The Mining Museum of Broken Hill
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The Mining Museum of Broken Hill

Glenn Murcutt

This article is based on conversations between Glenn Murcutt and the editors during 1989 and 1991.

In the middle of my final presentation of the design for the Mining and Minerals Museum at Broken Hill to the museum's board of directors, one of the board members got up and walked out of the room. After a while he returned with a copy of a late nineteenth-century photograph which showed some miners from the Broken Hill mines standing beside an opening to a mineshaft where they had rigged some canvas to catch the wind and scoop fresh air down into the tunnels. The degree to which their solution resembled the system of wind-aided evaporative cooling that I'd used in the museum struck us all. I'd never seen this image, or even heard of such a practice, but I was pleased to learn that there was such a direct precedent for my design and that the architecture of the museum would be closely tied to both the imagery and the processes of the mining industry that it would exhibit. I've never attempted to use local images in my design work, and I'm uninterested in pursuing historical forms toward a nostalgic end. But the coincidence has compelled me to reflect on the idea of building legibly and articulately in the twentieth century.

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The landscape of Australia is remarkable. Through the course of my career I've attempted to develop a greater knowledge of that land and to discern the lessons that I can draw from it. Most importantly, I am learning of its economics in the very broadest possible sense. It is about survival, really, and the poetry and legibility in that survival is extraordinary.

There is an integrity that operates in the landscape. It presents warning and provides inspiration. On the one hand, if we do something to the land, the results of that intervention will show up, perhaps not immediately but over time, and the problem that we've created will define itself. But this legibility also provides an incredible array of solutions to difficulties we face when we attempt to occupy the land.

I'm not advocating the mimicry of some simplistic natural paradigm. When I began my practice, over twenty years ago, the architects of the so-called Sydney School in Australia were borrowing heavily from Frank Lloyd Wright's ideas about building and nature. We were building with a great esthetic respect for the land, choosing bricks of the very same color as rocks on the site, keeping the build-

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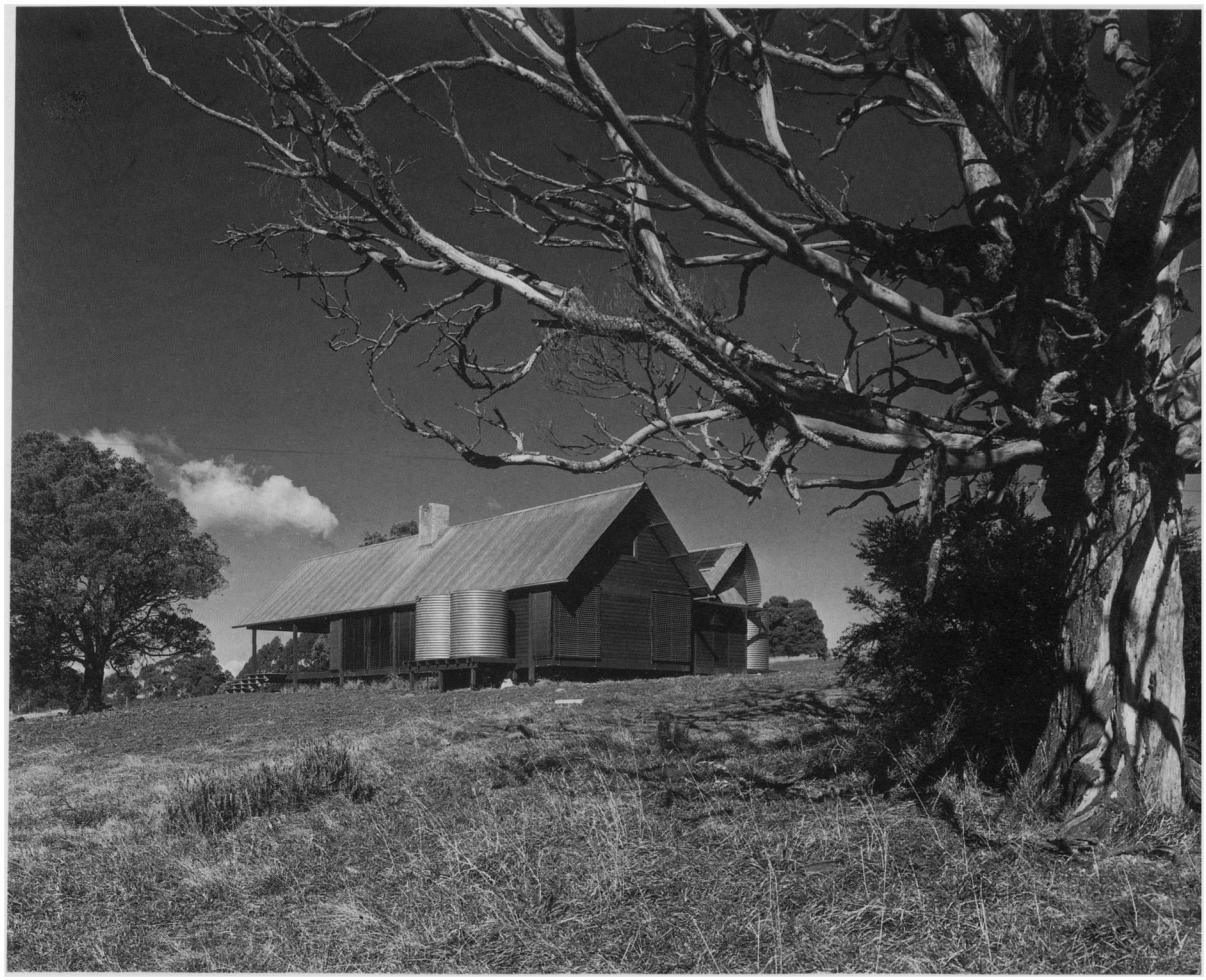

