29 PROGRAMMING OF BUILDINGS

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A vital function of a building is spatial organisation of activity. Designing must have a sound insight into points of departure objectives and wishes of users: their activities, organisational structure and ensuing spatial consequences. When a new organisation is looking for an adress; or when an existing organisation has decided that present premises are no longer suitable, a lot of thought should be spent on possible and desirable variants of solution. Instances are: remodelling, expansion, disposing of (a part of) the building, joining, moving into another building, or (commissioning the) designing of a new building. In order to ensure that the building supports activities in an adequate way with respect to cultural, aesthetic, economic, climatical, technical and judicial considerations, the requirements must be carefully charted.

This is also mandatory for weighing alternatives against one another and for ascertaining whether wishes and potentials match. It is extremely rare, that what is deemed desirable is completely feasible in terms of time and money as well. Present laws and rules delimit possibilities as well. This necessitates formulating priorities and making choices. Charting requirements, wishes and boundary conditions is termed in the building process 'programming'; or 'briefing'.

In this contribution we discuss how programming of buildings is effectuated and identify the means available to trace and record wishes and requirements in a document: the programme of requirements, or brief. These requirements must get the form of a description of the performance to be delivered. They may be of a quantitative or qualitative nature and have regard to location, building, spaces, building parts and facilities.

29.1 PROGRAMMING IN THE BUILDING PROCESS

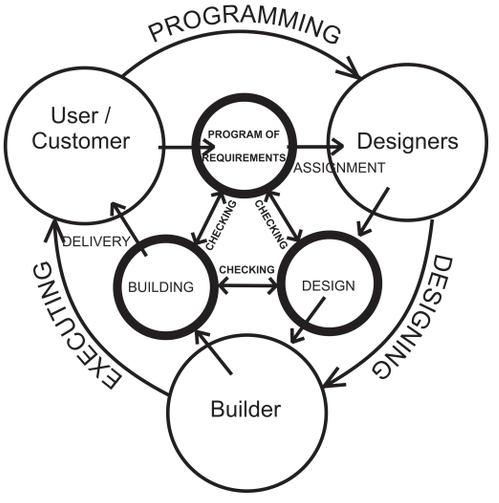
Programming and recording the results in a brief is an essential step towards a well-considered plan development. It will preclude that solutions are embraced too readily who have shown themselves to be adequate elsewhere, but are not tailored to the specific requirements and wishes of the organisation calling the shots. By thinking too early in terms of solutions, this stage of the programming often becomes a weak link in the building process. This sometimes causes that in a later stage, when the solutions proposed have already been discussed, it is nevertheless decided to formulate explicitly the requirements and conditions. Additional work and loss of time goes hand in hand with it. Other objections *vis-à-vis* the slipshod passing of the programming stage and preliminary brief are:

- profitting too little from usage experience;
- the designer must spend a lot of time on collecting and analysing the information;
- the feasibility of the project can only be checked much later; on the basis of the first sketched design;
- the design must be altered more often; and more extensively. This costs time and money; and often irritation for the parties concerned;
- a lack of time and attentiveness for alternative solutions;
- one has to settle for a building more expensive and less appropriate than the one opted for.

29.2 PROGRAMMING, DESIGNING AND BUILDING

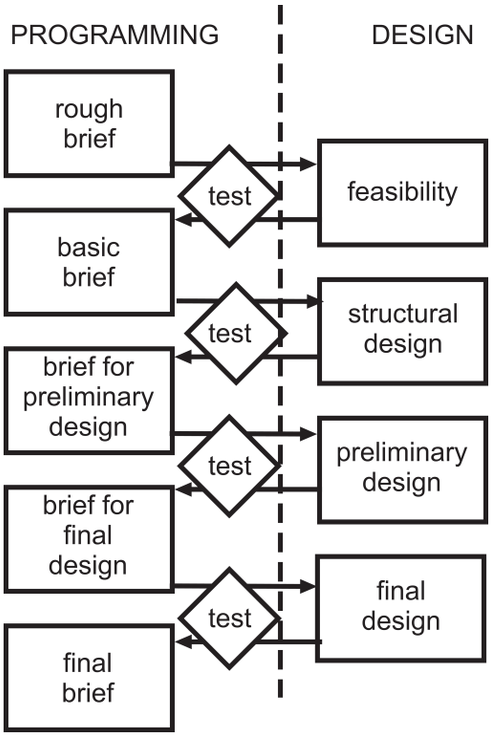
Programming, designing and building are three main activities in the building process. The diagram to go with this here gives a systematic view of the place of programming in a traditional building process.[a]

