The Zonnestraal Sanatorium is an icon of the Nieuwe Bouwen that is recognized the world over. Designed in 1925 by the architects Jan Duiker and Bernard Bijvoet, the ensemble of buildings is a national monument that enjoys international regard as one of the architectural highlights of the 20th century.

The restoration of Zonnestraal was carried out by the architects Hubert-Jan Henket and Wessel de Jonge. The tale of the struggle for recognition of Zonnestraal’s enduring value and the complexity of its restoration reads like a thriller, while at the same time it represents a crucial dossier for the stewardship of monuments of the recent past.

This monograph presents analyses by renowned international experts about the Zonnestraal complex’s genesis as well as the architectural, technical, landscape-related and managerial aspects of its restoration. The volume is richly illustrated with historical plans, sketches and photographs that capture the Zonnestraal of today and yesterday in its full glory.
Sanatorium Zonnestraal

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(eds)

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Zonnestraal after the completion of the Dresselhuys Pavilion, ca. 1931. There is still an open landscape with heath south of the sanatorium.

Main building in 1928.

Main building after the restoration in 2003.
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The redevelopment of Zonnestraal in which area, directly bordering the built-up zone, will provide a more distinct identity, allowing it to stand out from the rest of the area. This is particularly important in the 1980s and 1990s.

The Landscape Plan restores the complex's original position within its surroundings. North of the main building coniferous trees will be planted in the open space created by the removal of the barracks in the south of the complex. These trees will be thinned out. It has been decided not to create any new trees in the area around the Pampahoeve, where the old Loosdrechtseweg used to be (now marked by a walled bank) and undergrowth removed. The historic brick columns will remain in place. This will create a new introduction to the estate with respect for the past and opportunities for ecological development.

The decision to restore Zonnestraal was made in the 1980s.1 It explored the consequences for the building if it were to undergo restoration which was either entirely (model I) or not at all (model IV) geared towards preserving its original state or if it were to undergo a restoration which runs counter to what Duiker himself might have anticipated, it was prompted by the fact that the complex represents exceptional value within the large group of buildings produced by the Modern Movement in the Netherlands. Any other forms of documentation, including drawings, models and 3D imaging, would have failed to convey the full significance of Zonnestraal in all its facets of space, its relationship with its surroundings and the sometimes almost anachronistic relationship between its concept and materiality. At the same time it goes without saying that the preparation of a restoration concept for a throw-away building is a paradox; the team had to find a delicate balance between conservation and change, on both a conceptual and a material level.

The original state

The decision to aim for conservation and restoration is followed by the choice to show all phases of a building’s history or to revert to the original; permutations of the two can be interesting as well. With modern heritage it is particularly important to convey the designers’ way of thinking. So when it comes to unique examples of modern architecture such as Zonnestraal we want to preserve the building in its original state. Besides, later additions and changes were less the result of a conceptual architectural intervention than of pragmatic extension and major repairs, which is why, during the early stages of the survey process, the researchers were particularly interested in Zonnestraal’s original conceptual architectural qualities, such as the overall layout, the sense of space and the design of the façades. As more and more information surfaced about the experimental construction techniques, which underlined the apparent contradiction between the innovative architectural concept and the more conventional materials and building methods used for the interior, for instance, it became increasingly clear that the materialization was of greater significance for the buildings’ historical value than had been anticipated.

Deliberations

The decision to restore Zonnestraal was made in the 1980s. This was driven by the decision-support model developed on the basis of the Dresdnerhaus Pavilion in Bouwkunst’70 (Technical Investigation of Younger Architectural) in the 1980s.2 It explored the consequences for the building if it were to undergo restoration which was either entirely (model I) or not at all (model IV) geared towards preserving its original state, or if it were to undergo a restoration concept.
The redevelopment of Zonnestraal with minor, imperceptible improvements for more according to intervention model II, that is to say preserving the building largely in its original state to be lowered as well was found to benefit from being achieved without undermining the fragility of performance to present-day levels could never.

From the start it was clear that raising the energy performance to present-day levels could never be achieved without undermining the fragility of Zonnestraal.