2 Nicholas Farmhouse, Glenn Murcutt, Mount Irvine, NSW, Australia, 1972.

ing's scale as low as possible, sometimes bringing a tree through the roof or even placing it in the house, using rocks as part of the building's structure. I have come to believe over time that this is a dangerous simplification of environmental concern. Such romanticism, choosing a palette of materials to blend into nature, obscures an economical and realistic course of action for the builder.

The natural stresses on an environment and the responses of the land are the keys to the incredible emotional power of a place. I'm very interested in that emotion, and so I'm interested in the expression of those stresses on an object. In Australia the light is so intense, so clear and sharp that it separates and isolates elements in the landscape in harsh contour. The physical as well as the visual effect of that light on the land is extraordinary. In parts of the Australian desert, the leaves of the trees, unlike leaves in European and North American temperate zones, which curl and turn their faces toward the sun, instead face away from it, hanging down to reduce the evaporation of surface moisture. And the edge of the leaf picks up the track of the sun and follows it through the day. The light that penetrates the foliage creates a dappled shade so more sunlight strikes the tree trunk. In a particular desert species, the trunk during the summer is pure white, nearly silver in its reflectivity. As the summer tapers off into the winter, the white bark peels and reveals a new dark brown bark beneath it. It is a simple expression of the stresses of that climate. The extreme heat from the sunlight is reflected during the summer, while during the sub-freezing temperatures of the winter, the warmth of that light is absorbed and the tree can survive. The incredible delicacy of the leaf articulates the enormous strength of the tree in its survival. At once, one sees the expression of delicacy and strength. This is what I mean when I speak of a legible landscape.

