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empêchent un développement précis. Le coût de transformation pour l'adaptation des appareils de cuisine et de buanderie est, à l'heure actuelle, trop élevé pour justifier cette normalisation. Ce problème à résoudre est du domaine de l'avenir.

Choix d'un module approprié

Il peut étonner que seuls quatre modules standards soient reconnus aux Etats-Unis. L'importance de cette mesure n'ait cependant pas à sous-estimer. L'accord sur le module « pouce » pour la construction représente un pas en avant. L'adoption unanime d'un nouveau module est la base primaire pour toute activité future. Elle est le résultat d'études très approfondies.

Normalisation des plots de construction

L'adaptation des fabriques de plots à une mesure de module a eu des résultats très concrets. Cette industrie est considérée depuis toujours comme la clef de toute la fabrication du bâtiment.

Normes types

Le développement technique et social, l'expression architectonique, les expériences pratiques, les différences de climat et les détails particuliers de chaque construction, ne permettent pas de concevoir des normes types définitifs avec succès de garantie.

Histoire du développement de la normalisation

1921 Premières études avec le module de 4" par l'industriel Bemis;

1936 Publication « The Evolving House » par Bemis dans laquelle il propage le module de 4";

1938 American Standard Association (ASA); fondation du Comité A-62. L'American Institute of Architects et le Producers Council deviennent « parains » du Comité A-62.

1939–1943 Normalisation de bâtiments militaires;

1945 Mise en vigueur du module de 4" comme standard américain;

1948 La Modular Service Association est dissoute;

1949 L'AIA fonde un bureau pour « modular coordination »;

1950 La National Association of Home Builders devient troisième « parain » du Comité A-62;

1956 AIA Bureau pour Modular Coordination est dissout;

1956 L'Associated General Contractors of America devient le quatrième « parain » du Comité A-62;

1957 Fondation de la Modular buildings standards association sous le patronat de AIA, AGCA, NAHB et du PC. Bonnes organisations avec de solides finances, grands progrès.

On remarquera combien une organisation mal dirigée et avec des moyens financiers limités est handicapée dans son développement normal.

Organisation actuelle et son travail de normalisation

L'instance supérieure de cette organisation est la American Standard Association (ASA). Cette organisation nationale est financée par l'industrie. Le Committee for dimensional coordination of building products and materials (A-62) lui est subordonné. L'autorité exécutive du A-62 est le secrétariat de la Modular Building Standards Association (MBSA). En complément de ces organisations, l'U.S. Army Corps of Engineers et la Veterans Administration ont leur part méritoire dans ce travail d'avant-garde.

Difficultés dans l'exécution des normes

Deux facteurs importants ont empêché un travail fructueux pendant les 35 dernières années:

- le manque de moyens financiers;
- le choix d'une époque non favorable à l'adaptation de produits normalisés auprès des architectes et fabricants.

Offres et demandes

L'index momentané de la demande de produits normalisés de la part des architectes et entrepreneurs d'un côté, et de l'autre l'offre de produits normalisés de la part du fabricant, est un des problèmes les plus difficiles à résoudre dans l'application de la théorie d'une norme.

Conclusions

Normes types et dimensions normalisées

Les normes de construction des Etats-Unis se divisent en dimensions normalisées et en normes types. Les dimensions normalisées règlent les questions de mesures, c'est-à-dire depuis le plus simple niveau jusqu'au système de module coordinateur.

Les normes types spécifient la forme, les mesures, ainsi que les avantages et qualités des éléments de construction.

Une dimension norme correspond toujours à un module de 4". La norme type comprend toutes les autres normalisations. Si, par exemple, nous parlons d'un plot normalisé, cela veut dire que le produit est aussi normalisé dans sa forme. Autant un ordre de dimensions offre des avantages indéniables, autant les efforts de vouloir produire à tout prix une norme type ne se justifient guère. La normalisation, dans ce cas, a tendance à paraître superflue. Il est regrettable que les autorités compétentes ne discernent pas mieux les différents buts et les nécessités de ces deux genres de normes.

Alors que nous comparons un produit dans ses dimensions et ses raccords à d'autres matériaux dans le cadre du module, nous constatons, malheureusement, que les formes et les profils standards sont sujets à un marché dicté, ce qui empêche une concurrence libre. Le développement d'une norme type devrait être du ressort particulier de chaque fabricant. La difficulté de produire une norme type, et la réalité, qu'en dehors des briques aucun produit, dans sa forme et dans ses dimension, n'ait pu être declaré normalisé, explique clairement les inconséquences de conception entre la dimension norme et la norme type.

But de la normalisation

Le désir d'introduire dans la construction un ordre de modules paraît aujourd'hui s'avérer approprié et prometteur. Le module ne définit, en fin de compte, que les dimensions de raccords d'éléments finis. La liberté d'expression peut ainsi être sauvegardée. La discipline dans le choix des dimensions extérieures ne devrait, en aucun cas, porter atteinte à l'esthétique. Avec l'introduction d'une unité de mesures dans la construction, on doit pouvoir s'attendre à une rationalisation du travail, et, par conséquent, à une réduction du côut de la construction. Le travail de l'architecte s'avère d'année en année plus difficile étant donné l'apparition sur le marché de nouveaux matériaux et produits. C'est avec réserve que l'on accueillera tout optimisme qui promet d'obtenir une réduction du prix de la construction.

La création d'un ordre de module n'est, en fin de compte, pas le moyen définitif pour parvenir à une épargne dans les méthodes de construction. La simplification du travail est, par contre, indéniable et semble aujourd'hui le facteur principal pour cette normalisation.

Summary

Jacques Henry

Business Planning
General Planning
General Undertaking

(pages 442–445)

General Planning and Business Planning

In Europe, as in other parts of the world, general planning is ceasing to be a purely speculative affair and is now assuming a more and more important role.

Ideas such as collectivism, planned economy, etc. are concepts falsely used in connection with this expression "general planning", which, by the way, describes the present period even more felicitously than one such as "the atomic age" (UNO, UNESCO, EEC).

Unlike planning, in the restricted meaning of the word, such as was carried out in the past, nowadays it is an easy matter to draw up 20-year programmes on a different level of coordination, organization and combination.

Modern planning is flexible and adaptable; of all things it is not rigid, for its essential prerequisites are free commercial exchange and maximum flexibility in management.

The rapid development of general planning is explained by the frequently unsatisfactory results arising from the method where the "free play of forces" is brought into application. Over and above this, the astonishing expansion there has been in the world's population makes generalised planning of the world's economy necessary (international market, exploitation of energy, etc.).

