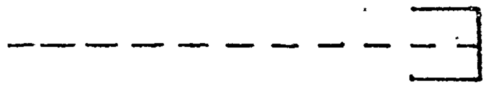
UTILITIES:

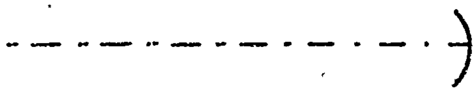

Cable or pipe, existing


Cable or pipe, proposed

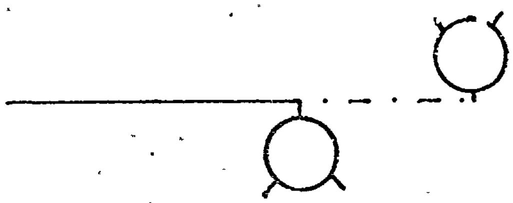
Cable or pipe, abandoned or destroyed.

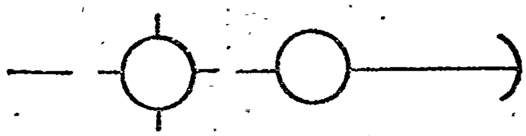

Meter, gas, water, electric, etc.


Cap or terminating plug.

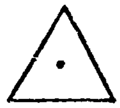

Anchor


Valve

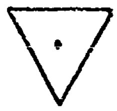

Fire hydrants showing an existing and a destroyed hydrant.


Light pole with a stub pole and anchor

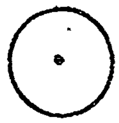
CONTROL POINTS:



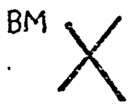
Horizontal control point, national network



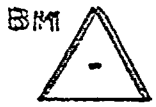
Horizontal control point, state or local network



Landmark object

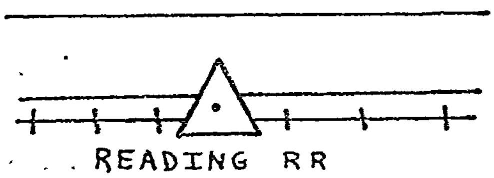


Monumented bench mark



Horizontal control point and bench mark

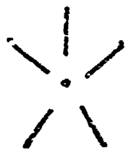
Spot elevation



Horizontal control point on a road and railroad.

VEGETATION:

