

COMPUTER AIDED ARCHITECTURAL
OPERATIONAL PLANNING - CAAOP

Prof.ing. Marcello Picone
Istituto di Architettura Tecnica
Facoltà di Ingegneria di Napoli
P.le Tecchio 80125 Napoli

The operational planning parameters data processing, by means of computerized methods, allows:

- . to outline the steps forming architectural planning;
- . to point out building systems, manufacture processes and laying procedures of the constructive components;
- . to prefigure the flowchart of operations and estimate their own time;
- . to analyze organisation, management and time control;
- . to subdivide the leading among the pertaining areas .

Leading must be referred to different coordination problems and regarded to:

- available fund, materials supplies and components,
- engagement of workers to employed in building,
- equipments' work loads and mechanical outfits of yard.

On the other side, such a large range of performances that can be got by the use of data processing, excludes those steps involving discretionary options and choice criteria which could not in any case be achieved, or even only expressed, by means of an automatic calculation.

For this reason the contribution of computerized methods is mainly suggested for those aspects of processing referred to repeating or routine data understanding steps still to correction or further definition of architectural program steps.

Structure of architectural operational planning.

Building up processes must be considered as a system of activities following each other in a fixed order: starting from the design and the bid, through the manufacture, to the delivery, the texting and finally to the use of the architectural product.

Building up activities are differentiated non only in terms of type of work, but also according to the place where they are carried out - yard, workshop, factory - or to the combination of means used - workers, equipments, plants.

Iterative and adjustment methods are the only choice to find both operation flow - in sequence, or in parallel,

or in connection - and the times required by activities, depending on capacity of the means used.

These calculations, particularly when hand-made, result very fatiguing; therefore a more convenient use of computerized methods is strongly recommended.

The processing study of an architectural production plan can make use of other computerized elements, called logistical restraints, which are not so fixed as the technological ones, and contributes to make the program performance more deducible with automatic proceedings.

The operational technique, carried out by electronic instruments, involves two fundamental steps: the planning compilation, when design has been making, and its management, during the work progress.

The gradual drawing up of the operational plan involves at first a brief but global out line, by which it is possible to go on dividing the building process into spacial units in terms of "place" and operational units in terms of "time".

Works distribution can be made according to several criteria. Works can be collected because of their location or by grouping them in following time periods, but also by working steps and, above all, by functional models and definite operating level or morphologic bonds.

The criterion chosen in the working distribution is fundamental in the subdivision of the operational planning as the sub-aggregates are evidently different, even if are referred to the same building activities.

Relating to accuracy degree to be achieved in data processing, a peculiar significance is given to:

- the architectural design complexity,
- the more or less specification of executive ways,
- the possibility of checking and bringing up-to-date the plan in its course, according to the real works progress,
- the preliminary availability of all data process, of the restraints among the operations and of the comparative evaluations among the possible operational alternatives.

Data processing architectural models.

By the input to computer of the most of the processing data necessary to the drawing up of the operative plan, a primary advantage is gained, because planning operations are made easier.

This lets a range of results to be achieved both in a short time and in a versatile way, which can also be susceptible of up-dating and to refer to operating levels.

The above mentioned results can be expressed by tabulates, grids and forms, related to the prescriptions and instructions necessary to the working performance.

That's possible provided that starting data of the planning are suitably arranged for processing and that, successively, can be decoded and set up for the recording into instructions for the operating levels.

The elements necessary to data processing of an operating plan, named input informations, mainly include the list of activities, their chronology and logic sequences, the terms of finished works.

In addition to the previous data, other informations can be collected, such as:

- works distribution according to building cycles,
- regulations' codes and service or logistical restraints,
- works peculiarities, sources needs and productive capacities, workers' and equipments' efficiency,
- provisions in order to up-date or correct the planning.

These data, once translated into machine language, are recorded by the computer that will process them according to instructions of the machine program.

Inputs are usually pre-arranged for calculations by checking possible errors, such as: bonds, duplicated or not connected calculations, invalid dates or incompatible times required for works.

Following this check, calculations are performed in two stages, in order:

- . to get a final drawing up of the connections network and of time program from the preliminary drawing up, by means of sub-routine analyses and further definition of building intermediate objectives;
- . to clarify needs, arranged by pertaining areas, of sources and building factors, required to carry out work progress, as previously assumed.

The chronological results of data processing can be expressed in terms of running absolute dates, starting from the works' beginning, or in terms of real calendar dates, if the related connections are given by means of an up-dated report.

The operational and typological choices resulting from data processing consist in the:

- combining the chronological data processing results with the register of activities' nomenclature; bringing together the results referred to the sequence of stages with direction of workers, equipments, materials, products and with execution modalities;

- arranging the needs of each activity, in terms of sources and production factors, based upon the optimizing productivity, by suitable areas and progressive dates;
- providing the workers with instructions report arranged like schemes, schedules and building forms.