The problem as regards existence has become more acute with the development of the countries susceptible to economic advance. The need for organization is growing with the importance of investment and the stocks of large concerns and will necessarily lead to global planning, and this on an international level even. The end product is, therefore, general planning.

The results of such planning are based essentially on a certain code of ethics, which, in this case, implies a sense of responsibility and infallible confidence in the choice of the aim to be pursued.

In the course of one generation our age has experienced fundamental economic, cultural, social, political and spatial changes, which have manifested themselves in our surroundings, in our towns and cities, in industry and in the nature of our experienced life.

But whereas the means open to us make a state of perfection possible over an increasingly great area, our "raisons d'être" are becoming more and more incapable of being fathomed. It is this – this lack of certainty, this shadow of doubt – which has created the tragic flaw in our epoch.

By virtue of the very fact that we are unable to pronounce judgment upon vital matters, we are confronted by an almost overwhelming sea of difficulties if we attempt to achieve even a meagre result.

To counter this problems of research, organization and planning must be re-examined and carefully studied. Nothing other than a systematic form of coordination will make it possible for us to master this confused situation.

Diagram 1 is a simplified picture of the position of general planning as a motivational force in business activity as a whole.

1. The outer triangle defines the key conditions imposed on industrial activity.
2. The middle triangle represents purely material, industrial activities.
3. The inner triangle symbolises rational and intellectual activities.

In this classification general planning falls under the inner triangle; it is concerned with projection and intellectual activities as a whole, whereas general business activities are concerned with the realisation and execution of the projects drawn up under general planning.

needs
production
analysis
general planning
general undertaking

planning	organization
consumption	distribution
demand	offers

Methods

In itself it is difficult to explain what are the essential features of general planning; it is even more difficult to elucidate its methods and we shall restrict ourselves to the description of various methods of procedure.

The first thing to be done is to reply to the following questions:
What are the motives underlying general planning?
Who gives the order for general planning to be undertaken?
Who does the planning?
What sort of contracts are drawn up for a planning programme when a contract is concluded with third parties? How does planning evolve; what is the course taken when it is executed.

We shall take an example from rationalised buildings to illustrate business planning, its origins and its causes.

1. The entrepreneur – or the contractor – and his collaborators are entirely taken up by their normal business activities.
They lack experience in the field of construction since these questions only concern them from time to time.
2. Although common sense is a factor of primary importance in building and in planning the site, in itself it is not enough to ensure success.
3. A certain cecity in the concern or intellectual inertia creates resistance to any innovation. Thus, it seems easier to retain old methods than to carry through to the end a way of thinking that is new and has no experience behind it to back it up.
4. In these circumstances the architects in charge of the projects and the building-site are, generally speaking, not aware of the real problems in the planning of the enterprise, since their principal concern is directed towards the artistic aspects of their assignments.
5. However, the ability to plan in advance mentioned earlier on is rarely given to architects, contractors and entrepreneurs.
6. In the German-speaking parts of the world teamwork is still something utopian, for the structure of their economies seems to lend itself only to conditions unfavourable for the founding and existence of planning offices where it would be possible to have under one roof all the indispensable experts demanded by the general planning of the enterprise.
7. Lack of time – effective or virtual – makes it impossible for the planning programme to produce satisfactory results.
8. The most important offices and organizations for general planning have, for the benefit of business men and the experts they employ, drawn up a set of guiding points which covers all the factors that have to be elucidated by the entrepreneurs themselves before the work of the planning organization can begin.

Here is a summarized version of such a set of guiding points (Kiddie Constructors, New York):

1. Production quantity defined by the sectors of distribution and commercial research and by the distribution statistics with consideration being paid to profit and loss as regards each product and the maximum capacity of all existing productive machines.
2. The operational plan drawn up by the management of the firm determines the quantity manufactured of

each product, bearing in mind both existing plant and investments planned.

3. The analysis of the profitability of the products and their constituent elements will define what products have to be made on the spot and what should be bought from outside and what the conditions of purchase will be; all this will be studied by the production engineers and the purchasing department.

4. The management of the firm will synthesize the above data.

5. Attempts should be made to improve the work flow and that of materials on the basis of the findings of the work study itself with a view to increasing simplicity and decreased wastage. In conclusion, the annual profit figures will be compared in relation to investments.

6. The management of the firm will then check the project based on the preliminar data and will set the scope of the planning office's research work.

7. The production engineers' department will coordinate the plans regarding the work flow with commercial requirements; this will make it possible for a basic plan to be drawn up covering the purchase of tools for the machines planned and the buying of plant.

8. Once the best possible lay-out from the point of view of rationalised production has been worked out, the three departments – assessment of investments, buying and production engineers – will give their definitive go-ahead, which will be based on a joint study of the foregoing proposals. At this stage they will opt for a business policy which will lay down the ratio between immediate distribution and stockpiling. The synthesis of this research will specify a constructive organigramme: level of empty space, equipment, gantries, energy quantum, secondary products, etc. (definitive adoption of lay-out).

9. The management of the firm – once all the preliminary data have been brought into line with its extension policy on a definitive basis – will draw up an inventory of equipment necessary for current production (machines, supplementary plant, etc.) and a programme, the lay-out, and the investment costs for the factory in the future.

These guiding rules will settle all the technical and economic questions; it will also constitute the basis for the implements used in rough work done on the site.

First phase of the general planning programme:

A complete overall project covering the enterprise.

The principle underlying this programme:

1. Perfect organization and planning.
2. Judicious choice of site.
3. Rational handling of problem in question.

Good organization of the opening up of the site requires precise programming at every stage.

Thoroughgoing general planning requires considerable time, for it has to coordinate all constituents and each of these, in the final analysis, is a separate field in itself.

Only an overall view of the situation, that is a comparative evolution of the problems and not merely simultaneous development, will condition new discoveries and progress. For this reason the attempt has been made to unite as many individual sectors within one form of organization, general planning.

Even today when a post-mortem is being held on some important assignment in a German-speaking country, it must be admitted that the lack of coordination results far less from external circumstances than from an absence of comprehension, a certain sluggishness, a refusal to collaborate in a rational manner and an inadequate programme.

The effective profitability of a planning team depends greatly on the quality of its programmes.

This team comprises:

1. The contractor, his financiers and his experts.
2. The architect in his role as organizer, technician and constructor.
3. The civil engineer in his role as an expert on building-sites and static calculation, as constructor.
4. The experts responsible for heating, ventilation, air-conditioning, lighting, sanitary equipment, acoustics and problems of insulation.
5. The expert on energy questions.
6. The firm responsible for the work together with its own experience in the field of construction.