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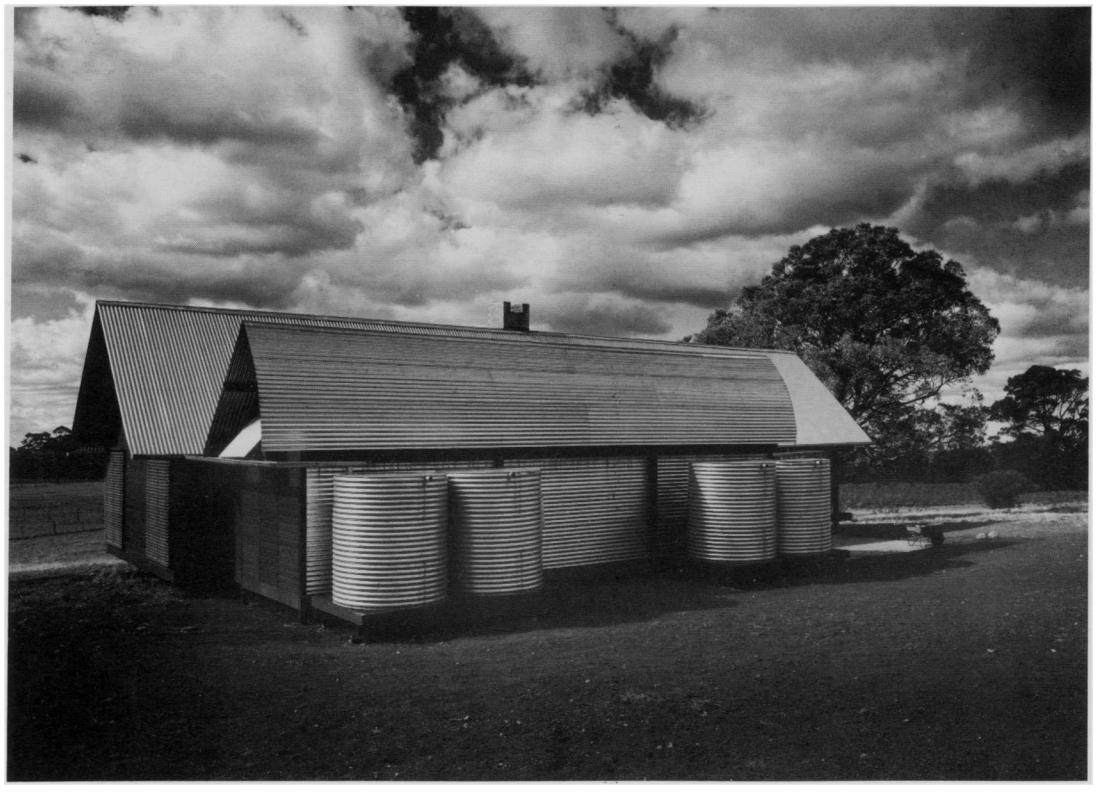
One doesn't build buildings to look like trees. One doesn't build houses to be white and brown. But one can read the language of this environment, which speaks of extreme stresses in climate, in heat and in light. Understanding the climate, understanding the way in which the geometry of the earth and the sun work so that one knows where the sun is throughout the day and year, understanding where the winds come from and knowing which are hot and which are cool, is the beginning of an articulate response to the incredible power of the environment.

I have come to believe that there's no difference between absolutely clear thinking and poetry, between the logistics of a project and its expression. A wide dry creek bed in the desert tells me, for example, about rain gutters for a house I might build there. For most of the year, I can use a gutter that is 150 millimeters wide. But four times a year, the house will need a gutter that is half a meter wide. If I use a gutter that is half a meter wide, it's perfectly logical. Like the dry creek bed, the gutter throughout most of the year will be dry, and then, briefly and suddenly, it will be swollen with water.

I'm interested in an architecture that has a strength and at the same time a delicacy, and where the process that links and modulates them is evident. What materials should I use? I'm not building like an ant, I'm a human being building a twentieth-century object related to the landscape. I believe that one can produce a building



3 Nicholas Farmhouse.

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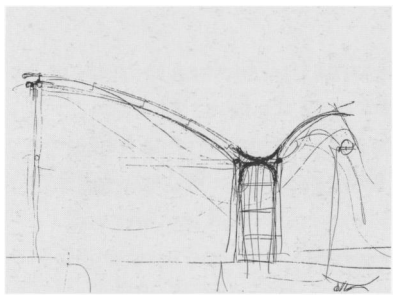
4 Moruya House, Glenn Murcutt, Bingie Point, NSW, Australia, 1985, east elevation.

5 Moruya House, interior.

The Mining Museum of Broken Hill



that clearly articulates the man-made, that is technologically of its time, with materials and products that are readily available and easily handled. I use a lot of industrialized components and run-of-the-mill iron. I use a lot of glass with standard metal louvres and shades to alter the light in the building as necessary. Dark metal louvres heat up beautifully during the winter mornings and radiate that heat into the building, and as the day warms, you can open them up so that the building breathes.
I often use wood, but I've also found that I can take a metallic material and make its color work beautifully in the landscape. I've used corrugated metal with the corrugations running horizontally and found that the top side of the corrugation takes on sky light, and the bottom side takes on ground light, and the resulting reflection of the site's light produces a luminescent absorption of the environment, a dialogue between the building and the color and the nature of the day.