 Deciduous tree

 Evergreen tree

 Burned tree

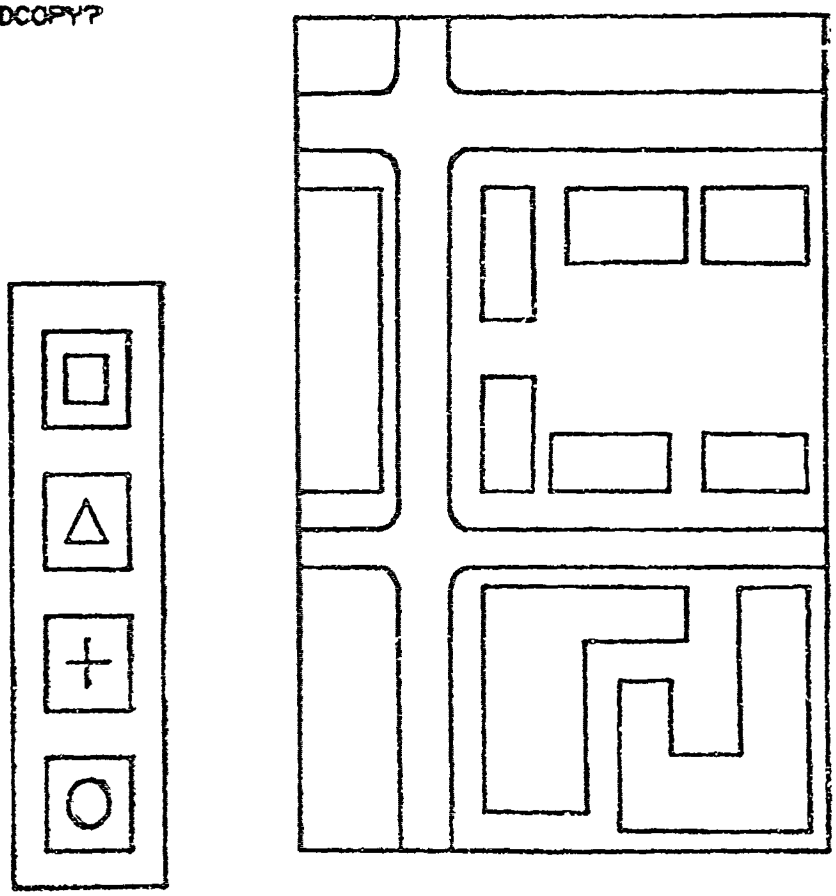
 Cactus

 Stump, cut tree

 Palm

DO YOU WANT TO ADD SYMBOLS FROM THE MENU? ANSWER YES OR NO.
NO

DO YOU WANT TO ADD SYMBOLS FROM THE MENU? ANSWER YES OR NO.
NO
DO YOU WANT A HARDCOPY?
ANSWER YES OR NO.
N



2

PLACE THE CURSOR IN THE CENTER OF THE DESIRED SYMBOL. PRESS "S" THEN TYPE IN THE COORDINATES IN REAL NUMBERS. THE DOMAIN MUST BE BETWEEN .5 AND 6.7 IN X, .5 AND 9.3 IN Y, FOR EXAMPLE: "2.5,3.7" WHEN DONE, TYPE IN 99.,99. AS THE COORDINATES.

DO YOU WANT A HARDCOPY?
ANSWER YES OR NO.
YES
PRESS HARDCOPY
AFTER COPYING
PRESS "1", "RETURN"
?