Likewise data processing combined with planning procedure, as above stated, form a group of extremely useful tools in works management, in their check, in recording the finished lots, in reproducing and understanding feedback informations and, consequently, in up-dating the program and in noting the changes brought.

Output reports, performed by the computer, can be expressed according to different models, which are divided into:

- . planning models, for the operational design,
- . management models, for the works leading.

The first models are meant to be referred to the operational aspects of the building up, whereas the second ones to executions and provisions.

In both models, reports give either the up-dated work project and management progress or the forecast until the works have been accomplished.

Planning models, given by the computer, can be applied to every point of the operational organisation chart, and the resulting reports may be collected, grouped or diffused according to the different ways as requested by planning.

Production steps classification obtained by computer may also produce advanced calculation systems, especially useful to building trade, as they allow to link up executive procedures with administrative, economic and legal operations provided they are contextual to them or, however, significative for the design and management of the building activity.

Computer Aided Architectural Operational Planning.

C.A.A.O.P. is a plan applied to building production, resulting from the syntesis of critical sequences method combined with operational planning techniques and based upon the computer employment.

C.A.A.O.P. , nowadays, is the most advanced and skilled whole of planning methodologies which has ever been expressed, well fit for the operating coordination of building activities.

"chronological programs"

Production Scheme - PS - relates works necessary to carry out the whole building product - promotes and work out hypothesis on the expected workers and machines utilization - points out the whole time of the construction and the operations dates.

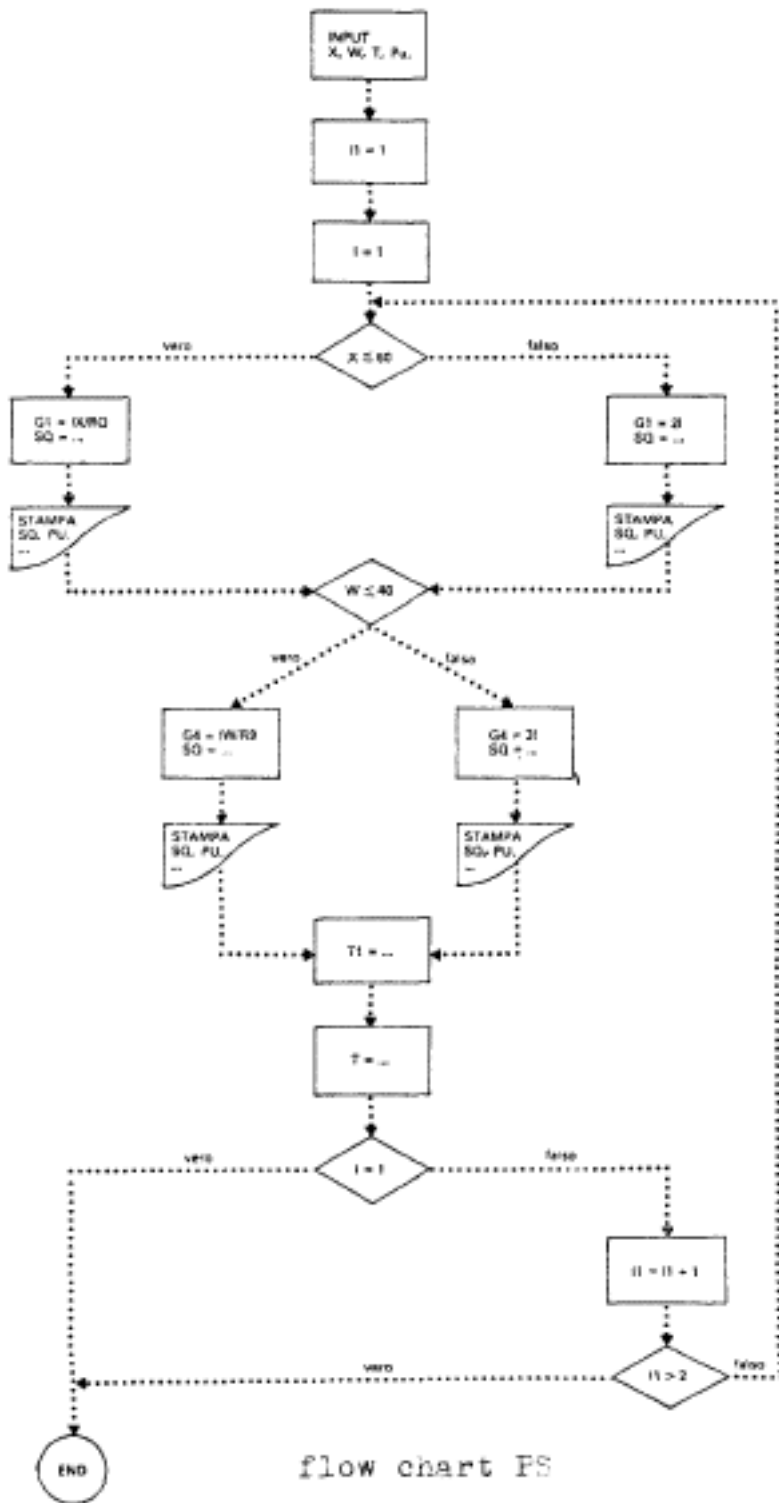
- . Summarized typical works data: - order number - belonging category - works nomination - measurement unit - product quantity.
- . Estimates the entity of production means, and makes hypothesis upon their efficiency: - required equipments - teams number - unitary production - total production.
- . Shapes production in the time: - typical times.