I'm interested in an architecture that continually acknowledges the physical and climatic character of its site; that recognizes the sorts of changes in scale we experience when we move from the inside to the outside, whether in the suburbs, where scale is broken down incrementally, or in the country, where the relation of a person to his environment goes through an enormous reversal as one moves from the land into a building. I want my buildings to use natural light and ventilation to the greatest extent possible, and so I adjust their orientation to maximize the potential cross-ventilation from prevailing breezes, and I shift roof lines and pitches to gain maximum winter sun and minimize summer sun. My long narrow house plans act as verandahs,

7 Moruya House, view from north.

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that architectural threshold Australians have inhabited so much more comfortably than the houses to which they're attached, and from which they've come to understand the land in which they live.

My clients are involved with these buildings, and I believe they understand and have a more immediate relationship with the outside world through them. One client who had lived for a number of years in a house that I'd designed told me that she operated the house as one would sail a boat. And so I like to think of my buildings as legible and functional in much the same way as a boat or a glider is. I want them to show what is structure, what is infill, and what is skin. If a building is put together in a legible and articulate way, where the process of its design and production is evident, then it can be used, pulled apart, and altered in that way. By keeping this in mind, I've been able to build many of my buildings for about three-quarters the price of most architect-designed buildings.

But aside from the immediate economies of building cost, I am looking for ways in which to control the deeper, embedded costs of building on the land. We must learn to understand the implications of our decisions as occupants. It is no longer enough to use a material because we like the way it looks or because it's cheaper. It's absolutely crucial to come to terms with the fact that our paints and coatings and adhesives may poison our water and air; that our choices of exotic and inaccessible materials may cause the destruction of a landscape in another part of the world; that our reliance on the long distance transportation of materials adds to the highways vehicles that consume energy and pollute the air. These are all factors that must affect our work especially at this time in history, when we can have almost anything we wish for.

People in my country have difficulty understanding this idea and tend to focus on the image of my buildings, making references to the supposed authentically "Australian" character of the forms and materials that I have used. This is a romantic response of a people who live in the most suburbanized country in the world but who cling to mythic images of the landscapes that have become so distant from their lives. With architecture, as with many other things, our eyes often misguide us. We are so tuned in to form that we frequently fail to find the thing that generates that form or the idea that develops a process. If we understand instead why a thing looks the way it does, or why it works in the way it does, then we understand the principle, and that principle, not the form it produces, is transferable.

8 Moruya House, view from southeast.

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Mining and Minerals Museum, Broken Hill, Australia

In the dry red earth of the desert outside Broken Hill I saw areas, in the plains and along the dry creekbeds, where I expected to find a high water table, but in fact the trees and plants were all stunted or dead. I found it especially intriguing because along the nearby hillsides, where there is little sign of water in the soil, the trees grow quite well. If you look closely at the situation, you discover the remarkable dynamic of the place. The dry creekbeds are not signs of a rising and falling water table beneath the surface, but rather, are the marks of brief bursts of intense rainfall that funnel off the dry land and inscribe huge gouges in the desert. And so, trees, at best, can survive only briefly in those conditions, where there is insufficient water to sustain any real growth. But on the hillsides there are large overhanging rocks. And the mass of those rocks collects heat during the day and holds it so that in the cooler evening air, water condenses and provides a small but consistent supply of water for the nearby trees. The landscape here tells us a lot about how life is sustained through the interplay of extremes of heat, light, and mass.

Broken Hill is a small, geographically isolated city located in the desert of far western New South Wales. It is sustained economically almost solely by a mining industry that has produced ore from the world's largest zinc, lead, and silver deposits for over a century. The city is dominated by the images of those mining operations and their residue. Huge mine tailings, the mountainous heaps of earth and stone pulled from the mines, and the giant headframes, which provide the mechanical lifelines to the mineshafts and tunnels that lie deep below the city, fill the horizon. But because these have become a mundane physical and economic presence in the city, and because the yields of the mines have begun to slow and the city and the industry have come to realize the limits of this economic and symbolic resource, the city is beginning to search for other ways to maintain itself. A museum devoted entirely to mining and mineralogy would provide an explanation to tourists and a reminder to inhabitants of the force of this industry in the development of Broken Hill.