The planning of the enterprise comprises the following people:

1. The planner of the enterprise.
2. The architect or civil engineer.
3. A representative of the firm's management for the factory planned.

The management of the team is a secondary matter. What is necessary is an infallible goal and the coordination of the team's efforts.

The essential phases in the general planning programme for the enterprise's overall project are:

1. Specification of the factory site.
2. Overall constructional project.
3. Summary plan for enterprise.
4. Detailed enterprise plan.
5. Execution of work (building-site management).
6. Highly detailed planning as regards internal layout and problems arising from any changes made to it.

In connection with this final point, we would point out the importance of applying a module, for only a modular system allows for a very flexible system that can accomodate itself to new circumstances.

The summary lay-out will show whether it is wise to build upwards or not. It is also necessary to be aware of overloading problems and those concerning the phreatic layer and grades.

This general work for the overall project can be summarized as follows:

1. Site plan (cadastre).
2. General zoning.
3. Specification of the main transport and movement axes.
4. Specification of module.
5. Specification of zones with their various building-heights.
6. Special questions (e. g. Is the entry grade suitable?).
7. Planning of building stages with their extension axes.

Here is a diagram that illustrates this idea:

siting

site plan	plan of zones
transport axes	module
building heights	special questions

summary planning
detailed planning

This diagram shows with compelling clarity the vital importance that devolves upon the choice of site.

As questions of transport, energy and finance are of roughly equal importance in flat regions, the basic question is the labour market. This has to be borne in mind when a sudden measure of decentralisation has been decided upon, for if coordination is poor, the range of qualified staff will be limited.

In connection with this, the resemblance between town-planning or the handling of land and general planning or business planning should be pointed out.

Town-planning:

1. Demographic problem, residence problem.
2. Activities.
3. Movements and transport.
4. Green belts and open spaces.
5. Public utilities.

Business planning:

1. Personnel.
2. Production, stocks, office.
3. Transport.
4. Free development zones.
5. Administration.

These examples go to show the importance of the relations which exist between the course of business, transport and the utilisation of space. These planning elements are not additive but correlative (see Diag. 3).

Of course, concepts like "the course of business" are to be taken in their widest extension; this term also implies production, stocks, administration or the factory canteen.

It is possible to give two principle regarding organization and the course of business:

1. Grouping work points strictly on the basis of production flow.
2. Grouping work points strictly on the basis of work flow.

Diagram No. 4

Production flow

surface diagram (volumes)		distribution and division of space
spatial requirements	transport links	detailed planning
structuration principle		destination of plant
processes machines plant		planning of changes
work flow patterns		execution of constructional work

business activities

Diagram No. 4 shows the constants that obtain between business planning and constructional planning. Any problem can only find its optimal solution by way of numerous experiments based on various possibilities. One could compare these various attempts to the work of the civil engineer, who calculates his static system on the basis of different loads. The main relationships have to be defined, the secondary ones eliminated. In addition, the height below the ceiling has to be fixed and a unit established for the quantity of materials to be transported at one and the same time. These considerations show the importance of the various forms of material flow.

In this case "material flow" means the movements undergone as a whole by the various materials in the widest meaning of the word. These movements are only really capable of flowing when the transport channels are short and easy to supervise.

First Method

The first method in business planning presupposes precise bases that will make it possible for an operational plan of a definitive nature to be set up.

A perfect plan for operational flow is then obtained (see Diag. No. 5). This specifies the order and the relationships valid for the various production procedures. To be in a position to assess operational flow it is necessary to select various 'load factors' on the basis of a transport unit which covers the quantity of material transported at one time.

The number of transport links are then loaded with this unit. As the data from the preliminary analysis of the enterprise give precise details regarding the quantity to be produced, etc. it is simple – with the help of a punched card system – to establish a sort of table from which one can read off the transport relationships, which will show the number of links that each section has with all the others.

By applying different loading factors to these links, there is obtained a table for the transport capacities in the entire concern (cf. Diagram No. 6). In a triangular diagram (No. 7), there are grouped the transport relations according to their density, amassing the most frequent links and siting the others at varying distances in proportion to their importance. The diagram reveals what will be the most heavily loaded links and will thus determine the distances between the different sections.

With the most favourable triangular diagram there is thus established a table of the surfaces or the volumes that are required (cf. Diagram No. 8), in which there is assigned to each section the space corresponding to its function in square meters, preserving their positions relative to one another, as can be seen in Diagram No. 7.

With the aid of this surface diagram and a plan elaborated in parallel by an architect, there is drawn up a layout of surfaces which takes into account all the architectural factors. Then the diagram and this lay-out of surfaces serve as a basis for the differentiated planning.

Here are the essential factors:

1. Surface (or volume) for each section according to the surface lay-out.
2. Models (of machines, of staff, of vehicles, etc.).

And there is sought:

1. The optimal surface utilization which can eventually lead to a correction of the summary lay-out.
2. The most rational flow of materials on a differentiated scale (from man to man, from machine to machine, etc.).

The methods for doing this are as follows:

1. To attempt different variants on models.
2. Different possibilities for the realization of models and reproductions.

These are the criteria:

Clarity in representation.
Facility of handling.
Ease of copying and reproducing of each of the variants (so as not to lose them) minimum expense in labour and materials.
Normal scale: 1:50.

Here are the principal types of models for a lay-out:

1. Lay-out in cardboard.
2. Double-face collage process.
3. Magnetofix process.
4. Spatial model.

The three-dimensional model is the most costly, but the most representative, above all, for a non-expert. The expert will content himself with a collage model or a Magnetofix one.

It is interesting, however, to note that the most rational solutions from the point of view of spatial economy differ only very little from solutions having other criteria.

Second method

The second method presupposes neither the type nor the quantity of the different operations. It is based on results issuing from measures taken during fabrication. Then, it makes use of the same types of diagrams as the first method for the definition of a lay-out.

Here is a summary of the principles giving rise to a good lay-out:

1. The execution that is most favourable according to a time budget, investment and labour costs.
2. The most favourable execution according to the possibilities of future development and according to its development costs.
3. Determination of the warehouse surfaces for raw materials, secondary materials and elements purchased outside.
4. Establishment of a preliminary layout utilizing machine extracts, samples or models taking as basis plans of work flow.
5. Determination on the spot of warehouse surfaces and stock installations taking into account the possibility of easy but constant inventory checks.
6. Determination of warehouse installations taking account of an adequate over-all view as well as of an economic means permitting easy loading and unloading.
7. Disposition of fabrication installations according to a logical sequence of work flow taking special account of intermediary stocks.
8. Elimination of useless transport and tendency toward transport lines kept as short as possible.
9. Grouping of secondary installations: distribution of tools, cloakrooms and toilets, repair shops, administration, access ramps, transformer stations, etc., with a view to rendering them more easy of access.
10. Taking into account future possibilities for an extension of the different sectors or of the entire enterprise.