An approach in which the running costs were to be lowered as well was found to benefit from preserving the building largely in the original state according to intervention model II, that is to say with minor, imperceptible improvements for more sustainable management. "The more this approach is abandoned in favour of the increasingly pragmatic restoration model III, the act of balancing the original quality and performance in use requires many special solutions that the intervention costs, and hence the overall annual costs, rise sharply."

Function follows form

In view of Fuller’s ideals about spiritual economy and the lifespan of buildings, the Structure Plan stated that the sanatorium buildings were designed in such a way that they can no longer meet the requirements of a modern-day health care programme. Besides, a national landmark Zonnestraal is expected to be nominated for UNESCO’s World Heritage List, which means that since 1993, when it was vacated, the complex’s primary function has changed from a building that is in use to a monument. However, the conservation of a monument, now and in future, depends on the kind of use that enables sustainable management. So the adaptive reuse of Zonnestraal was to be based on a function with a programme that would be largely compatible with the original state of the complex and with the buildings’ structural and physical performance. Any part of the programme that did not fit this brief would be projected in the new build development. The expectation was that that would result in fewer deviations from the original state, which would benefit both the monumental quality and the financial feasibility. That said, it meant that Louis Sullivan’s principle of ‘form follows function’, the byword of the Modern Movement, had to be reversed.

A differentiated restoration concept

At individual building level the choices were more complicated. After all, the three sanatorium buildings were very different in what remained of the original design and materialization. When it emerged that a full restoration would not be feasible for all buildings, it was stated in the Dossier that it would not be necessary to restore all the Zonnestraal buildings in detail to their original state and that a differentiated approach could be adopted for each building.

The main building

At first the original concept of the main building was the original material form of the building as it stood. Little appeared to be left, except for the concrete frame and two recovered partitions, attention focused mainly on the remaining architectural characteristics and aspects of the basic layout. When the researchers received the go-ahead for destructive surveys they found a great deal of information about the original materialization behind the lowered ceilings and facing walls, including a complete section of the façade.

The approach to the main building would therefore combine models II and III: broadly back to the original state, but with a pragmatic slant and with the greatest efforts to remain as close as possible to the original building, use of materials and detailing. Model calculations had already shown that this combination of conflicting objectives would require major investment. Because the concrete frame and a small part of the façades were almost all that remained of the first phase of construction, this approach involved a great deal of reconstruction. The pragmatic slant, for instance, is reflected in the acceptance of deviations from the original state in the case of essential functions such as disabled access, deemed acceptable because the many more original features at the Dresselhuys Pavilion enabled the pavilion to undergo a more conservative restoration according to model II. This was made a condition for the approach to the main building.

Given the ambitions to restore the ground floor to its original configuration and to reopen the northern passage, the functional programme required clustering so that future uses on either side would not interfere with one another.

The Dresselhuys Pavilion

Calculations made in the 1980s showed that the concrete frame of the Dresselhuys Pavilion had theoretically collapsed. Demolition and reconstruction with contemporary concrete technologies would be the cheapest method of ‘preservation’. Despite the scarcity of original materials, such a
The redevelopment of Zonnestraal is why reconstruction was abandoned in favour of retention. It is unlikely to have many original materials and finishes, which is why reconstruction was bandied in favour of preservation and restoration according to model II.

The Zonnestraal Pavilion The radical transformation carried out in the 1950s comprised the Dresselhuys Pavilion. It is the least original of the three buildings the Ter Meulen Pavilion could simply be preserved as part of the overall complex. The Dresselhuys Pavilion was seen in an entirely different light than we are used to since the energy crises of the 1970s. Besides, the buildings were targeted at users who were advised to keep their windows open at all times, even in winter.

Duiker and his consultants also developed a few original solutions in the field of climate control. Respecting these is even more difficult than respecting the structural components. After all, the buildings’ new function differs greatly from their original one, while users also demand a lot more comfort. This is more so if the renovation is similar for artificial lighting and data networks.

None of the model II restorations is to maintain the new systems in such a way that they are barely visible. Model III stipulates that the new systems must be neutral and preferably as unobtrusive as possible. What goes for all cases is that it should still be possible to decipher the reasoning behind the original solution. Design

It is clear that the original state is inevitable, any conflict with the architectural appearance as Duiker realised it, must be kept to a minimum. The same applies to the interiors and fittings. For minor and incidental interventions, such as additional insulation for the roof and doors, or a slightly different layout the restoration team opted for a design that is true to the original appearance. Thus design is as unobtrusive as possible. What goes for all cases is that it should still be possible to decipher the reasoning behind the original solution.