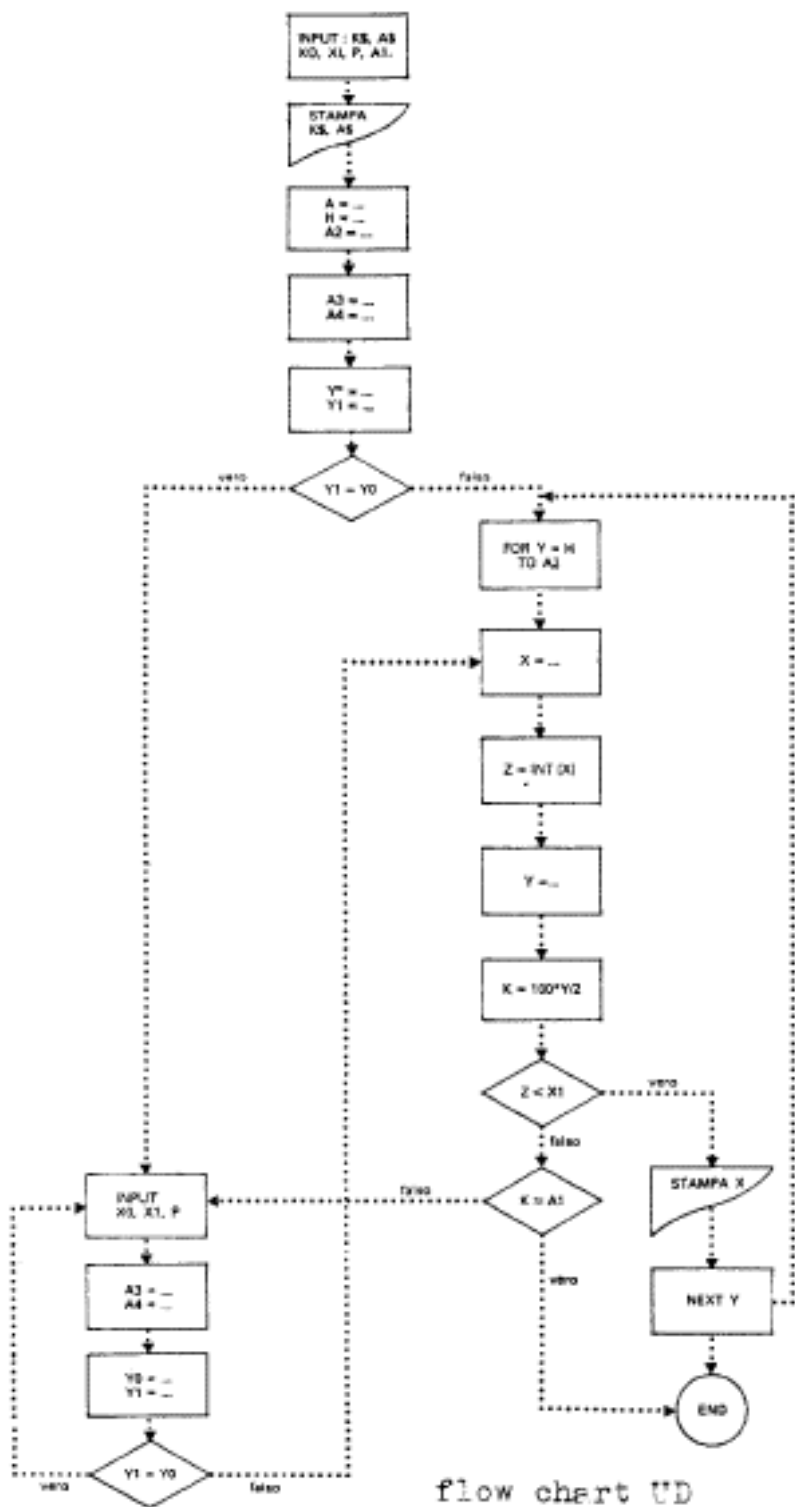
Time Program - TP - estimates and shapes in the time, the progress of the works, shared synthetically into building categories.