In order to keep the scheme simple, it is pre-supposed that the principal co-incides with the owner and is acting also on behalf of future users of the building. The three parties mentioned are often supported by advisors, sub-contractors and providers; that have been disregarded. The arrows between the products (brief, design, building) indicate that there is



289 Place of programming in a traditional building process

a Derived from Vrielink, D. (1991) *Hoe verder met het prestatieconcept? Kwaliteit maken, meten en vergelijken*.



290 Brief developed from global to detailed

always – or should be – a reciprocal checking, giving the process a cyclical character. When, for instance, the design does not accommodate the programme, this may be ground on which the design or programme may be adapted. This does not take away from the fact that in traditional building the programming stage is, in principle, closed off by a final brief. Next, the designer picks it up. This approach makes the brief a rather static document. Subsequent detailing concerns primarily technical matters and hardly anymore spatial-functional aspects. Also, in building processes with modern organisational forms like Design and Build, General Contracting, Build Operate Transfer (BOT) and contracting on the basis of a performance contract, the programme of requirements is a rather static document. First, the brief is developed. Next, one party or one building team is responsible for design and realisation. BOT implies that this party also sees (temporarily) to maintenance.

An advantage of a distinct programming stage, is separated up to a degree, from the designing stage, so that time and attentiveness is spent explicitly on clear formulation of the requirements, without thinking immediately in terms of solutions. When the result is recorded in a brief, all parties concerned know what they are doing. This is opposed by the fact that translation in images and sketched designs often leads to new forms of insight; and, together with that, to different wishes. A designer can envisage solutions not called for in the programme of requirement, or even opposing it, but which may imply an essential improvement of the plan; for instance by using in the design properties of the environment. The brief may also contain contradictory requirements, or those of a type that can not be accommodated; emerging during the designing process. In this, it is up to the principal to assess differences between programme and design and to accept or reject. It should be added, that delivering information 'just in time' is meeting with increasing demand: more information should not be provided than is needed on that specific moment. That is the reason why the *'Stichting Bouwresearch Rotterdam'* (SBR; *Foundation for Building Research Rotterdam*) makes a plea for a gradual development of requirements, from global to detailed; in combination with plan development.

29.3 CONTENT OF THE BRIEF

In order to give the designer and other parties a sufficient grip on the building process, the programme should be as complete as possible *vis-à-vis* requirements and wishes of the principal and other conditions the building must comply with. As a function of the size of the building and complexity of the task, the number of requirements can grow considerably. It is important, therefore, to order the requirements for surveying purposes. Different ways of categorising are used. We restrict ourselves to categories of the Netherlands Normalisation Institute (NEN 2658, the current 'norm') and the categorising of SBR 258 (often applied in building practice).

29.4 NEN 2658

According to NEN 2658, *'Programmes of requirements for building and matching project procedure'*, a programme of requirements should comprise the parts of boundary conditions, of characteristics of the target group to be housed, and of requirements put to the object. The boundary conditions are relating to the laws and rules applying, technical aspects and financial aspects. The characteristic of the target group(s) to be housed should give an insight, among others, into the objectives of the organisation, the users and their activities and expectations for the future. With regard to the requirements relating to the object, NEN 2658 distinguishes requirements for location, the building as a whole, building parts and facilities on the premises. In addition the project procedure should be recorded. It involves two parts:

- Identification of the project (type of the building, purpose, situating, main sizes and building volume, costs and financing, relevant documents and participants etc.).
- Task description (tasks and responsibilities of the agents concerned), process description and temporal planning.

Various practical guidelines have been developed for filling-in the programme.[a] The lists for controlling and checking provided here are giving a good picture of the subjects on which the programme should shed light. NEN 2658 is less clear on the content of the requirements, the conceptual framework and the phased emerging of requirements.