Materiality

The original state of Duiker’s design in terms of planning, architecture, function, techniques and materials has been taken as a reference for the restoration of the sanatorium buildings. Early indications suggested that for practical and/or pragmatic reasons restoring the buildings to their original state was not always entirely feasible. The guiding principle, therefore, is a hierarchy in which the building’s conceptual originality is prioritized over the originality of the materials used during the restoration process. But Duiker’s quest for new, specially designed technical solutions and materials – such as the prototypical curtain walls – augurs that the immaterial architecture is the most sensitive. To that end, second thought, it was decided to attach great value to the low costs of Duiker’s technical innovations. The remnants that were salvaged during the fieldwork give a reliable idea of the buildings’ materiality. Exposing his experiments in building technology was therefore adopted as one of the principles underpinning the restoration. The advantage that can be seen in this area between the first building phase of 1928 and the completion of the Dresselhuys Pavilion in 1931 is an important aspect here. A faithful restoration of the original state of both should shed light on such differences.

Model II is the guiding principle for the restoration of the Dresselhuys Pavilion. It allows minor, imperceptible technical improvements for the benefit of sustainable use, such as easing the thermal bridge effects by inserting thin strips of insulating material underneath the plaster. The approach to the main building and the first three workshops veers more towards model III, making the limited use of, for example, special insulating glass acceptable. With a view to manageable running costs, after 2003 the planned approach to the facades and architectural elaboration were original, unlike the materialization and detailing.

It was decided to approach these workshops in the same way as the main building. For the exterior this means a balance between the original state and discreet interventions for the benefit of adaptive reuse. For the interior such an approach could not be combined with the original state, as Duiker recognised this promptng a more pragmatic approach according to model III. The fourth workshop was merely valued for its position within the complex. It was decided not to develop the fifth position, which would have complemented Duiker’s ‘finger’ plan, because there is no need for such a building.

Building services

Another challenge is that the Zonnestraal buildings were designed at a time when energy performance was seen as an essentially different light than we are used to since the energy crises of the 1970s. Besides, the buildings were targeted at users who were advised to keep their windows open at all times, even in winter.

As the least original of the three buildings the Ter Meulen Pavilion could simply be preserved as part of the overall complex. The Dresselhuys Pavilion was seen in an entirely different light than we are used to since the energy crises of the 1970s. Besides, the buildings were targeted at users who were advised to keep their windows open at all times, even in winter.
When, after years of wrangling, the restoration of the main building and the three workshops was finally given the go-ahead, there was no stopping it. A restoration plan had to be drawn up immediately before the suspended field research and the historic building survey had even been completed. To get round the gaps in the restoration plan, a rather general restoration permit (monumentenvergunning) was granted. A Task Force of representatives from the municipality, RDMZ (Netherlands Department for the Conservation of Monuments and Historic Buildings), the client, the project manager and architects worked out the missing parts of the restoration plan. These were reported in the form of dossiers containing the relevant building-historical data, a restoration proposal and its consequences expressed in quality, time and money. Where paper fell short, for instance for the special glazing, additional field tests were carried out. Only if the Task Force failed to reach agreement would the steering committee step in with a final decision, as happened in the case of the costly re-creation of the linoleum. Although the restoration of the carcass of the Dresselhuys Pavilion was not carried out under time pressure the dossiers method was considered a success and continued.

The main building
Both the interior and exterior of the main building were completely restored between July 2001 and May 2003. The restoration’s primary goal was to return the building as close as possible to its original state, in both the original design and its materialization. On balance, the sole remnants of the first building phase were the concrete frame and an original part of the façade, both of which were carefully restored. The other work centred largely on the reconstruction of much of the original floor plans, façades and finishes. As a result of the decision to make the necessary concessions to ensure that the management of the building would be economically viable and sustainable, there were some departures from the original state, including some variations in the floor plans, the special insulating glass and the contemporary climate-control systems in the workspaces.