- . Calculates the building categories time: - works distribution by category - typical times of each work - cumulation of category time.
- . Points out time flowing: - priority according to the logic sequence - advanced and delayed starting dates - advanced and delayed work's end - free fluctuation.
- . Values the allowable overlaps: - complementary works compatibility - following works continuity - convenience limits of the flowing.
- . Sets the assigned times: - effective starting dates - effective end dates - technique breaks - time assigned to the building - safety margins.
- . Plots the diagram: - puts the dates in chronological order - records the program dates - confirms forecasts during the works course - changes the running absolute dates in calendar dates - records the works progress.

Work Plan - WP - relates, referring to the time, the works progress which are the object of the process marking the building category.

- . Derives the considered category time: - starting date - ending date.
- . Calculates the times to be assigned for each process: - production unit time - required product quantity.
- . Plots dates for the starting and ending process.
- . Looks for the chronological positions where to place the intermediate processes times.





"logical sequences",

Category Scheme - CS - shapes the sequence of processes and recognize them within the building category.

- . Points out the making up activities: - similar works association - process definition - procedures coding.
- . Arranges the operational processes: - logical sequence - priority sharing - functional arrangement - interferences and discontinuities.
- . Compiles the connections reticule: - records the processes - points out the production progress - finds the repeatability degree - prearranges the detail analyses.

Process Schedule - PS - compares and describes analytically the operational characters concerning the process.

- . Points out the operational sequence through the events which mark the process development: - procedure sequence transcription - operational modalities recording - statistics of production factors behaviour and efficiency.
- . Calculates the assigned production: - looks for the medium-normal entity - evaluates the influence of the subjective, objective and environmental factors - gives the production unitary time - relates the assigned time to each building event.
- . States operators team and works loads for each operator: - numerical composition of the team - workers qualification - utilization coefficients.
- . Shows the necessary materials by quantity and proportion: - primary components - complex materials - component products.
- . Points out the equipments to be used regarding to the choiced method.
- . Specifies data processing: - schedule number - drawing up date - operator analyst - comments and remarks.

"operational analyses"

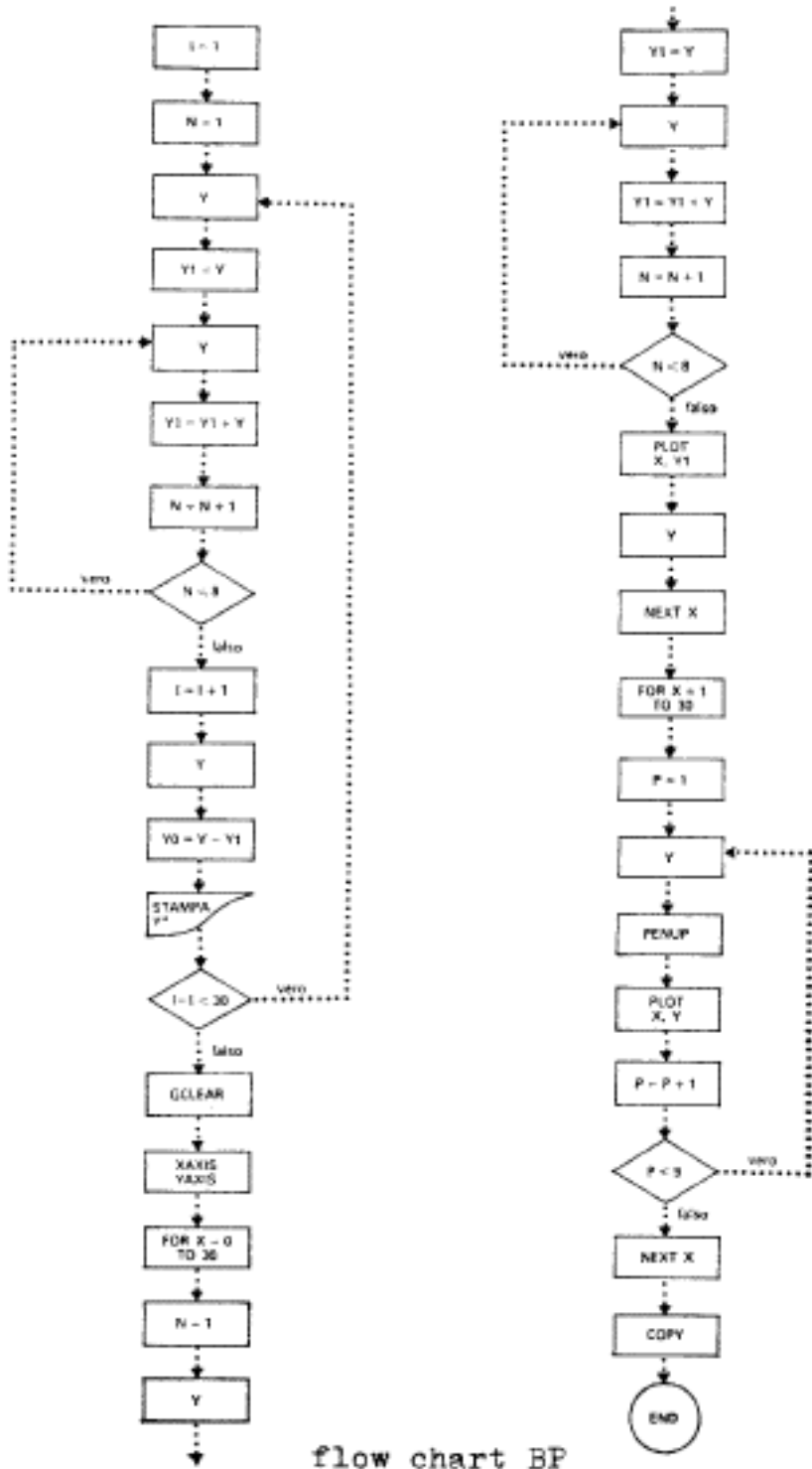
Utilities Diagram - UD - relates the materials employment according to work program, and fixes supplies dates and needs to carry on the preestablished program.

