posts, primary bearers and secondary framing: it was only after a certain period for getting used to the new methods had passed that Robert Maillart developed the inherent principles of reinforced concrete construction: mushroom supports that fuse atectonically with flat flooring and thus provide something like a hybrid, three-dimensional node at the support head into which the reinforcement, invisible later, is inserted. This leads to an inversion of "art form" into "core form" (Carl Boetticher), which now indicates the accumulation of forces only in the non-poured shuttering, through the thickening and concentration of the steel reinforcement. These observations lead to the following conclusion: the shaping criteria that are inherent in the system for new technologies cannot come into being until culturally permanent images (stereotypes) have been overcome.

Looking for appropriate structure and form

So if the classical prefabricated frame building with internal stays and planking on both sides represents an intermediate developmental form, clearly oriented towards traditional craft carpentry and the austere tectonic rules of timber construction, how does the inherent and appropriate structure and form of current timber construction technology look?

To investigate this question, we must first look at how timber is usually processed today. The processing stages of semi-finished manufacturing follow a downward path: the first stage involves producing high- and middle-quality sawn timber like boards, squared timber and planks for traditional use. Laminated boards are the most important half-finished product at this stage. The various off-cuts are then further reduced in size: the second stage produces beading, laths and other strips that are made into multi-layered sheets, stock lumber panels etc. The "waste" from this process is broken down even further: cut or stripped veneers are made into high-strength veneer strip or chip-board, for example. After this the fine waste, e.g. sawdust, is boiled down to a fibrous pulp in the final stage: the wood is divided into fibres and lignin, and pressed into sheets: hard fibre, medium dense fibre and soft fibre sheets round off the product range.

Every stage in this size reduction has a corresponding counter-stage of composition and reshaping, mainly in the form of sheets of various kinds. And each time gluing is the technology that determines the make-up and consistency of the product. This is why the material is so astonishingly supple in the later stages where the semi-finished products are used, in "finishing" and in further handling as part of a prefabricated package. In fact these products are almost totally susceptible to any attempt to shape them – a CNC controlled shaping head, or robot manufacture. The concept of modelling is entirely appropriate here: complex cut patterns are made, but three-dimensional shapes like reliefs and other custom-made pieces are also produced; their surface configuration can be defined and processed by computer.

How CAD programming affects design

This production process makes timber a material that can be freely modelled, and is thus indifferent. It is easy to imagine the possibilities that this affords: architects using the CAD production approach and contractors working with CAM and CNC-roboting can entirely realistically order a "uniquely manufactured" copy of a complicated craft structure – for example a Japanese Shinto shrine – even at a relatively moderate price. That would be the beginning of serially limited production of architectural rarities (as in fashion design or the car industry) that could be afforded by a select illustrious clientele.

These pipe-dreams bring us back to the starting-point of any project, the design: the use of CAD programs in project development is now standard practice in architects' offices. The data-line links up with this absolutely seamlessly, so that the way the plan is treated on the screen, independently of classical building techniques, in timber-building, for example, is bound to feed back to the production and tectonics of the building. Non-modular, object-specific building parts are produced. Or put in another way: the concrete architectural project is broken down into manageable elements (slabs, planes and shells), sent into production via the data-line and fitted together on-site to produce a building. This type of sheet tectonics, involving fitting layers of storeys together or accumulating elements, has long been everyday practice in massive building, and in timber construction it is triggering new construction and building processes. Furthermore, technological development is producing materials that are constantly more robust, enabling the individual parts to be thinner.