Programme
The decision to contract a number of individual tenants from the paramedical sector rather than a single user fitted quite well with the specific layout of autonomous wings and two passageways, allowing the northern passage and the turnabout to be reinstated.

The original internal layouts were taken as reference and found to fit well with the programme for adaptive reuse. The original direct link between use and the...
The redevelopment of Zonnestraal

After the dismantling of the main building, little remained of the concrete skeleton, a main building, little remained of the concrete skeleton, a main building, little remained of the concrete skeleton. It was only following the dismantling that the original details and colours became apparent amid the ruins. Because of the fragility of the concrete frame of the main building, the lifting of a ceiling partition wall that had been slotted into a relate in the concrete constructions yielded more information about the building's dismantling in 1998 such an important moment, as the demolition of the many extensions, both functional and of an aesthetic nature, had been available for field research in time. This made the hypothetical wall layouts are virtually identical to the original state.

The demolition of the day clinic designed by the architect Duiker's floor plan was only changed when a new function could not be accommodated. The former dispensary, for example, has not been reconstructed, creating in its stead a spacious lobby for a lift, necessary for disabled access. The lift-shaft cuts through the roof and opens out beside the end elevation of the upper hall, leaving the latter's volume intact. The hall itself, which is used as a conference centre, can be divided into three by transparent folding partitions.

Dismantling

The new layout, which formed the basis of the client's operating cost calculations, was based on the original layouts which had been pieced together from archival research, as the building itself had not been available for field research in time. This made the building's dismantling in 1998 such an important moment, as the demolition of the many extensions marked the beginning of an understanding of the building's original substance. When in 2000 permission was granted to remove the floor coverings and ceilings as well, the presumed position of the partition walls could finally be verified by the concrete rebates beneath the concrete floor slabs into which the walls had been slotted. The research confirmed the kitchen wing layouts and the contours of the projection booth in the upper hall. Other construction traces yielded more information about the materialization and finishes, such as three original partitions and remnants of steel window frames, roof coverings, stuccoed ceilings and a piece of the cement border around the linoleum flooring on the basis of which all the rendered borders could be reconstructed.

Concrete frame

It was only following the dismantling that the bigness of the concrete frame of the main building became apparent amid the ruins. Because of continuous use most of the concrete had enjoyed an indoor climate so the condition of the supporting structure did not disappoint. According to structural engineer ART the replacement of a single girder and some repairs on two others was all that was needed. Four round concrete columns beneath the central part of the upper room, which had been added during construction because of cracking of the concrete frame, were replaced by steel columns filled with concrete.

All the concrete was sand blasted and repaired with classic methods: the defective concrete was cut away, the reinforcement depassivated and new mortar was applied, based on pure cement to prevent thermal expansion differences with the old. The original thickness of the render was used instead for an extra layer of sprayed concrete to ensure sufficient coverage and strength. With a thin layer of stucco covering the sprayed concrete any difference with the original is barely visible.

To satisfy the requirements for its new use as a meeting room, the floor of the upper hall has been structurally reinforced with a compression layer of some 70 mm. The heating, cooling and electricity pipes could also be incorporated into this layer, though with difficulty. Through lack of time and money the demolished projection booth, which was originally of reinforced concrete as well, has been filled in with timber, plasterboard and stucco.
The redevelopment of Zonnestraal

Sanatorium Zonnestraal

Infills and finishes

While the easy restoration of the concrete frame exceeded expectations, the infills and finishes did not. Some missing parts, such as the steel window frames and interior façade units, the drawn glass and the linoleum and terrazzo flooring, were carefully and expensively reconstructed. A number of products, including window hardware, were mass produced in the 1920s so that Duiker could simply order them ‘from the catalogue’, but as their production has since been discontinued replicas would now have to be hand made. All components for which a fairly similar standard model was available were therefore replaced with a contemporary factory-made product. Because nothing could be found for the handles of the remote control unit for the transom lights these were eventually reconstructed on the basis of a salvaged original.