Organization of the planning

If we consider the American planning enterprises and their organizations, we should recognize that these offices function neither in an orthodox nor in a schematic manner. In the USA there exists, however, this type of architectural office which is current in Europe, but it associates itself on a voluntary basis with other liberal institutions for the elaboration of a particular assignment.

There is more frequently encountered, however, a permanent association of four specialists: architect, civil engineer, mechanical engineer, electrical engineer. If the team decides on specialization, it can associate, for example, with engineers versed in the lines of production which also are concerned with lay-outs.

It can happen that these lay-outs are drawn up by the contractors themselves who then associate with engineers specializing in rationalization.

The general enterprise which is entrusted with the execution of the work and which is confronted by an institution for the general planning of operations is in principle solely responsible before the contractor for correct execution of the actual job within the time limit. This enterprise is entrusted with all orders, even if, generally, it carries out only the rough work.

For other projects it engages subordinate enterprises, but it is the one that guarantees everything, it is the one that undertakes the supervision of the entire project and of coordination of all separate functions.

This type of enterprise therefore concerns itself with a number of jobs that in the German-speaking countries fall within the domain of architects.

In the USA there also exist institutions which are engaged not only with the general operation but also with planning. When they associate with still other specialists, they can assume the following type of contract:

We have 8 million dollars; propose a profitable undertaking to us; look for an adequate site and build on it a factory; tell us what machinery we ought to purchase; install it and find men capable of directing this operation. Finally, turn over to us an enterprise ready to function according to a pre-determined manufacturing and sales program.

This kind of contract is called a turn-key project or package project.

In the USA planning can comprise dimensions that are unthinkable in Europe. It begins with the study of the market and the determination of the scope of production envisaged, and it ends with a construction project and its execution.

What are the features of the contract concluded with a general enterprise?

1. Contracts at unitary prices:
Rarely employed (prospecting; Government projects: schools, hospitals, etc.).

2. Contract on basis of investment cost with a supplement calculated in %.

3. Contract on basis of investment cost with global supplement.

4. One of the contracts on a basis of investment cost with a guaranteed final sum the surplus of which is divided between the contractor and the organizer (usually 75 % for the former and 25 % for the latter).

5. Global contract.

It is rare to find later changes in this type of work, for the plans are executed to a point of the utmost precision. Moreover, for a contract of type 5, a change could create difficulties. They ought therefore to be based on a special order that comprises all the conditions for the undertaking.

What is the make-up of a team of such an undertaking as we have described above? Here are some of the possibilities of organization for such teams:

1. Architects, planners and engineers in free collaboration.
They are not bound either by contract or by a common place of work.

2. Large engineering firms with their specialists. For other experts: free collaboration.

3. Studies by managers with minimum executive personnel. They engage associates either in the shape of an organization or on an ad hoc basis, depending on the importance of the projects.

4. Giant planning concerns with their own employees (one thousand and more). They have all needed specialists and undertake as well the direction of the work project, when they are working for a general enterprise. The methods of operation of this kind of organization resemble one another more or less.

Types 2. or 3. Would be best adapted to European conditions.

Diagram No. 10 illustrates such a general planning organization.

This form of organization always remains flexible, simplifies the job of the contractor with regard to his planning and gives him a guarantee that the job will be well done. The advantage of such a solution resides in its economy with partners benefiting. This solutions also permits a strict organization as well as a high degree of flexibility. This general planning organization can assume the responsibilities of a general enterprise, if it has collective contracts with the personnel carrying out the actual works. Thus we find again the principle of a total general planning enterprise.

contractor

exclusive relation on basis of general planning based on a corresponding contract — general planning with architects and engineers

collective contracts (long or short term)

market study — organizer of operations — economic geographer etc.

Franz Füeg, Solothurn

The plan of the University of Punjab in Lahore

(pages 446–455)

Planner and architect: Doxiades Associates, Athens
Direction of planning: Dr. C. A. Doxiades
Chief of planning group: C. Crantonellis, architect

Plan initiated in 1958, construction 1959

The University of Punjab in Lahore (Pakistan), founded in 1882, was the first institution of higher learning in the country. It assumed especial importance when Lahore, after the partition of India, became the capital and a cultural centre of West Pakistan.

The old University buildings are situated near the centre of Lahore and are surrounded by a business district. The expansion of the University would have been possible only on a site in the midst of intense urban activity. The University authorities judged the location to be inappropriate as a centre of learning. Moreover, real estate prices were far too high. The University of Punjab therefore decided to establish a new university complex in another part of the city.

The firm of Doxiades Associates of Athens was assigned the project. The planning work was carried out by a group in Lahore, and the actual project by another group in Athens. The former assembled and marshalled the elements necessary for the setting up of the program; the latter presented the final building plan.

Historical Aspects

The Punjab is situated in the north-west of the Indian sub-continent. Lying between central and western Asia, it has suffered continually from invasions, from Alexander to Queen Victoria. It is owing to these constant cultural influences that the Punjab has become one of the most important academic centres of Asia. The main influence has been that of Islam, especially under the rule of the Moguls. Islamic architecture proceeded mainly from Persia. Lahore was founded toward the end of the first century A.D. and rapidly assumed a position of importance within the kingdom. Mosques and royal palaces were constructed here.

Indo-Islamic architecture is famous for its sublime disposition of open and enclosed spaces; halls and towers delimit the interior from the outside.

The filigree work of the elevations is expressed in a geometrical rhythm among the halls, fountains, lawns, as well as the avenues and paved squares.

The lay-out of the open spaces shows Islamic influence. Not only the important or princely buildings, all situated on the interior of fortresses, but also simpler structures in the city bear the seal of a noble architectural tradition. There are also buildings of several storeys with wooden skeletons.

The climate of Lahore is sub-tropical with great differences between the hot and the cold months. Daily temperatures range 11° C; maximum humidity attains 66 %.

The factors cited above have been crucial in the planning of the new University. The enclosed spaces have transverse ventilation. The corridors are, as a general rule, open. The avenues and verandas are often disposed in front of the rooms thus protecting them from the sunlight.

The classrooms are open to the prevailing winds (north-west and south-east) for the sake of ventilation. Other rooms, such as the library or the offices, are ventilated and air-conditioned mechanically.

The interior courtyards and the stoas are not only connecting elements among the various buildings, but also serve as common open-air assembly areas.