?
3.,3.
?
3.,3.
?
2.,3.,
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2.,3.75
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2.,9.
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2.,7.75
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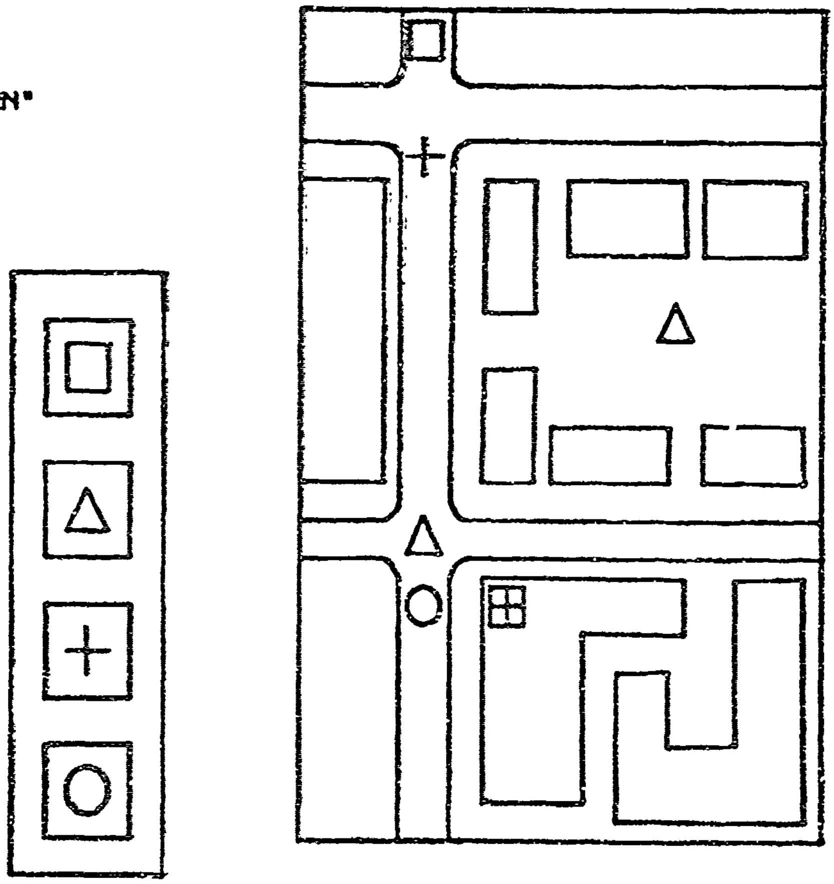
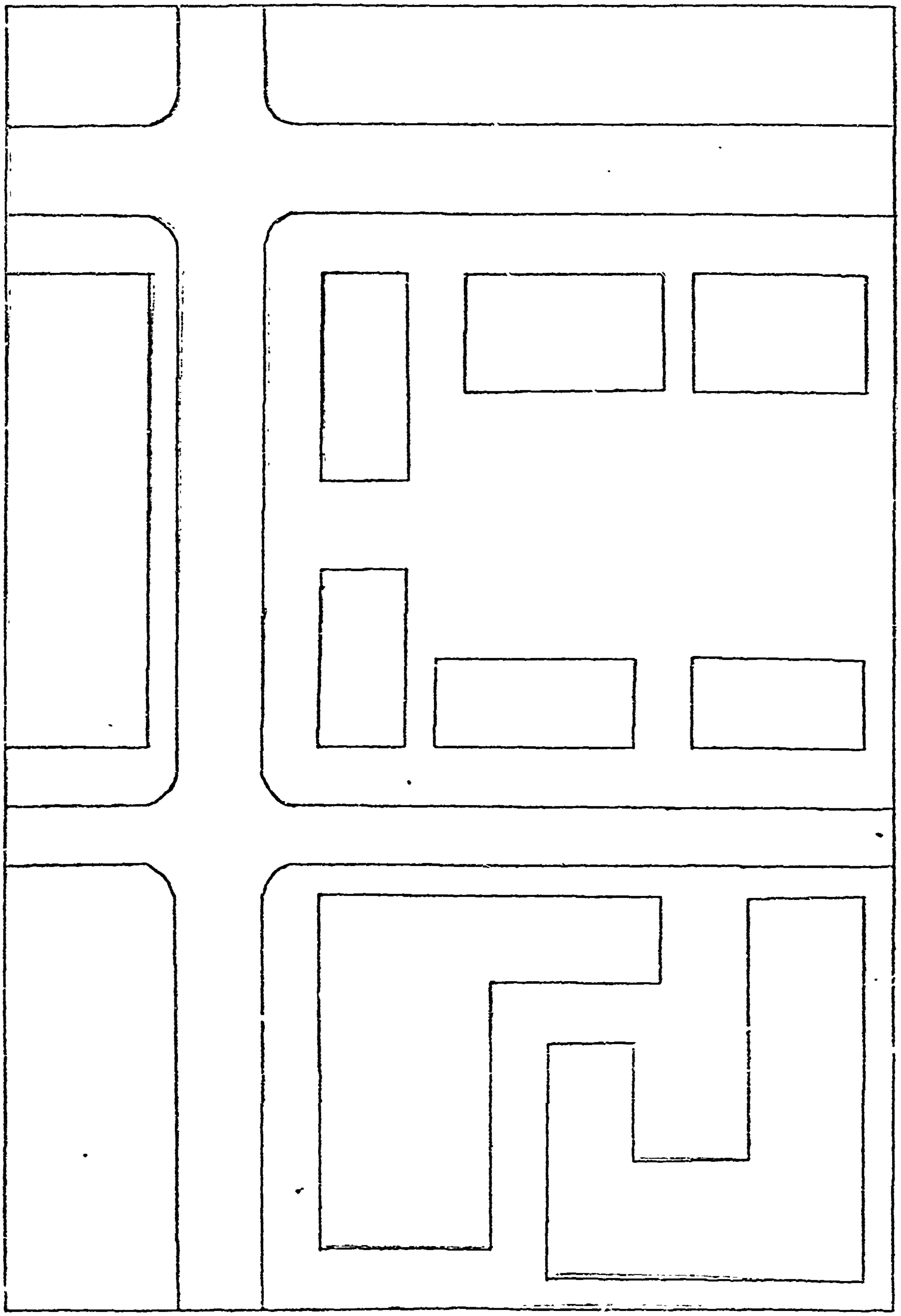
5.,6.
?
99.,99.