Façades

Extensive preliminary research revealed the original layouts of the façades in considerable detail. The discovery of an original part of the façade in the administrative wing following the demolition of Kloos’s 1967 extension of the day clinic confirmed the final details in 1998, including the original window hardware and the colours of the paintwork. That part of the façade could not be preserved where it was found because the double glazing that was a condition of the adjacent workspaces, could not be fitted into the 25 mm profiles.4 Once dismantled and repaired it could be replaced in the corridor to the right of the main entrance, where single glazing was acceptable. In that part of the façade the original INP 8 steel posts and the original, unventilated parapets with an inner and outer leaf of plastered metal mesh have also been conserved, so that we can speak here of a fully authentic materialization.

The posts for the reconstruction of the façade were still available, but the manufacture of the window profiles had been discontinued.5 Besides, the shallow steel profiles were known to have caused problems during the first building phase, which is why Duiker used the much heavier 40 mm profiles during the second phase.6 With this in mind the 32/37 mm series was chosen for the restoration, which may be slightly heavier than the original window profiles, but is still clearly different from those of the Dresselhuys Pavilion. The deeper profiles allowed the retention of the characteristic sharp putty framing, even when using insulating glass.

The original façade system consisted of prefabricated elements, although only the first window frame was installed as a complete unit. To save material, the other window frames were fitted with only a single side mullion and were then welded to the previous
element to form a stable whole. At the level of the INF 8 profiles the window frames therefore share a single T-section as a mullion. So in effect the elements form a continuous window frame of about 33 metres whose lack of dimensional tolerance undoubtedly led to problems during construction in 1928, prompting the decision to redesign the façade elements as autonomous units with an L-section on either side. As soon as two frames are placed side by side, the two L-sections form a kind of ‘T’. The frames have been attached to the vertical posts with clearance of just 3 mm. Upon close inspection, the slightly recessed joint sealant reveals which parts of the façade are reconstructions and which are original.

Underneath the new window frames the parapets have been reconstructed with porous brick (porier) and given exterior wall insulation to improve thermal performance, finished with a mineral plaster. As its finish and paintwork are quite similar to the original, this solution is visually satisfying, even if the hollow sound when it is tapped is a clear indication of its new construction method.

The cement plaster has been finished with a mineral paint. On the advice of the RDZM both the inside and outside of the steel window frames were finished with alkyd paint, which of all of contemporary products available bears the most resemblance to the original leaded paint.

Glazing

The main building is little more than a concrete cage enclosed by a light and transparent membrane. To recreate the perception of the original materialization as faithfully as possible the choice of glass used for the restoration was critical.

Zonnestraal predates the invention of float glass, which was a standard product in the 1920s when it was made of sand with low levels of iron, was eventually imported from Lithuania. In consultation with building physics specialist DGMR, it was decided to install single glazing in all the spaces that did not require careful climate control, such as corridors and stairwells. Because it was possible for single and doubling glazing to appear side by side, it was necessary to keep the differences in appearance between the two to a minimum.

Single glazing was unacceptable for the work spaces. A special solution with 11 mm insulating glass was designed to meet the criteria of both comfort and original appearance. Because it was clear for single and doubling glazing to appear side by side, it was necessary to keep the differences in appearance between the two to a minimum. The decision to use the Lithuanian glass for the outer pane was a first step. To avoid any colour differences with adjacent single glazing the possible even clearer Starphire float glass was imported from the United States for the inner pane. Contractor Jurriëns had it successfully made into insulating glass with a full guarantee.

Roofs

During the restoration the roofs were refitted with thermal insulation. Because many of the roofs are clearly visible from the upper hall, the aim was to recreate the original look as best as possible.8

The minimalism of Duiker’s architectural solutions is reflected in the absence of any roof edge detailing: the roofing was simply stuck on the stuccoed concrete roof edge and extended up to where it meets the stucco finish of the elevation. This meant that very shortly after completion the roof edges began to show signs of dirt and molten bitumen. In many places the roof edge was found to have a small concrete upstand, which was fitted later to combat this.9

The remnants of the concrete upstands were removed to restore the building’s appearance to that of the first building phase of 1928. The roofing was pulled over the roof edge again, although not before an aluminium strip was attached to which the roofing was fixed which reduces the risk of damage from, say, ladders against the roof edge. The joint between the aluminium strip and the stucco has been sealed with an elastic sealant.

31 The testing of the window panes in the corner of the large hall. The glazing was always tested on corner locations so that the view through two panes of glass could be evaluated.