29.5 SBR 258

Additional study of the conceptual framework and the phased approach was conducted by *Stichting Bouwresearch Rotterdam*. The third edition of SBR 258 *'Programme of requirements. Instrument for quality control'* was published in 1996. Next to a clear explanation of the conceptual framework this publication contains a manual for drawing up the project orientated programmes of requirements. SBR 258 is following a compartmentalisation in 5 blocks:

- Usage requirements
- Functions and performances
- Image expectations
- Internal conditions
- External requirements and conditions.

Ad a. Usage requirements

These are the requirements and wishes regarding (parts of) the housing, resulting from the foreseen usage. A picture should be given of the organisation to be housed in terms of nature, size, organisational structure and patterns of activities, now and in the future.

Ad b. Functions and performances

The characteristics of the organisation to be housed should be translated into spatial-constructive requirements and wishes with regard to the location (ease of access, facilities in the surroundings, possibilities for expansion, etc.) and requirements and wishes with regard to the building. Relevant items are – amongst others – the spatial need for the building as a whole and per room, physical building conditions envisaged (temperature, light, humidity, sound, view), safety and flexibility.

Ad c. Image expectations

Although the creation of visual quality is belonging to the competence of the designer, the principal is well-advised to formulate his own wishes in this respect as clearly as possible. Does he want to have an atmosphere of luxury or one of soberness and effectiveness? Is a traditional style of building assumed, or rather something rubbing shoulders with high tech? Should the building express something of the function or the corporate identity; or exactly the opposite?

Ad d. Internal conditions

This concerns financial-economical conditions (possibilities and limitations with regard to costs of investment and exploitation charges) and conditions relating to time (date of completion, time-frame of the housing process). Other internal conditions are, for instance, specific requirements with respect to sustainability.

Ad e. External requirements and conditions

This concerns requirements as seen from the perspective of spatial ordering and other laws and rules. Examples are functional zone planning, requirements ensuing from a protected urban

a NNI, Nederlands Normalisatie Instituut (1992) *NPR 3405, Programma's van eisen voor gebouwen. Indeling en aspecten van gebouwdelen en voorzieningen op het terrein;* – (1993) *NPR 3401, Programma's van eisen voor gebouwen en bijbehorende projectprocedure, Algemene naooplijst.*

view, the Building Decree, security standards, alcohol and food industry law, consumer's law, environmental maintenance, general police ordinance etc.

29.6 KINDS OF REQUIREMENTS

The requirements should really have something to say. Platitudes like "The building should not leak" are to be avoided. In addition the requirements should be formulated clearly in a maximal verifiable manner. An important distinction is the one between functional requirements (or usage requirements) and performance requirements.

Functional requirements describe the intended functioning of the building. They are formulated in a qualitative way; for instance: "the building should be integrally accessible." A variant is the description of the activities to be housed; for instance: "there should be space for placing 12.000 books in an open shelf arrangement, taking in and giving out of books, the reading of books and magazines and consulting reference books."

Performance requirements record the performances that are asked for. It concerns requirements that can be checked objectively. With that in mind the desired quality level needs to be quantified as much as possible. Examples are: "a gross floor surface of 12.500 square metres", or "free width of passing of doors minimally 850 mm." In the example of the library: "a lending room of 180 m^2 with 12.000 books, an in-take and lending desk of 20 m^2 and a reading room with 30 seats of 90 m^2 in total." Performance requirements literally point to what the building should perform.

One should be cautious in formulating descriptive requirements in the form of solutions, like: "the floor should be made of white marble." This formulation is leaving hardly any room for alternative solutions. On the other side it does not make sense to give a description in performance requirements when the commissioner is saying explicitly to accept this specific solution only. However, in many cases a demanded solution is referring to underlying wishes, for instance: "can be cleaned simply and has a luxurious atmosphere." By making the underlying wishes explicit and including them in the brief, a space comes into being for alternative solutions obeying the requirements just as well.