Cardboard model on the scale of a building

It thus follows that the "basic element" of current timber building is the sheet, not the rod. A sheet consists of three or more layers of cut timber, e.g. strips or leaves of relatively low quality wood (formerly off-cut or waste timber), glued on top of each other crosswise . This "criss-cross weaving" makes the sheet highly solid and rigid as an element, and thus statically it can function as a shear structure.Rather like a woven textile, the homogeneous sheet is without any recognizable internal hierarchy and in terms of production technology can be extended almost ad infinitum in the two surface dimensions (restrictions only being imposed by the size of the sheet presses and the capacity of the transport trucks). In the material dimension they can be layered (specific sheet thicknesses, according to load distribution and strain). Even the quality of the "threads" – laths in soft or hard wood, and of mixed consistencies – can be appropriately optimized to meet the intended requirements. The sheet is thus directionally neutral, or better, "indifferent to direction". Theoretically it can be produced to infinity in any desired direction, and practically in the maximum size that can still be transported. Both requirements have an effect on current timber construction: sheet tectonics and thin-walled sheets (e.g. stock lumber panels) behave on the scale of 1:1 like card, as though a cardboard model had been magnified to the dimensions of a building. This does not apply only to physical perceptions. This becomes rather more obvious in the treatment of openings: the incredible resistance shown by sheet tectonics in buildings is clear from the way in which openings can be punched into or cut out of the sheets, as if cut out of cardboard. We are familiar with a similarly inert response from the American "Balloon Frame", construction using a nail gun. Here it is possible to simply cut away an entire corner of a building retrospectively without the structure collapsing, as it is statically over-rigid by a very long way. (It would be impossible even to think of such a thing in the case of European frame building!) But in fact in comparison with current European sheet tectonics, the American Balloon Frame technique seems more or less antiquated, to say nothing of the apparently "stone-age" insulation and planking work, which has to be carried out subsequently on site.

Prognosis: compact systems

The current state of European sheet tectonics suggests the following developments in future: the only systems that will be interesting are those that solve the problems of supporting framework, building physics and weather protection compactly (sandwich façade elements, so-called compact systems) and at the same time simplify the laminated structure of the element, that is to say reduce it. I call these complex synthetic systems made up of multi-functional components. Façades were completely splintered into countless layers in the seventies because of the increasing importance of building physics brought about by the oil crisis. Construction was broken down into individual functions that are now reduced to a small number of components because intelligent steps have been taken towards synthesis. There is a corresponding tendency in massive construction, where single-sheet materials than can bear loads and be insulated are used as a reaction to the requirements, complicated in planning terms and ever more demanding as far as guarantees are concerned, of multi-layered, monofunctional complementary systems (double-wall masonry etc.).

A synthetic façade element could then look like this: the basic element consists of a thin-walled ribbed sheet, e.g. a lumber panel with a layer thickness of 3.5 cm. The 20 cm deep transverse ribs in the same material that are glued on, with their gaps filled by the heat insulation material, act as an anti-buckling device. This basic element, with the flat side placed against the warmth, functions as a load-bearing sheet (load-bearing, bracing, stabilization), as an enclosure for the heat insulation and as a condensation brake (the internal gluing gives the lumber panel this quality). The homogeneous inner surface of the wall can be treated simply and directly afterwards, painted or wallpapered, for example. No interior offset planking is needed so long as no electrical installations are arranged along the inner façades. Simple timber boarding, applied to the ribs outside, closes the wall sandwich and becomes the support for the outer skin. In the case of the Bearth-Candinas House, which is described in detail below, these were larch shingles, which were nailed directly to the structure without rear ventilation.

Thin-walled rib sheets represent a mode of construction related to coachwork- building and aircraft construction, where thin-sheet membrane support frameworks in light metal and plastic and braced with ribs are subjected to strains at the highest level: maximum rigidity and stability with minimum material requirements. In aircraft construction the key factor is the weight of the structure, but in the sheet tectonics of current timber building it is compactness and a simultaneous ability to derive multiple functions from synthetic elements.

Comparison with the timber-frame construction explained at the beginning of the article sheds a clear light on the subtle "revaluation": if the inner planking of the frame is merely bracing and the frame post clearly load-bearing, then the image of the rib-sheet, which seems formally and structurally similar, is reversed: the sheet is only 3.5 cm thick, and braced with fine cross-ribs, yet it is load-bearing – but this analytical way of looking at things must be corrected at once: the two components, sheet and ribs, form an inalienable, compact, synthetic package (thanks to impact gluing), in which the support structure (load-bearing, bracing) and building physics (vapour diffusion), structural inner workings and visible surfaces fuse with each other, and every component takes on a multiple function, working in combination with all the other components. This is why the term compact systems is used in current timber construction.