32 South wall of the main building, edge of the roof of the stairwell with drip stains, 1930s.

33 At a later stage a plastered drip edge was applied to a large part of the building, which gave it a very different appearance.
The glass in the sound-proof transom lights has been made of a laminated variety. Despite all the care that was lavished on the restoration, not all solutions were entirely successful. It only emerged afterwards, for example, that the use of two hinges at the top and one at the bottom of the inner door is in a contemporary convention, whereas back then it was just as common to have one of the hinges in the middle.

In 1928 the outer corners of the plastered mesh walls were protected with corner beads up to door height. Above, the manually drawn corners had much loftier edges which, like the glass, emphasized the building’s physical character. During the restoration the plasterer managed to achieve a similar look by covering the corner profiles. By applying the original picture moulding all over, even need not drill into the partition walls.

Concrete enamel and terrazzo

In 1928 the walls of sanitary facilities such as bathrooms and kitchens were finished with concrete enamel and the floors with terrazzo. The same principle was adhered to during the restoration. Duiker called this type of wall finish by its product name ‘fortoliet’; a special water-proof plastering technique in which pure cement mortar is applied in two consecutive thin layers and the top layer is usually applied with a brush to achieve a bumpy surface. The same technique has now been applied to the dado of the partition walls and the splashback behind the wash basins.

The inside of the parapets has been finished with gypsum plaster and painted. The water-proof finish of the original window sills with concrete enamel has been meticulously restored. Because the substrate is so different for today’s wall plaster, careful planning was required.

The reproduction of the pipe radiators proved to be a costly affair. The switch from steam to hot water also meant that the heat emission would be much lower than in the past. Nonetheless, the appearance of the system was considered to be such an important element of Duiker’s design, as suggested by the almost ostentatious display of the boiler house, which showcased the steam-heating system in its full glory, and by the striking chimney with water reservoir and condensers which occupied a prominent position in the asymmetrical exterior composition. A less conspicuous but innovative system was that for the mechanical extraction of the kitchens and the upper hall. The scale of the other services was modest. Warm water was available only in the bathrooms and kitchens; lighting and other electrical equipment was used sparingly and there were only a few telephones.

One of the aims of the restoration process was to highlight the experimental services engineering. Where possible, the original principles were adhered to, although sometimes modified to achieve more sustainable solutions. New systems have been concealed or else applied in an inconspicuous and neutral way.

The original steam-heating has been replaced by a hot water system. The model of the boilers and their installation in the boiler house are very similar to those in the uniform, while Kropman Installatietechniek has carefully reproduced and placed along the walls of the entrance halls, corridors, stairwells and the upper room, and was technically possible because it emerged that there had been three types of linoleum, but in reverse. As a result the standard height of the interior doors is a contemporary convention, whereas back then it was just as common to have one of the hinges in the middle.

Concrete enamel water-proof finish for the walls, which has been meticulously restored. Because the substrate is so different for today’s wall plaster, careful planning was required.

the difference between the original and the new layer, the walls and floors of most of the new bathrooms have been tiled.

Linoleum

As before, a linoleum finish proved suitable for the building’s new function, in part because it met the requirements for antistatic flooring. Lacking information about the original types of linoleum, it was initially planned to use plain Linoleum. It was not until long after the restoration process had got underway that it emerged that there had been three different colours of linoleum with a woodgrain pattern.

In the laboratories of the DLW in Germany, samples of the various wall and floor finishes are examined and floor samples are made. The test samples are made by hand and evaluated.
The redevelopment of Zonnestraal was more expensive than contemporary standard ones. Especially available and the porcelain base of another fixture had to be doubled or even tripled in most cases. As the original wiring had been integrated into the concrete floors, the extra electrical boxes could only be installed by cutting more than 400 holes out of the roof slabs. Only for the kitchen were these holes made with a compression layer on the floor of the upper hall.

As a result the replica fittings were not much more expensive than contemporary standard ones.

Building management and maintenance

Some of the solutions were subject to a close attention from the building management when the main building is in use, including the balance of roof edge details, the horizontal struco surfaced, the white colour and the many sealed joints that will require constant maintenance. The special glass came with a small supply of extra panes, but the coloured glass for the glass fitting can only be ordered in large quantities. The service systems are more fragile than normal. The condensation in the glass facade doubles up as safety barriers. The room has also been fitted with additional under-floor ventilation.