The program provides for a single building that includes exhibition spaces, an auditorium, laboratories and workshops for conservation, private offices for museum officials, and a public cafeteria. The museum, to be placed on a long rectangular block at the edge of the city center, is to create a sort of diagonal connection between the high school and the main business area of the town. With the existing school, nearby railway museum, and town hall, it is to stand as one of Broken Hill's civic institutions, each placed as a freestanding monument on its own block. The future museum's site now stands empty except for some mining machinery, most notably an abandoned mine headframe, that will become part of the museum display. The budget is low, and its constraints are further compounded by Broken Hill's extreme distance from any large cities or industrial centers, over thirteen hours by truck, which will limit the range and availability of materials.

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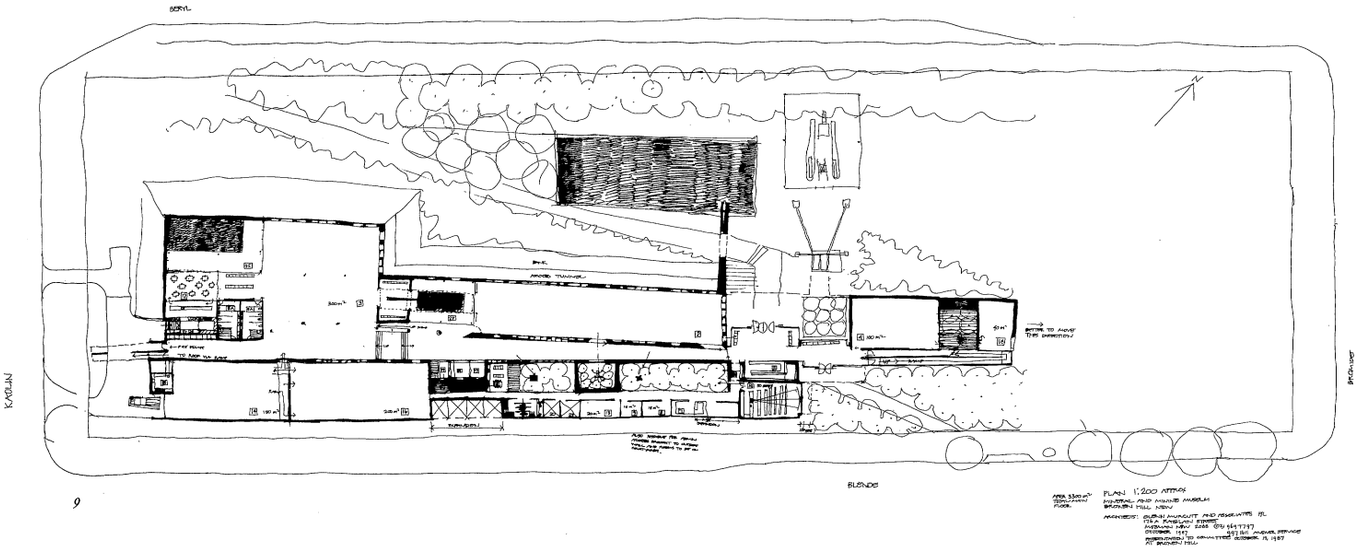