Location of the University

The University will be located 8 km from the centre of the city on a sloping site. The complex will be accessible from all parts of the city. The site of 1,000 hectares, crossed from north-east to south-west by the Bari Doab Canal, is bordered by trees. Provision has been made for some transformation of the banks of the canal in order to protect the existing vegetation.

General Lay-out

The University is planned to accommodate 10,000 students, with possibility for a further 10,000.

It will comprise lodgings for 5,000 professors and their families, as well as for 5,000 students.

The University complex will be composed of various groups of buildings (direction, administration, lecture theatres, senate, printing-shop, library, museums, all the science installations, athletic facilities, gardens, business schools, fine arts, architecture, restaurants, hotels, etc. Along these buildings are grouped the playgrounds and 32 residences for 5,000 students.

The residence quarter will be completed last and will comprise different types of houses at medium price range and those for more affluent residents (430 houses in all) along with the necessary common buildings, plus a primary school. The low rental houses (total 1,400 houses) will share the above-mentioned common facilities. Moreover, each primary school will have its kindergarten. The service centre will comprise workshops, shops, laundries, garages, filling stations, fire station and dairy. The complex will be able to accommodate a total of 15,000 residents.

The arrangement and siting of the different buildings and other institutes separates academic activity from the private sphere. The difference also covers the conception of the buildings and their sites. Even the private life of the professors and students will be subject to this principle.

All the buildings are accessible to pedestrians and vehicles by well defined roads which do not intersect. The Bari Doab Canal separates the academic centre from the private residential area. Along this canal there has been run the principal avenue, which connects the different schools of the University.

The Schools

The main entrances of the different institutes are on the canal side. They can be extended independently toward the north-west. There have been planned on the north-east the buildings of the classical departments, and on the south-west those of the natural sciences. The buildings comprise one of three storeys. The administration offices are, in general, on the ground floor on the canal side; the classrooms are oriented toward the north-east. The professors' offices are on the upper floor. The labs and the utility area are concentrated on the north-west, on the ground floor or on the upper floor.

The total construction cost was estimated at around 200 million francs.

Fritz Haller

General Solutions for Structural Problems

(pages 456–475)

Development of certain types of construction:

History shows us that the people of each epoch have hit upon specific solutions for their problems: clothing, their tools, their methods of building. In construction, the basic principles have been preserved for centuries differing only in details, and we apply them to this day.

For fifty years, however, the industrial revolution and the influence of the machine have obscured the old traditions.

It is on the basis of the innumerable possibilities offered us by modern technology that the question has to be raised whether our era will lead to general solutions or whether it is characterized precisely by the number of solutions that it opens up for each of its problems.

The machine is designed for mass production: the machine itself is produced on a mass basis and on the basis of elements which are manufactured in different places and are designed for assemblage in different types of machines.

What we need is a common ground on the basis of which normalization can be achieved. Now, these norms are being established at a time when machine elements have not yet attained their perfection. Later changes then become difficult, if not impossible owing to the interdependence of the different elements. Thus, the development of machines and industrial products is suffering from inertia and is leading to general laws.

As for construction, this development can be noted in the field of household installations, where the influence of the machine is best shown; the result is a standardized furniture with little variations.

The interior atmosphere is coming to depend more and more on technical installations which, for their part, are requiring a modification of the conception of structural elements (partitions, ceilings, doors and windows); moreover, the new demands imposed by modern planning require new arrangements, a greater flexibility realized by movable partitions; also, the labour shortage and the increasing industrialization in the field of building are likewise contributing to the emergence of new work and building methods. All these factors constitute the fundamental change taking place in the building trade; it will become normed; typed or standardized.

Although everyone can see for himself the necessity for all this, a true realization of the consequences and interrelationships resulting therefrom remains excessively restricted to builders.

Te examples presented below are for the purpose of furthering such a realization; these are projects that were carried out consecutively in the same office and that are intended to be mutually corrective.

It is well-nigh impossible to arrive at perfection in detailing even on one single job, and a modification of the data obtaining will perhaps prevent this type of building from ever maturing. The perfecting of machines for the production of metal parts opens up new possibilities for the building trade, as does the discovery of new materials. Thus, in the USA it has been possible to develop transparent exterior walls much more rapidly than in this country.

Now, the question has to be asked as to what point individual research is justified. Our conclusions resulting from these four works presented here are the following:

It is only by a concrete application that one can realize the laws and the origins of these problems. This also permits a better understanding of other types of building and their field of application. It strikes us as of paramount importance, however, to recognize rather rapidly the ties among the different partial problems involved in construction and their relative influences when one of them is modified to obtain relatively achieved solutions. The new possibilities ceaselessly being offered us by industry are forcing us to call everything anew in question; this is why we are asking ourselves whether the establishment

of norms is justified at this time, when the development under way is causing the constant rejection of its own intermediate solutions. It is only when the possibilities of the machine itself are stabilized that it will be wise to fix definite solutions for the problems that are arising in the building industry. It strikes us as less important to know whether the creator of spaces is called a technician or an artist than to recognize his capacity for grasping connections and for applying them in the achievement of a synthesis.
Whoever concerns himself with the art of construction ought also to be familiar with the technical aspects unless he is to remain ignorant of the essential.
Thus the machine will concern him as an instrument and an integral part of the construction and he should recognize its beauty as constituting a part of the art of our age.

School at Solothurn
(pages 460–461)
Built 1958–59

The bearing structures of the two buildings consists of a system of horizontal and vertical concrete curtains. The main building is supported by DIN pillars and in order not to overload the static elements a light construction was adopted for the open outer walls. Ventilation and illumination are effected by way of these empty spaces.
The irregular dimensions of the rooms gave rise to similarly irregular apertures, whence the need for unitary standards. All surfaces have been equipped with two-ply glazing.
The tubular steel skeleton was welded together in the workshop into sections 3.40 m. high and 8.30 m. long and then fixed and mounted between the concrete curtain walls. The junction points are so arranged that the elements exposed to the weather have sufficient play.
The frames of the glass wall in the gymnasium have been reinforced against the wind with NP pillars.
The rooms are heated by hot water in spirals set in the floors and ceilings.