Clients' requirements may relate to different scales, e.g. the total building performance and requirements for different spaces. The latter can be documented per room using so-called activity sheets and performance criteria, including:

- user characteristics: number of users, their functions and personal characteristics (only when these have spatial implications);
- activities (type of activities, time schedule);
- facilities and furniture, temporary or permanent;
- spatial requirements with reference to accessibility, efficiency, ergonomics, spatial orientation and finding your way, privacy, flexibility etc.;
- technical and physical requirements regarding floor load bearing, thermal comfort, acoustics, lighting and fire safety;
- wall finishes, floors and ceiling, regarding aesthetic preferences, ecological issues, maintenance;
- dimensions and square metres, if relevant, both minima and optima;
- number of required areas of this particular type;
- a brief explanation, if required.

29.7 METHODS FOR PROGRAMMING

The most important materials for preparation of a brief are:

a. Accurate documentation and analysis of the organisation and activities for which housing is needed. The necessary information can be collected by interviews with the client, ques-

tionnaires, analysis of documents, behavioural mapping, counting occupancy rates, and workshops with prospective users. Scenario techniques can be used to comprehend spatial implications of future developments.

b. 'Translation' of organisational characteristics and functional requirements into performance criteria. This functional analysis is normally based on clients' experiences and the programmer's professional expertise (often a specialised consultant or architect). Additional research is frequently required, especially when new functions are involved. Testing design variants in a computer model, scale model, or full-scale mock-up are techniques often used

c. Site visits to similar projects (reference projects or 'precedents').

d. Analysis and Post-Occupancy Evaluation of similar projects (see the Chapter on ex post evaluation of buildings).

e. Review of literature, searching for data, experiences with particular design solutions, standards, guidelines for programming and design, etc. It is particularly worthwhile to review references of similar building types. Furthermore, general studies on anthropometrics and ergonomics or functional aspects like safety, sustainability and cost-effective design may be extremely useful, both for programming and design

The activities named first are known as 'functional analysis' or 'function analysis'. The translation from function analysis to a functional design is sometimes called functional designing. The methodical approach of this inter-connects with the ergonomic analyses of the American Frederick Taylor. In the sixties and seventies his approach was worked out for architecture by Zweers and De Bruijn and Polak.[a] For a more recent treatment of functional designing we refer to Van Duin *et al.*, Sanoff and Blyth & Worthington.[b] Here we restrict ourselves to a summary of how function analyses are taking place, which literature is especially relevant and how use may be made of reference projects.

Function analysis

Programming starts with analysing the organisation and activities needing housing. The analysis entails determining the nature of the activities and the required spatial condition, like the floor surface needed, possibly minimal sizes for width and depth, physical conditions (lighting, acoustics and such) and spatial-psychological requirements (view, privacy, territoriality). Careful thought should be given to which activities are needing their own, specific space, and which activities may be housed in a common space. Should copying and fax equipment be installed in the space of the secretariat, in a separate space, or in an (open) intermediary room? Is each office getting its own place for discussion, or are there meeting rooms for common use and informal corners for sitting together? When it has been settled which activities need their own space and which activities may be put together, spatial conditions per room can be formulated. This determines to a high degree the spatial need in terms of separate rooms and conditions. By the way: not every activity requires a specific spatial solution. From the perspective of flexibility and future value it is important to design the spaces in such a way, that they can not only serve the activities intended, but other activities as well. A narrowly 'tailored suit' in the form of an unequivocal 1:1 relationship between function and form restricts the possibilities for adapting to changing circumstances.

Activities and spaces with a strong mutual relation should be positioned close to one another, if the situation admits this. Other considerations for spatial proximity or of clustering spaces (zoning) are common characteristics in terms of public / private, hot / cold, silent / noisy, view / inner space, etc. The analysis of spatial relations can be done easily by hand, in the case of simple buildings. For more complex structures using the computer is advisable.

Box 1: Example of a functional analysis of an office restaurant

The required number of square metres depends on the number of people using the restaurant at the same time. Professional literature includes the following guidelines:

- Restaurant: number of seats x 1.4 m^2
- Counter, kitchen, storage space: number of seats x 0.7 m^2
- Staff rooms (cloakroom, informal meeting place during breaks, office space): number of seats x 0.4 m^2.