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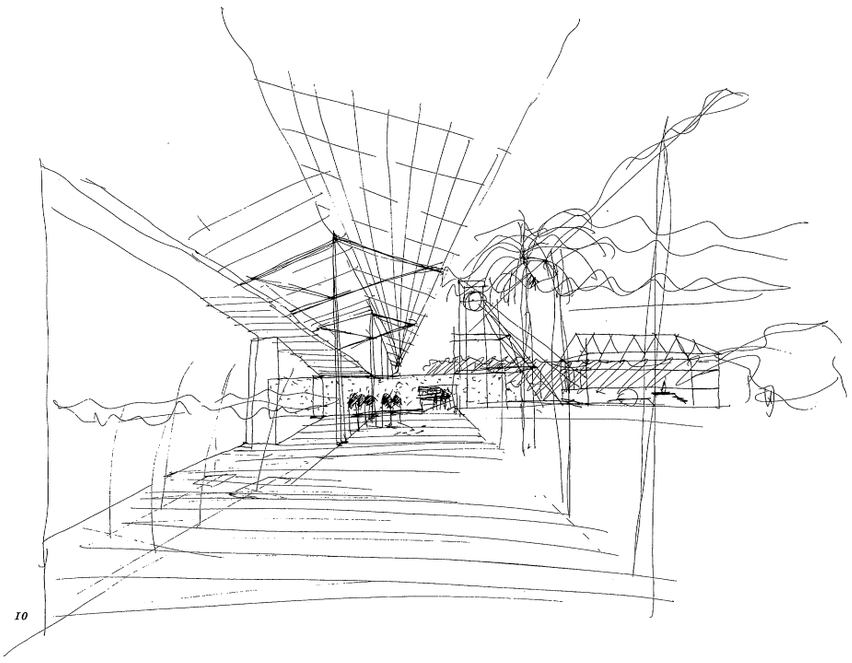

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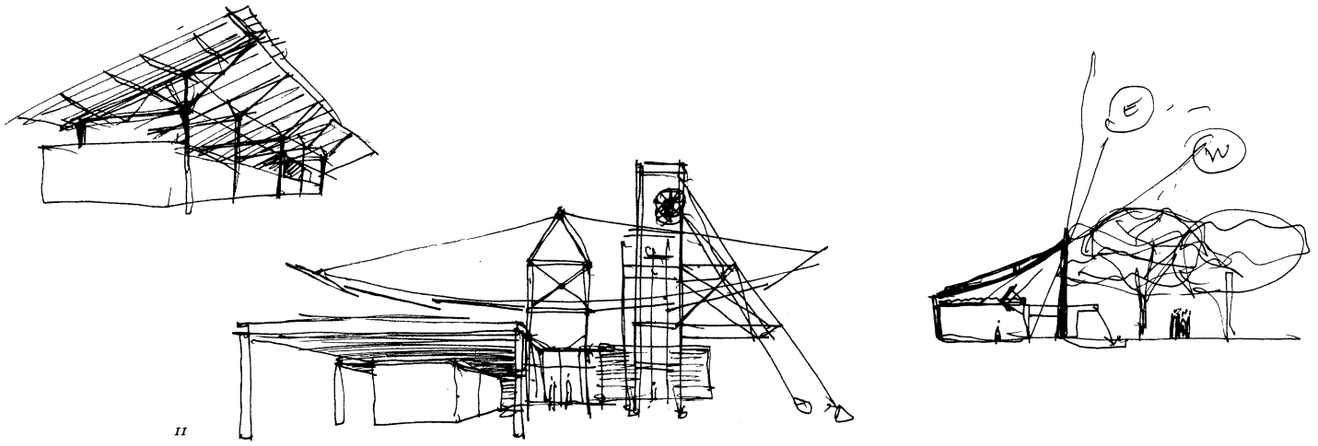
A series of early sketches show the development of the museum design.

9 An initial plan study of the museum, the first presented to its board of directors, shows a series of courtyards and pools of water in and around the building, organized in relation to a diagonal route across the site that was called for in the program. The path crosses through the building entry, which lies next to the existing position of the abandoned headframe. The building is split down its length into two halves separated by a narrow courtyard: the public spaces face pools to the northwest, and the administrative spaces are adjacent to the street, providing easy freight access. Unfortunately, the diagonal route and the existing placement of the headframe force the building into a corner of the site. The clients reviewed those constraints.

10 In a sketch of the view toward the entrance, the headframe and its machinery shed stand as a kind of iconic sculpture at the gate to the museum, marking the beginning of the exhibition. The building begins to take shape as a concrete container with a light skeletal roof.