School at Bellach near Solothurn
(pages 462–465)
Built 1959–60

After the school at Solothurn we took into consideration certain details regarding the plan and the glass elevations when we came to the designing of this building. Thus production problems and questions concerning assembly, expansion and statics were solved by calling into play the experience we had gained at Solothurn. The glazed walls, in particular, with their tubular steel construction were extremely sensitive to temperature changes, which gave rise to undesirable movements in the joints. To remedy this, the glazed wall was set in front of the skeleton and as a result the tolerances between the outer walls and the bearing structure were made more capable of being exactly checked.
The skeleton consists of vertical T-irons spaced 1.13 m. apart with sheet metal strips running horizontally in front of the ceiling slabs. The interspaces are glazed with laminated glass. Ventilation apertures have been set where necessary. The horizontal part of the structure is suspended from U-profiles. The latter are attached to the concrete part of the construction. Expansion joints have been installed every 25 metres. The various parts of this construction were manufactured in the workshop, assembled on the building-site and then welded. All metal parts have been galvanized and coated with synthetic paint.
All the rooms have floor and ceiling heating; some of them have blinds on the windows.

Wasgenring Secondary School in Basle
(pages 466–469)
Built 1960–62

The problems in this building were the same as those in the preceding examples.
Experience has shown that metal skeleton constructions entail the use of a limited number of profiles. The use of L, U and Z profiles did not give the results hoped for. On the other hand, although aluminium profiles are more expensive, they possess greater advantages. Using the experience gained from Bellach, an attempt has been made to evolve a glazed wall with these aluminium profiles.
The vertical profiles are taken from floor to floor. The horizontal belts consist of a lower and upper part and are brought level with each vertical profile. This gives rise to simple elements which can be put into position without difficulty. All elements were made in the workshop on standard machines. Work on the building-site consisted solely in assembly.
Problems of heating and the glazed walls were the subjects of several research projects. Convection heating turned out to be the most efficient and the cheapest. In consequence, it proved possible to glaze the windows with 6–7 mm. glass instead of using double glazing. Comparative calculations showed that the increase in heating costs would be balanced out by the reduction in those of glazing.
In the south section of the building the radiators form an independent group with its own thermostat, which makes it possible, in winter, for the rays of sun to be used to the full. On the other, blinds have been installed as protection from the summer's heat.
The various research projects undertaken to find out which form of construction to adopt showed that unit breast-walls would considerably simplify matters. When the Solothurn school was in the project stage, it was objected that a totally glazed wall was not desirable as the temperature would be too great in summer and in winter not in keeping with the costs of maintenance. It was also claimed that teaching within these glass walls would be more difficult as the pupils' attention would wander. Our view of the matter is that any novelty will inevitably become a bone of contention. In this particular case the opposition will lessen in the course of time and will give way to new views regarding teaching.

Factory at Münsingen
(pages 470–475)
Designed 1961

In this project an attempt has been made to solve a problem current in present-day industrial building.
The building had to be made of prefabricated elements that could be assembled on the spot in such a way that extensions and alterations at a later date could be made without difficulty. What had to be found was a form of element that could be used for the construction of multi-purpose rooms by virtue of the number of ways in which it could be assembled.
This attempt was to serve as a basis for research work on a form of industrially manufactured element, one that was therefore cheap and time-saving in assembly.
The first thing to be done was the analysis of the advantages and disadvantages of modern buildings. Moreover, trends in development had to be considered when it came to the design of a factory shed that would serve a number of purposes. Forms of illumination were compared (sheds, twin fixtures or domes). Modules arising from manufacturing requirements were compared with those issuing from construction principles. This analysis formed the basis of the project shown here.
The basic element was a square – sides 14.4 m. – without any supporting structure. A number of lattice girders (made of welded steel and 1.2 m. high) carry the load to the angle supports; the skin is formed of reinforced concrete slabs 4.8 m. in length.
Lateral wind thrust is taken by the roofing and carried to the supports. These elements can be assembled freely to create various volumes with relatively few bearing points and regularly distributed in two directions. In this way production management is not subordinated to construction. Mobile bridges are unrestricted and the ventilation channels, leads, etc. can be housed in the lattice girders with the result that the effective height is not impaired.
The outer walls are made up of a skeleton of T-girders set vertically and which take the wind. The 2.4 m. long and 1.2 m. high interspaces are glazed. These elements are interchangeable with doors, etc. and can be dismantled to be set up again after the work of extension has been accomplished. To prevent dazzle and excess heat at work points, use has been made of double opaque insulating glass with a layer of glass wool sandwiched between the two sheets. Only the horizontal head-high strip is transparent. Given certain conditions, it is possible to replace these elements by fully insulating panels.

Craig Ellwood
Collab: J. E. Lomax
Engineering consultants: Mackintosh and Mackintosh

Aluminium Bearing Construction
Acme-Arcadia Office Building in Los Angeles
(pages 476–478)
Design 1960–61

Acme Metal Molding Company and Arcadia Metal Products manufacture aluminium goods for the construction industry.
So far as we know, this is the first time that sole use has been made of an aluminium skeleton in a building. The formula of the Russian engineer S. Timoshenko was employed in the static calculations made for the construction of the roof. At first it was planned to use standard profiles but as a result of the tests on models new profiles in compressed aluminium were evolved; these will make the structure lighter, cheaper and more elegant.
The models show the building with mass-produced profiles. Thanks to the research work, it is to be expected that the aesthetic effect of the skeleton will correspond with that of the first project of 1960 (photograph).
This first project was carried out for Acme Molding Company. When Arcadia Metal Products merged with the former, the building turned out to be too small. Nevertheless, it proved possible to increase it to the size wished for by adding two axes.

In nature form and structure are one. This is the law of nature. The law of physics.
In architecture there must be a like order. An underlying force must motivate form. Form must have reason.
The art and science of building is the art and science of structure. Form is structure. Structure is architecture. Form is valid only when shaped by the structural forces resisted.
Non-structural form is non-architecture, and it has no survival value.
The art in architecture is an immeasurable quality. But the means is measurable.
Herein are the limits of architecture, herein the order.
Architecture must certainly be more than an esoteric expression of an abstract philosophism.
And the real art in architecture is not arbitrary stylism or ethereal symbolism, but rather the extent to which a building can evoke pleasure and profound emotion while simultaneously reflecting with clarity and logic the technology which alone conveys its validity to exist...
The extent to which a building can transcend from the measurable into the immeasurable.
My order is structure. My direction is refinement.
My hope is perfection.
6 July 1962 Craig Ellwood

Kajima Construction Co., Ltd.

Steel Construction Unit for Industrial Buildings
(pages 479–482)

The 24×24 m. bearing elements are suitable for one-storey buildings.
With a roof area of 572 m², one pillar – that in the middle – is sufficient to support the structure. The 4 25 cm. I-girders and the secondary lattice girders in the region of the four triangles complete the static elements and are relatively light in weight themselves. The upturned-mushroom shape makes it appear pre-stressed. The elements are assembled by way of screws at the end of each girder.