Data based on client's information and assumptions based on consultant's experience:

- Number of employees: 400
- Number of people actually present: 90% (10% absent for reasons of sick leave, vacation, training etc.)
- People have staggered lunch breaks: from 12.00-12.45 and from 12.45-13.30.
- Assumption: 60% of all employees use the restaurant.
- Assumption: even in peak hours not all seats are loccupied (e.g. 3 persons using a 4-person table). For this reason 15% extra space is required.

These data and assumptions lead to a calculation of the number of seats as

$$\frac{400 \times 0.90 \times 0.60 \times 1.15}{2} = 125$$

and required floor space of:

-	Public space	125 x 1.4 m^2 =	175	m^2
-	Counter/kitchen	125 x 0.7 m^2 =	87,5	m^2
-	Staff	125 x 0.4 m^2 =	50	m^2
-	*Total*		*313*	*m^2*

a Zweers, B.H.H. and W.N. de Bruin (1958) *Een analytische methode voor het ontwerpen van bedrijfsgebouwen;* Polak, B. M. (1973) *Functioneel ontwerpen*.

b Duin, L van, W. Wilms Floet et al. (1989) *Functioneel ontwerpen, ontwikkeling en toepassingen van het doelmatigheidsbeginsel in de architectuur;* Sanoff, H. (1992) *Integrating programming, evaluation and participation in design;* Blyth, A. and J. Worthington (2001) *Managing the brief for better design*.

Relevant tools and literature

Obviously, principal and programme advisor will use their experience(s) with their own organisation and with drawing up programmes of requirements. Programme consultants are often making use of a brief used before, for a comparable task; while going through it with the client, or without him, and adapt it to the present task. For auditing the organisation use is made of interviews, workshops with (representatives of) users, ratios of usage, scenario techniques, and sometimes also space planning studies in a 1 : 1 model. Many things do not need new thought. During the years many publications have appeared that may support a function analysis and that may be useful for formulating internal and external conditions. Without trying to be comprehensive, we mention just a few important publications:

- Studies specifically aiming at the development of a brief; among them SBR 258 and the booklet 'Bouwstenen voor het PVE (Wijk and Spekking) and the publications of Preiser *et al.*, Preiser, Sanoff and Blyth & Worthington.[a]
- Space planning studies translating the activities in spatial measures, like *'Architects' Data'*, the English translation of Ernst Neufert's *'Bauentwurfslehre'*.[b]
- Studies of buildings for a specific kind of function(s), e.g. books focussing on office buildings, libraries, schools or hospitals.
- Studies of specific aspects like:
  - Integral accessibility, social security
  - Flexibility
  - Sick Building Syndrome, sustainability
- Norms and directives, such as NEN 1824, Ergonomic recommendations for sizing office rooms.
- Branch-specific building norms and design directives. Hospitals, for instance, must comply with the building norms of the College for Hospital Facilities. For schools, homes for children and libraries norms and directives have been developed as well.
- Surveys of law and rule giving.

Reference projects ('precedents')

Buildings with identical or comparable function(s) may teach a lot. It is wise, therefore, to visit kindred buildings to get *'in situ'* new ideas by observing and discussing for one's own housing. Documentation on buildings and especially evaluations of buildings in stages of use and maintenance are extremely valuable as well. This kind of evaluation is sometimes termed 'Post-Occupancy Evaluation' (POE). When the evaluation is also extending to other aspects than just use and experiencing – for instance to costs, technology, aesthetics – the term may be (Total) Building Performance Evaluation (BPE). For a working out of that notion see the contribution by Van der Voordt and Van Wegen on evaluating study ex post.

Evaluative studies are gaining power when characteristics and experiences from a sequence of kindred building are compared.[c] Comparative building analysis has the advantage over traditional methods of study like observation and interviews, that the information is linked to spatial variants of solution. Each building is the result of a complicated decision forming process, in which points of departure and objectives are translated into an organisational structure and activities and are receiving form in blueprints, floor plans, cross-sections, materials and facilities. Analysis ex post is enabling that thoughts, ideas and points of departure can be rediscovered after the various choices. Obviously, problems of interpretation may result from this; for the design realised has always been influenced by interpretation of the designer and by internal and external boundary conditions; as there are the available budget, and characteristics of the location (functional destination plan, size and shape of the plot, surrounding functions e.t.q.). By the same token, it is desirable to complement the analyses with study of the realisation process, interviews with the commissioner (at the time) and other parties involved in the building process; for instance the architect and advisors. The combination of a com-