- . Relates the scaled units: - of the finished product to be performed - of the complex materials to be composed - of the primary components to be supplied - of the supply units.

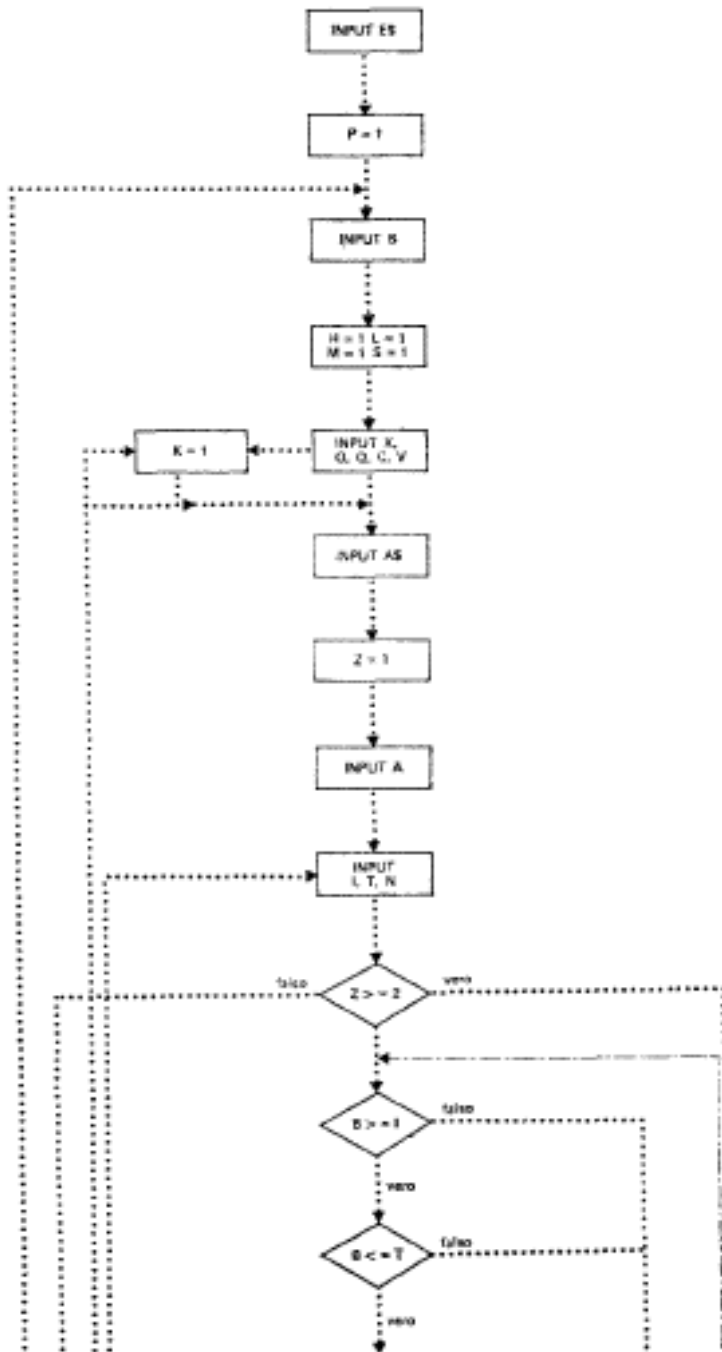
- . Plots the diagram: - cumulatively reports the product quantity to be performed - refers the plot to the respective scales - understands the diagram.
- . Points out the supplies technical terms: - locates supply units within the components scale - outlines relation of the specific supply units - points out these relations on the plot - records the supply critical dates.

Budget Program - BF - translated the production hypothesis given by the planning, into budget forecasts, by means of a cost components and probable proceeds analysis, time referred.