Cedric Guhl

Constructional Norming in the USA
(pages 486–494)

Importance of the Module
In the future it will be of primary importance to the architect and contractor to establish an order of mensuration scaled to the work in hand. It will thus be possible to drop superfluous, intermediary standards of measurement and to obviate their concomitant disadvantages. The module will be the nodal point linking the various interested parties in such a way as to make coordination feasible.

Disadvantage of Free-scaling
Up to now it has been customary to build and to scale buildings on the basis of individual standards of measurement. In consequence this has entailed an individuality of execution that bore no relation to profitability.

Industrialization of Construction
The advantages inherent in the industrialization of construction will not attain their culminating point until there is no longer any need for adaptations to be made on the spot. In order to make use of the evolution of detail, which for some time has been the subject of research, a new modular scale has been taken up. Thanks to it, the designer will be in a position to carry out all the finishing work without making a particular study of it. By virtue of this fact alone it can be regarded as a key factor towards the rationalization of industrial construction. Without making any inroads on flexibility, its employment makes it possible for any material to be used.

The Module
The putting into use of a modular scale in construction means that the free employment of inches or centimetres must give way to a form of mensuration that allows for the exchange of ideas among architects, manufacturers. The basic measure in the USA is 4″ (10.16 m), which is employed three-dimensionally. At the time of building coordination is achieved by way of this grid (Ill. 1).

Using the Module during Planning
When making practical use of the module, the architect must obey three rules:
1. The three-dimensional application of the module. The grid divides each construction element. The modular measurements comprise the elements as a whole, including half the joints on each side (Ill. 2).
The detail plans (Ill. 3) and the 1.50 plans (Ill. 4) have no detailed grid and only employ the main screen where necessary (Ill. 5).
2. The dotted parts are those which do not fall within the modular frame (Ill. 2). They indicate the exceptions that the architect has seen fit to employ.
The grid is a very useful auxiliary at the time of designing. Frank Lloyd Wright made use of it as far back as the beginning of this century (Ill. 6). In the USA the 4′ scale (121.92 cm.) is very widespread.
4′ corresponds to 12 4″ modular units. It is likely today that American architects prefer the 4′ scale to that of 4″ because of the correspondence of machines to it. A 2′ grid is employed when wood is the constructional material, a 3′ grid for standard housing and a 5′ one is used for special constructions.
It may not be unnecessary to point out that the 4′ scale (121.92 cm.) represents for us Europeans one of 120 or 125 cm. Cf. E. Neufert, Design Elements in Construction, 1961.

The Module in Production
Adaptation raises more complicated problems for manufacturers than it does for architects. Above all, it is necessary to fix scales for his products. This will be done by dividing the scale of the module up into two halves (Ill. 7). It is also necessary to bear physical moments and production tolerances in mind.
When the dimensions have finally been established, it is necessary to regear the plant to the new products, which will involve considerable expenses (new machines, etc.) and sales difficulties as the demand for normed products will rise only gradually.

On the building-site itself the contractors will have to become accustomed to reading the plans with the aid of grids.

Advantages of the Module

Norming will allow for great flexibility in the use of constructional materials. Normed products can be replaced easily. In particular, the following benefits can be cited:

For the architect:

- plans can be dimensioned much more rapidly (Ill. 8);
- a help in the choice of room size (Ill. 9);
- freedom in the choice of dimensions outside the grid without any inconvenience arising;
- precision and clarity in the execution of plans; ease in discovering mistakes;
- reduction in number of detail plans; subsidiary appendices eliminated (Ill. 10);
- thanks to the plans the basic idea can be simplified, for the architect, engineer and contractor will be working jointly;
- fewer errors, time taken over design reduced;
- the grid will be a coordinating system and will replace detail designs, which up to now have been the best way of making a point of detail comprehensible (Ill. 10);
- materials and products can be changed without any difficulties as to junction points or size;
- aid in the drawing up of estimates;
- estimates can be established more rapidly and accurately;
- more accurate tenders;
- lower tenders by virtue of the advantages accruing to the contractor;
- greater security in assessing expenses;
- a better way of comparing various products.

For the manufacturer:

- production unit;
- simplification of storage, ordering, despatch, supervision, etc.;
- reduction in transport costs;
- increased markets;
- competition will be based on technical and economic factors and not on advertising alone.

For the contractor:

- speed, ease and accuracy in the fixing of tenders;
- less scope for error in the reading of plans and estimate;
- rationalized work and enhanced profitability;
- no more waste on the building-site;
- reduced pilferage;
- better masonry at a lower cost (7 to 10 % reduction);
- fewer problems on the site;
- fewer foremen and superintendents;
- facilitation of survey and supervisory work;
- reduced building-time, higher annual turnover;
- limited stores and inventories, simplification of ordering;
- transport economy;
- simplification of site plans;
- easier supervision of material.

For the owner:

- reduction of building-time, less interest to pay;
- less mass-produced work;
- higher quality, better joints (Ill. 12);
- regular building despite weather conditions.

Application of the Module

20 % of the American firms use the module; more than 50 % use the same principle for scaling foundations. This is understandable in view of the fact that the cement flags are themselves normed.

Use of the Module in Forms of Construction

The following buildings have been erected and dimensioned on the basis of norms:

Hospitals	16 %
Schools	14 %
Housing	14 %
Churches	10 %
Industrial buildings	10 %
Administrative buildings	6 %
Other types	5 %

The high percentages for hospitals and schools built on the basis of norms are due to the laws and regulations governing such buildings.

Sales Openings for Normed Products

Normed building products are very much in demand. 66 % of all architects order such products when they can be had. It is interesting to note that nowadays the sales openings for normed products are twice as favourable as those for the same products which have not been normed.

Adoption of the Module by the Architect

A questionnaire drawn up in 1959 showed that of all the architects who had tried working with a modular screen 85 % had adopted the principle. Moreover, it is worth pointing out that where conditions have been normal this system of mensuration has received an enthusiastic welcome from architects.

Number of Products Normed at the Present Time

Official norms

At the time of writing there are 4 official standard scales recognized in the USA:

- the 4″ scale, which is used as a base for all constructional products (1945);
- normed cement flags;
- normed bricks;
- normed fireplace bricks.

Normed Products that have not yet been Officially Recognized

In addition to the norms mentioned above work is going ahead in every branch of the sector. Thus we find the American construction catalogue indicating that 90 % of all current products have been based on normed standards. This does not mean, however, that these products are cheaper than those constructed according to traditional methods. As a result the trade is undergoing a critical phase of development.