3



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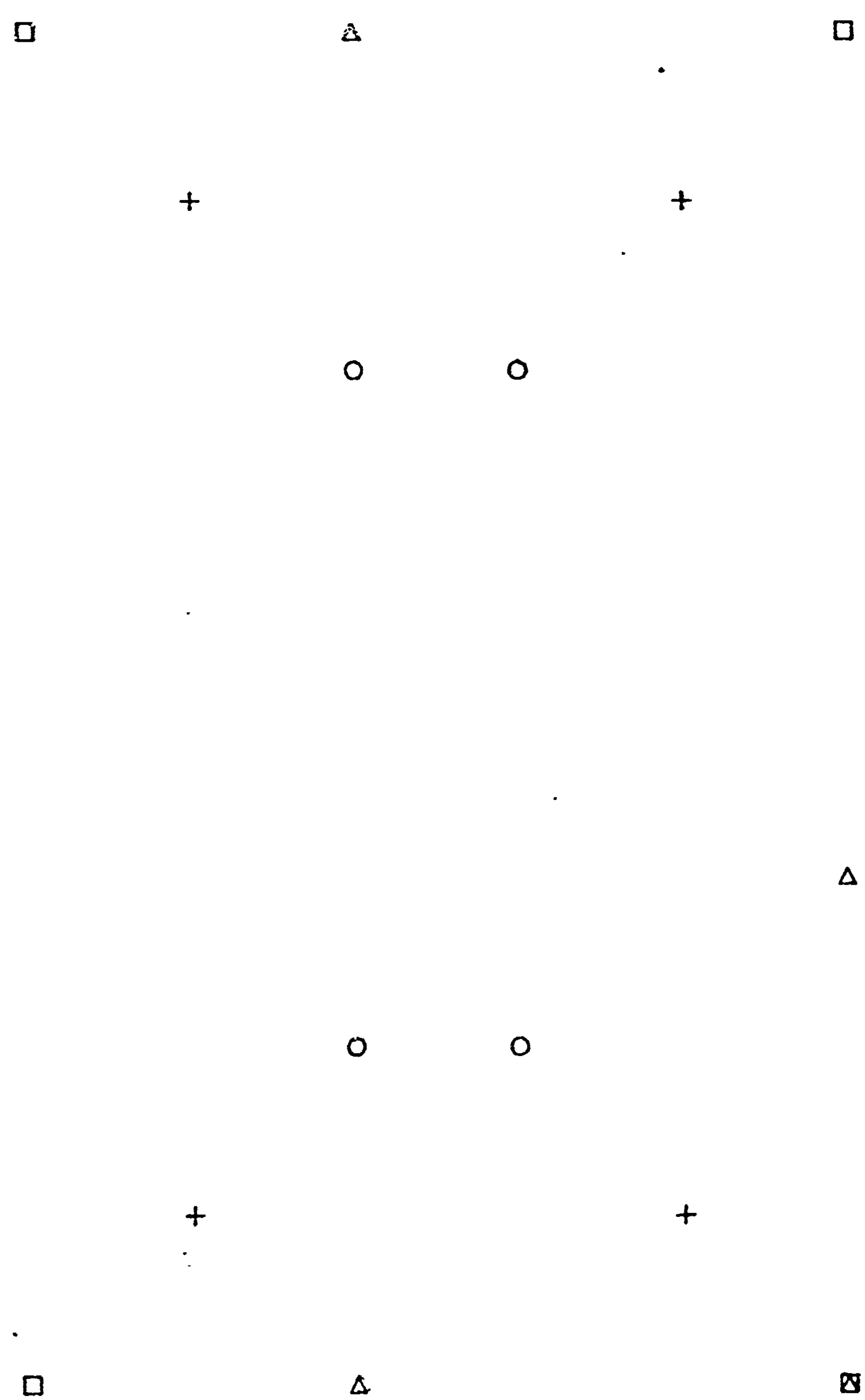