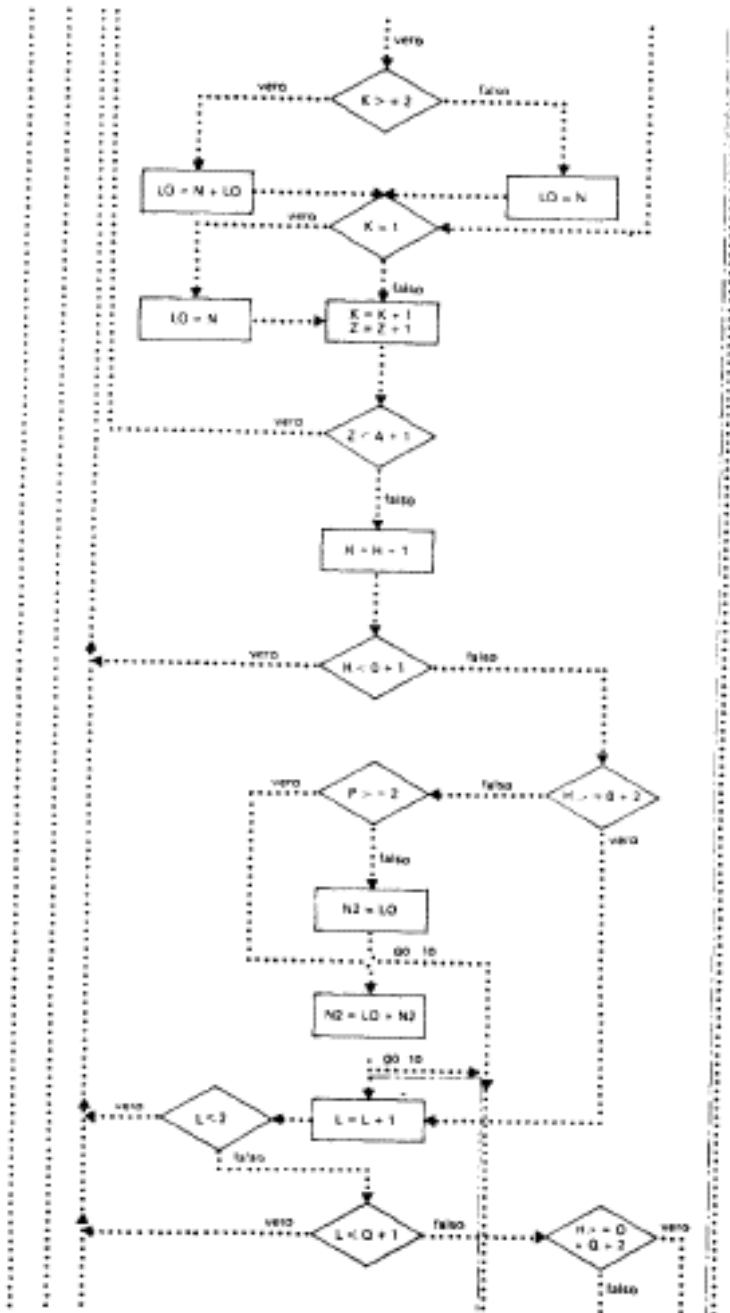
- . Yard installation cost diagram: - enclosures and accesses cost - barracks cost - connections, temporary nets and waste disposals - installations of operating machines - arrangements of conveying plants - adaptations to the internal net - arrangements of fixed work places - surveys and layouts.
- . Yard management expenditures diagram: - water and power supply expenditures - fiscal expenditures - insurance and surveillance expenditures - telephone expenditures and others - removal and recovery expenditures - maintenance of the executed works.
- . Contractor management expenditures diagram: - administration costs - book-keeping costs - aid and technical direction costs - valuations and plotting - contract costs.
- . Workers cost diagram: - attendances summaries - payment levels - foresight contributions - specific costs.
- . Equipments cost diagram: - required equipments - utilization times - depreciation, maintenance and year allowance - hire cost - tools cost.
- . Supplies cost diagram: - supplies distribution by goods - quantities and measurements surveys - terms of payment - amounts to be allowed - payment dates.
- . Sub-contracted works cost diagram: - pieceworks - work supplies cost - assistance costs and subsidiary performance.
- . Proceeds diagram: - prices, formalities and terms of the payments agreed upon with buyers - bid prices and work quantities to be performed - delayed tankings and resulting interests.
- . Funds cost diagram: - financial exposures fixing - time discount survey - interest rates fixing.
- . Summarizing costs and general expenditures diagram: - yard installation - yard management - contractor management - workers cost - equipments cost - supplies cost - sub-contracted works cost - funds cost.