Products that have not been Normed

A survey carried out by a construction journal in the autumn of 1959 showed that out of 298 product advertisements 254 were based on norms; 5 out of 6 new products corresponded to the module. In general the non-normed products were as follows:

- synthetic flooring;
- tiles (ceramic);
- laundry and washing units;
- doors.

With regard to the flooring, it should be pointed out that the tiles can be had as standardized products. Should the architect, nevertheless, prefer special orders when it comes to this product, this arises from the fact that it is difficult to adapt these tiles to the dimensions of the building. Normed ceramic tiles are very rare. Production techniques and the tolerances demanded by the tiles themselves and the manner in which they are laid down make it difficult for norming to gain a footing.

At the present time adaptation costs as regards washing and laundry units are too high to make standardization feasible. This is a problem that has to be settled in the future.

Choice of an appropriate Module

It may seem surprising that only 4 standard modules are recognized in the United States, but the importance of this fact should not be under-estimated. Agreement to the "inch" model in construction represented a step forward. The unanimous adoption of a new module is the primary basis for any future activity and is the result of very thorough research.

Norming of Bricks

The adoption by brick factories of a standard scale has given rise to very concrete results. This industry has always been regarded as the key point in all constructional work.

Types of Norms

Technical and social development, architectural demands, practical experience, climatic variations and the individual features in every building are all factors that make it impossible to establish definitive norms with any guarantee of success.

The History of Standardization

1921 First research work on the 4″ module by the industrialist, Bemis;

1936 Publication of "The Evolving House" by Bemis, in which he urges the use of the 4″ module;

1938 American Standard Association (ASA); foundation of the A-62 Committee. The American Institute of Architects and the producers' Council become the Committee's "godparents";

1939–43 Standardization of military buildings;

1945 The 4″ module is introduced as an American standard;

1948 The Modular Service Association is disbanded;

1949 The AIA founds an office for modular coordination;

1950 The National Association of Home Builders becomes the third "godparent" of the A-62 Committee;

1956 AIA Office for Modular Coordination is disbanded;

1956 The Associated General Contractors of America becomes the fourth "godparent" of the A-62 Committee;

1957 Foundation of the Modular Building Standards Association under the auspices of the AIA, AGCA, NAHB and PC – good organization with sound financial backing, great progress.

It will be seen how greatly a badly run organization with limited finances is handicapped in its development.

The Infrastructure Today and Its Work of Standardization

The supreme body in this infrastructure is the American Standard Association (ASA). This national organization is financed by industry. Subordinate to it is the Committee for Dimensional Coordination of Building Products and Materials (A-62). The executive authority of the A-62 is the secretariat of the Modular Building Standard Association (MBSA). In addition to these organizations the US Army Corps of Engineers and the Veterans' Administration have played a meritorious part in this pioneer work.

Difficulties in the Establishment of Norms

Two important factors have hampered work over the past 35 years:

- the lack of finances
- the choice of a period in which architects and manufacturers were reluctant to switch to norms.

Supply and Demand

One of the most difficult problem to be solved in the application of a norm is the coordination of supply and demand as the latter cannot be great if normed products are not already available, which argument applies in reserve as regards supply.

Conclusions

Types of norms and standardized dimensions:

The construction norms in the USA can be divided into standardized dimensions and types of norms. Standardized dimensions cover questions of mensuration, i. e. from the simplest problem to the modular coordinating system.

The types of norms specify the shape, dimensions, advantages and quality of the construction elements.

A size norm always corresponds to a module of 4″. The type of norm covers all the other forms of standardization. If, for example, we speak of a normed brick, that means the product is also normed as regards its shape. Although the ordering of dimensions offers certain incontestable advantages, the desire to establish a type of norm at all costs is scarcely justifiable, for in this case there is a tendency for standardization to appear something extraneous. It is to be regretted that the competent authorities are unable to distinguish better the different ends and prerequisites of these two forms of standard.

Although we regard the assimilation of a product in its dimensions and junction points within the modular framework as sensible, the official establishment of shapes and profiles strikens as an unjustified limitation of the market. The development of a norm type should be the function of the producer. The difficulty of creating a norm type and the fact that apart from bricks no other product has been declared standardized as to its shape and size is clear evidence of the confusion of norm size and norm type.

The Aim of Norming

The wish to introduce modular coordination into building appears to be an appropriate and promising one at the present time. All in all, a module merely defines the dimensions of the joints in the finished elements. Freedom of expression is thus retained. Discipline in the selection of external dimensions should, in no case, affect aesthetic considerations. With the introduction of a unit of mensuration into construction it must be possible to rationalize works and thus to reduce construction costs. The architect's work is becoming more difficult from year to year because of the appearance of new materials and products on the market. The welcome we extend to any hope of reducing construction costs must, of necessity, be tempered with reserve.

The establishment of a form of modular coordination is not, in the last analysis, the only way of reducing the cost of methods of building. The simplification of work is, however, an incontestable desideratum and would appear to be the main factor at the present time militating for standardization.

Titelbild

Das Bild zeigt einen Ausschnitt aus dem Magnetspeicher einer elektronischen Datenverarbeitungsanlage. Im Speicher werden Instruktionen, Zwischenresultate, Konstanten usw. aufbewahrt. Jedes der Ringlein (Durchmesser ca. 3 mm) kann positiv oder negativ magnetisiert werden und damit eine duale Zahl darstellen. Moderne Datenverarbeitungsanlagen verfügen über Speicher, in denen einige Tausende bis mehrere Zehntausende von Buchstaben und Zahlen Platz finden.

Reproduction de la couverture

La figure représente une partie d'un enregistreur magnétique du cerveau électronique. Cet enregistreur peut conserver des instructions, des résultats intermédiaires, des constantes et autres données. Chacune des rondelles (⌀ 3 mm env.) peut être magnétisée positivement ou négativement et ainsi exprimer un chiffre en rapport avec le pôle. Les cerveaux électroniques modernes disposent d'enregistreurs capables d'emmagasiner plusieurs milliers de chiffres et de lettres.

Picture on the Cover

This picture shows part of a magnetic filer in an electronic brain. This filer can retain instructions, intermediate results, constants and other data. Each of the rings (⌀ 3 mm. approx.) can be positively or negatively magnetized and thus express a two-place figure. Modern electronic brains contain filers capable of storing several thousand figures and letters.

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Eine Notiz war leider fehlerhaft wiedergegeben. Es muß heißen:

Dipl.-Ing. Ulrich Klauss
Geboren 1932 in Stuttgart, Architekturstudium an der T. H. Stuttgart von 1952 bis 1956, danach Assistent von Prof. Volkart.