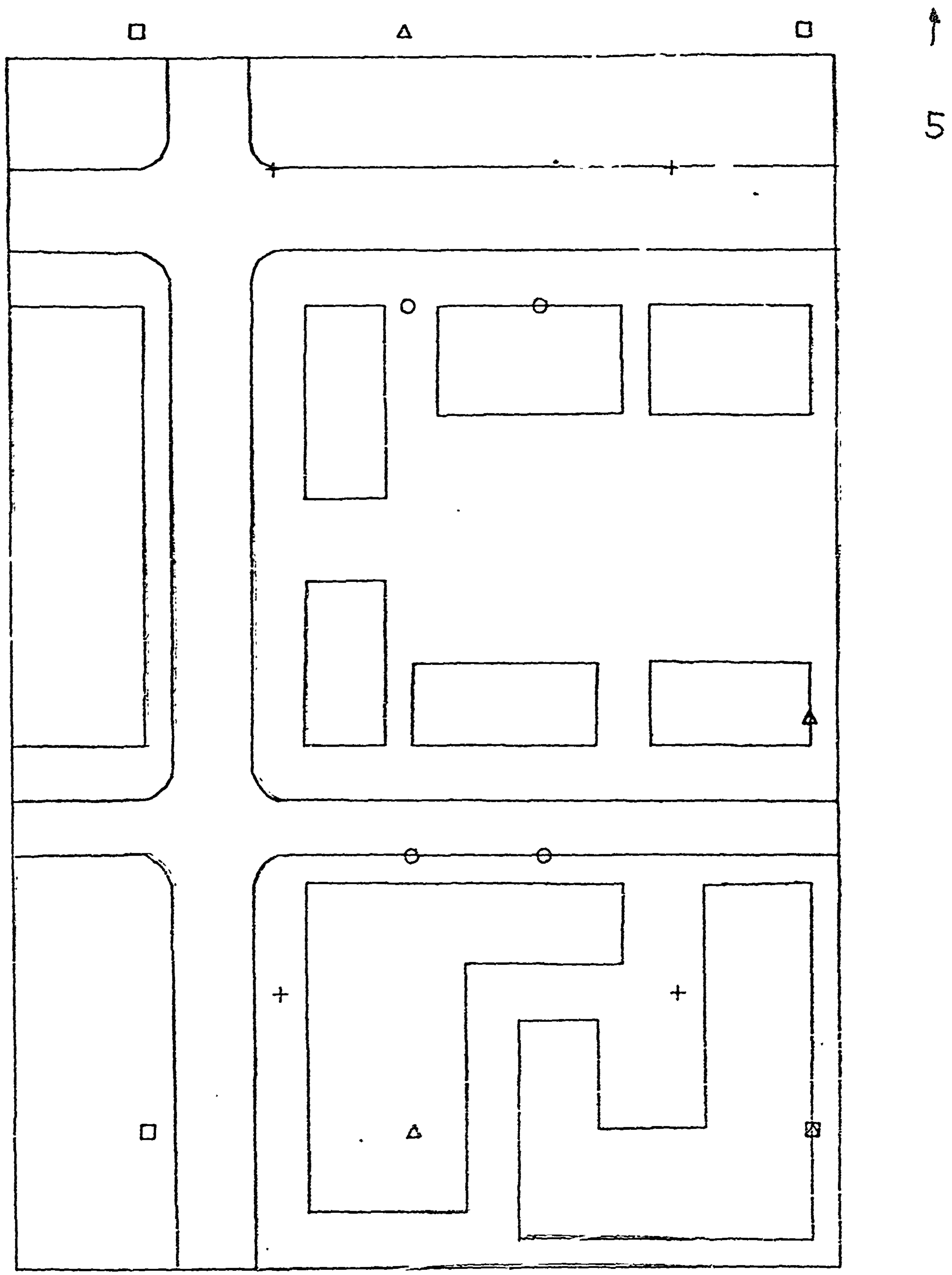
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