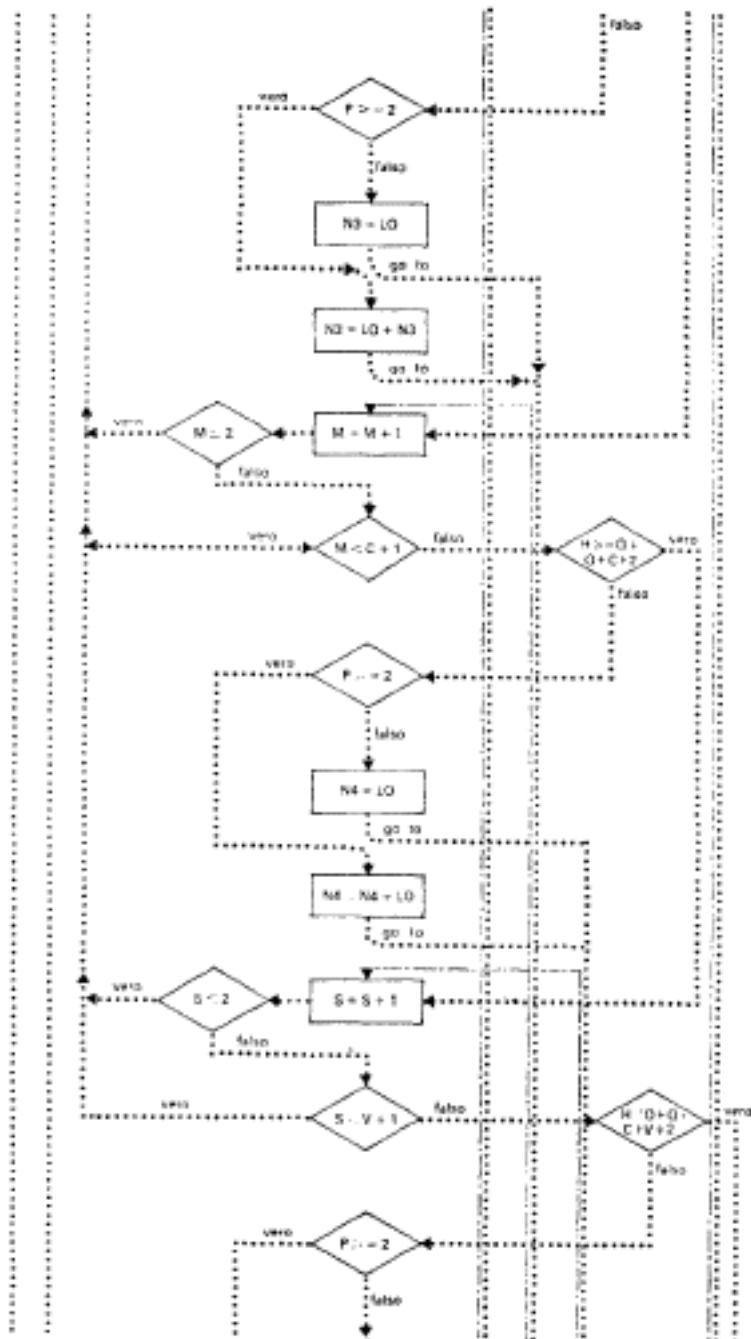


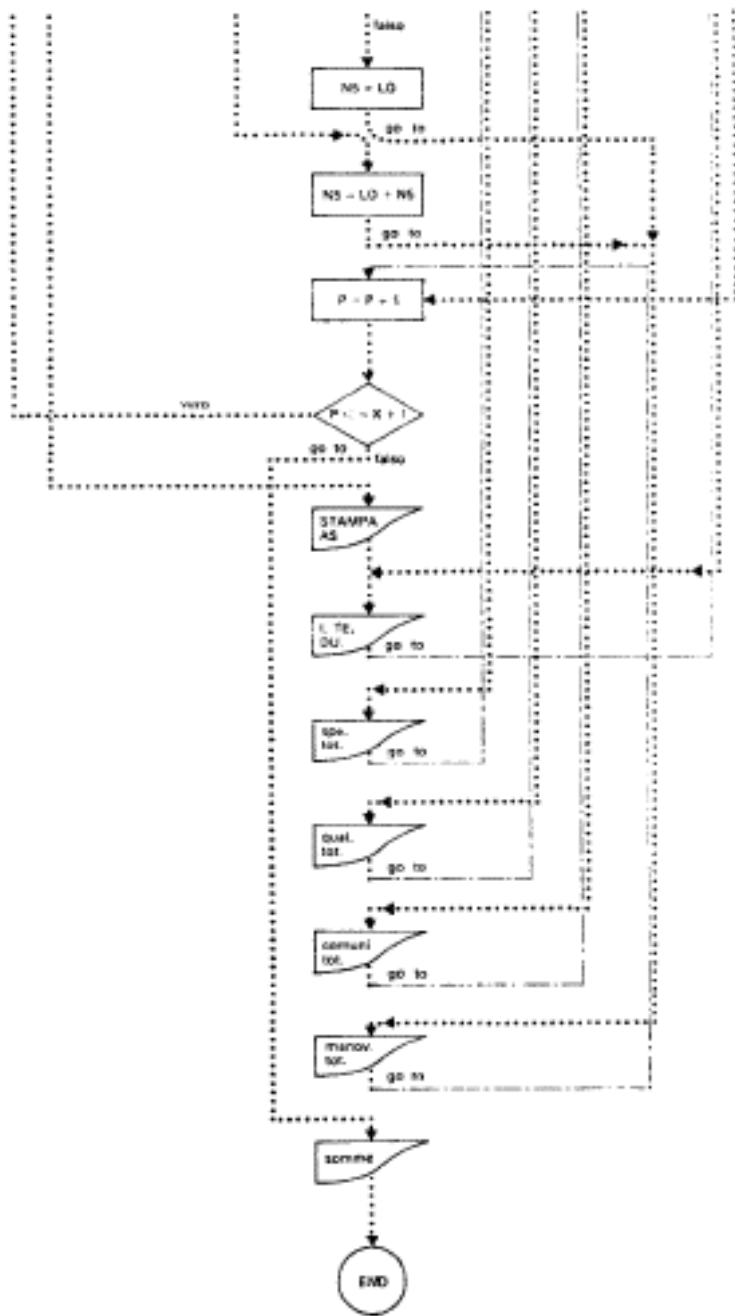
flow chart BP



flow chart WS







"proceeding phases"

Equipment Summary - ES - identifies and summarized the equipments utilization, according to the mechanization achieved by the building process.

- . Points out the equipment needs starting from the schedules of processes which use them.
- . Calculates the times involving the development of these processes.
- . Records the utilization times, starting and ending dates, of each equipment.
- . Provides to equipments check.

Workers Summary - WS - aggregate and detailed sets the needs of workers engaged in reaching the building program.

- . Reports the number of workers required with respective qualifications and specializations.
- . Draw up the starting and ending dates of each process.
- . According to yard needs, gets use times of general services workers.
- . Reports the total number of attendances, referring to the related specializations, for each working day.
- . Makes out the daily attendance summary by payment categories, dividing workers into specialized, qualified, common and hodmen.
- . Records, for checking, the effective attendances registered in the yard to be systematically compared with the foreseen ones in the summary.

Supplies Summary - SS - fixed, chronologically ordering them, maturities on which to give orders for supplies, referring to the established terms within which each supply must reach the yard.

- . Identifies supplies: - primary components - complex components - intermediate semi-finished products - simple finished products - complex finished products - working plants.
- . Reports supplies typical data: - necessary quantities - needs in the time - supply units.
- . Points out suppliers: - marketing researches - selecting criteria - contract and delivery modalities.
- . Gets the supply need dates: - deduced from the utilities diagram - deduced from the work progress plans.
- . Sets the supplies ordering dates: - supplies type - suppliers behaviour - findability on the market - previous

. Records the supplies delivery dates: - deliveries registration - unlikeliness survey - follow up interventions - behaviour to be assumed for the following orders.

"building planning"

Building Plan - BP - summarized building processes chronologically set, according to the starting data, and identifies them through the reference to the respective schedule, reporting the outstanding aspects of each of them.