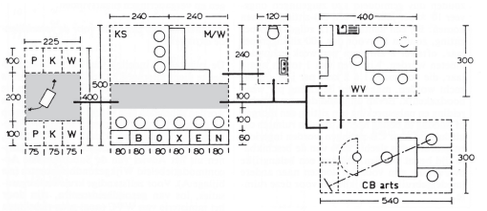
a Sanoff, H. (1977) *Methods of architectural programming;* Preiser, W.F.E., J.C. Vischer et al. (1991) *Design intervention, toward a more humane architecture;* Sanoff, H. (1991) *Visual research methods in design;* Preiser, W.F.E. (1993) *Professional practice in facility programming;* Wijk, M. and D. Spekkink (1998) *Bouwstenen voor het PVE, SBR 421;* Blyth, A. and J. Worthington (2001) *Managing the brief for better design*.

b Neufert, E. (2000) *Architects' data*.

c Voordt, D.J.M. van der, D. Vrielink et al. (1998) *Comparative floorplan-analysis in programming and design*.

parative analysis of buildings with evaluative study may lead to a reasoned typology of solution variants; together with pros and cons for costs and quality.

An example of programming study using evaluative study, is the one concerning health centres by Van Hoogdalem *et al.*[a] These are co-operative organisations, in which one or more general medical practitioners, neighbourhood nursing, social workers and often also physiotherapists have been housed under a single roof. The study aimed at the development of directives for programming and design to be employed in the case of new initiatives. In addition the study was conducted to check the Accommodation Policy Neighbourhood Health Centres at the time and adjust them; especially with an eye on the floor surface needed per discipline, and in total. Beside four case studies, some fifty purpose-built health centres were inspected and subjected to a comparative floor-plan analysis. The analyses were supported by means of one or two interviews and a short questionnaire in writing among daily users (both staff and patients). By way of illustration, we give an example of the programmatic data for an infant welfare centre, respectively a flow-chart for the course of the activities and an picture of the supports of the space.



291 Supports of space for a child health assessment new style

Legend: P K W = storage of prams
CB = doctor
WV = nurse
MW = measuring of length and weight
Boxen = boxes to (un)dress babies

Activity	Time / duration	Room
Parent arrives with child in pram	According to appointment, e.g. 1 child / 20 min.	Via entrance of the health centre or entrance of the nursing service
Parent parks pram	pm	Collective waiting room of the health centre, waiting room of the nursing service, or changing room.
Waiting (if changing room is full)	pm	Idem
Parent takes child out of the pram, undresses it and waits	10 min	Changing room with playpen or prams
Measuring and weighing child + keeping accounts	5 min	Changing room or room district nurse
Consult district nurse	20 min	Room district nurse
Possibly: consult doctor child health centre	20 min	Room doctor child health centre
Parent dresses child	10 min	Changing room
Parent lays child in pram	pm	Waiting room
Parent leaves	pm	Via exit of the health centre or the exit of the nursing service

292 Example of a flow-chart for a child health centre

29.8 CONCLUDING REMARKS

Nowadays a large number of references are available in order to support the briefing process. Apart from the Dutch NEN-standards and the SBR 258 report, English references are mentioned in this Chapter. It should be understood that a brief must not be too restrictive regarding the form of the building. Besides functional requirements, many other aspects will affect the form, e.g. personal preferences of designer and client, contextual aspects like physical, cultural and historical characteristics of the environment, flexibility with reference to changing functions in the future, economic aspects and legislation. It is still the task of the designer to work on a synthesis of function, form and construction, according to the old Vitruvian triad. Modern multi-media techniques and virtual reality will also improve opportunities to discuss formal aspects with prospective users. It is a challenge for designers and their clients to include such new information and communication techniques both in briefing and in design processes.

a Hoogdalem, H, D.J.M. van der Voordt et al. (1985) *Bouwen aan gezondheidscentra. Functionele grondslagen voor programma en ontwerp.*