The lighting is based on the original lighting design. Both indoors and outdoors, replicas of the old light fixtures have been used.

The building used to be sparingly lit with just a single ceiling fitting per room, which would achieve a light level of approximately 75 lx. To meet today’s illumination standards, the number of light fixtures had to be doubled or even tripled in most spaces. As the original wiring had been integrated into the concrete floors, the extra electrical boxes could only be installed by cutting more than 400 holes out of the roof slabs. Only for the kitchen were these holes made with a compression layer on the floor of the upper hall.

The historic building survey has shown how, in the three years between the initial building phase and the completion of the Dresselhuys Pavilion, Duiker continued to develop the structural detailing. The most striking examples are the steel window frames, which were made as separate facade units in the pavilion, and the segmented parapet construction. And whereas the main building had featured an unventilated cavity wall construction, for the second pavilion Duiker opted for a moderately ventilated version by fitting alternating ventilation grates and extruded glass in the walls.

During the restoration it was discovered that the external wall had been made on site of cement plaster on reinforcement bars. At most of the corners and spandrels the reinforcement could be repaired and thus preserved. The somewhat battered exterior has been carefully preserved in order to show that the pavilion has a history. Other external wall leaves were so badly damaged that they had to be replaced by new ones drawing on the original, albeit improved principle.

In 1931 the external wall was constructed first, so that the new facade could be properly rendered and thus preserved. The somewhat battered exterior has been carefully preserved in order to show that the pavilion has a history. The other external wall leaves were so badly damaged that they had to be replaced by new ones drawing on the original, albeit improved principle.

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The new structure of the pavilions. Right the original reinforced concrete slab, left the middle the new reinforced concrete slab with double stainless steel meshing coat, cavity, the new parapet panel, galvanised steel reinforcement (not visible), stainless steel clayed mesh and cement plaster left the final result.

40 A standard window with the corridor walls in the Dresselhuys Pavilion. They were securely damaged because this side was protected by a roof overhang's inadequate profiling meant that the window had held inwards, the bearing the ground was left by. The consequences can be seen from the aerial steel work of the site.
The factory in Lithuania could no longer supply the
sustainable re-use of the pavilion. Besides, because
chances of finding a user who would contribute to a
main building had been so well-received that it was
decided to install it in all the patient rooms in the
The specially developed insulating glass for the
window frames and doors.

The disintegration of the bottom sills into a
decision to get underway nearly the entire
steel façade of the pavilion was still in place. Many of
the pots could be preserved and repaired. The same 32/37 mm series was used
for the replacement frames as for the outside doors in the
The ventilation facilities could be reproduced and
the air flow has been improved by making larger
slots in the columns.

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The central workshop after restoration. The light fittings are copies, as in the main building, and fitted with PL lamps in a warm light colour.
The redevelopment of Zonnestraal Sanatorium Zonnestraal decades of dereliction the Dresselhuys Pavilion still awaits a new user. The greatest possible attention was paid to the conceptual and material ramifications of Duiker’s architectural approach. But what counts is that the buildings are back and that despite technical adjustments the fragile beauty of Duiker’s masterpiece can be enjoyed again by the general public – albeit at the expense of functionality and development.

Two aspects of the restored buildings stand out. The first is the newly-visible contrast between the dream and the reality of the materialization, the almost anachronistic relationship between concept and materiality, the differences in innovative construction techniques of 1928 and those of 1931. The second is the renewed contrast between the innovative exterior and the much more conservative interior. The fact that that was respected during the restoration of the main building enhances the story that Duiker’s creation tells us about the socio-cultural context of his time.

The restoration contributes to the historic continuity of our society and has won widespread praise. Even independently of its major architectural-historical value, the unique history of Zonnestraal has made it into an unrivalled symbol of Dutch social democracy. The interest from all over the world has been immense. On the occasion of Open Monumentendag (Dutch Heritage Day) in 2003 the recently restored main building attracted nearly 2,000 visitors in a single day.

The longitudinal facades of all four workshops consisted of sliding pivoted sash windows without a middle rail. This required a lot of patience and ingenuity to determine the details.
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