. Chronologically sets the works: - starting running absolute dates - running absolute times.
. Fixes the works calendar: - effective starting dates - supposed ending dates.
. Records the work progress: - effective ending dates - effective times.
. Reports the references in order to identify works: - references to the contractor and the yard - process schedules sigla - building schedules number - work type.
. Writes out the employed factors out standing data: - employed teams - used tools - needed materials - specific instructions.

Building Schedule - BS - gives operational instructions for each building procedure.

. Sets building times and procedures: - indicated production - production unitary time - building events description.
. Fixes the building sources: - team composition - material needs - equipments availability - remarks and executive drawings.
. Points out the references of sequence: - process schedule sigla - schedule order number - building form progression.
. Indicates times and building dates: - starting running absolute dates - absolute time - starting effective date - estimated ending date - effective ending date - effective time.

Building Form - BF - arranges the executions and the sources assignment of each work building, putting it in the time and in the place.

- . Gives the tasks to be assigned: - task description - work location - dates and times - reference and number.
- . Establishes the necessary sources: - teams - tools - materials - instructions.
- . States works direction procedure: - executory names - starting and ending dates - operational modalities check - instructions acceptance - occurred execution check - product suitability certificates - spurs and job contract evaluation.
- . States works execution procedure: - agreement with the execution prescriptions - execution engagements assumption - works ending proof.
- . Posts up to date the building planning: - possible unlikelinesses recording - influences of outer or production specific factors - planning mistakes - actions and interventions - book-keeping up-dating - spurs arrangement - efficiency indices recording - statistical data processing.

FICONE K. Building Production Technology
 Industrial methodics and operational
 technologies for the building yards
 UTET, Turin, 1984.

**Order a complete set of
eCAADe Proceedings (1983 - 2000)
on CD-Rom!**

**Further information:
<http://www.ecaade.org>**