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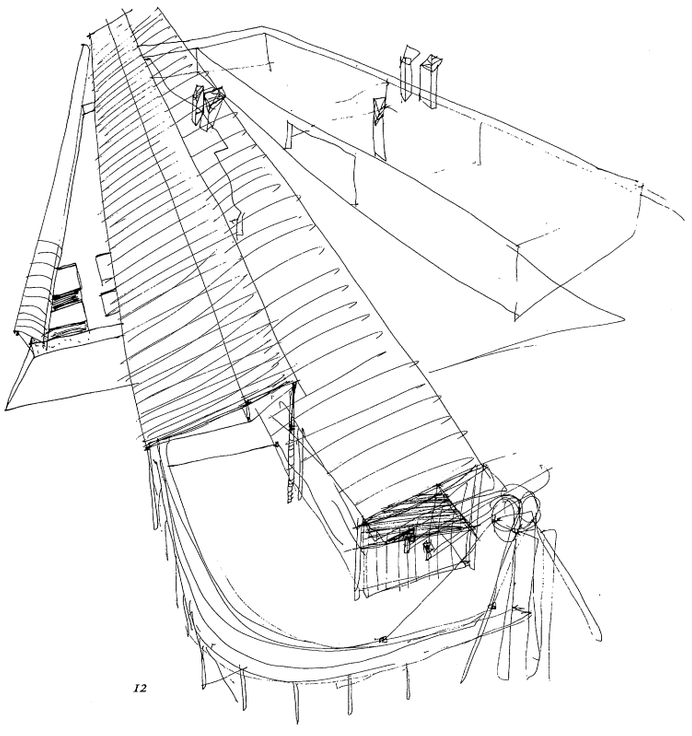

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11 These early studies further demonstrate the idea of a heavy base providing a thermal mass, shaded from the desert sun by a parasol-like roof, which is distinct from the base and suspended above it. The headframe's trussed construction, pulleys, and cables suggest one possibility for the roof's structure, although a simplified shed roof presents a more obvious and expedient solution. The changing angles of the sun throughout the day and year suggest a way of zoning the section of the building so as to produce maximum light with minimum heat gain. The position of the pools at the edge of the exhibition spaces would allow for evaporative cooling, enriching their initial esthetic function.

12 A bird's-eye view of the museum shows the beginning of the transformation into the building's final form. The headframe and entry, relocated at the head of the public wing, allow the building to settle into the center of the block. A curving ramp passing beneath the headframe initiates the procession of exhibition spaces, which are enclosed by battered earth berms that act as heat sinks. Five windscoops, positioned over rooms without exterior access, provide additional airflow necessary for cooling.

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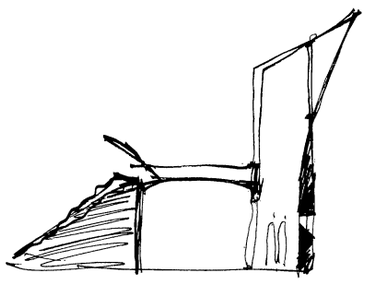

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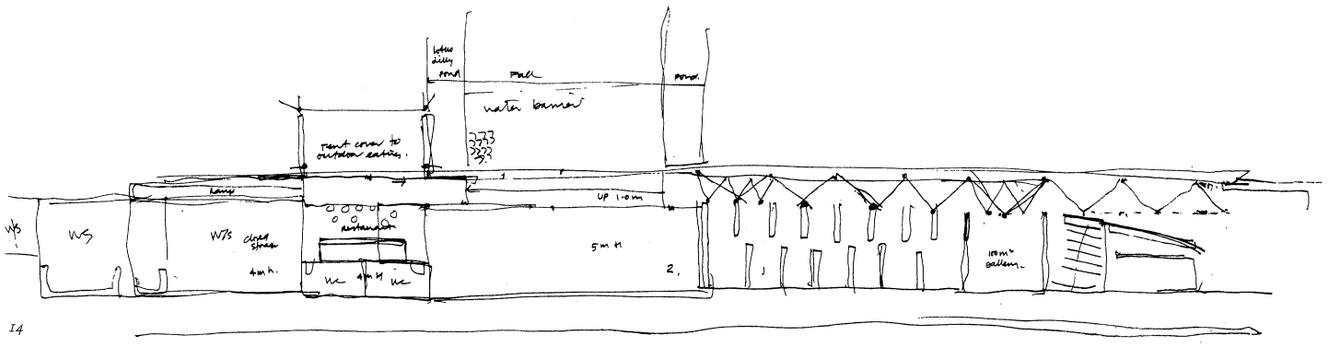

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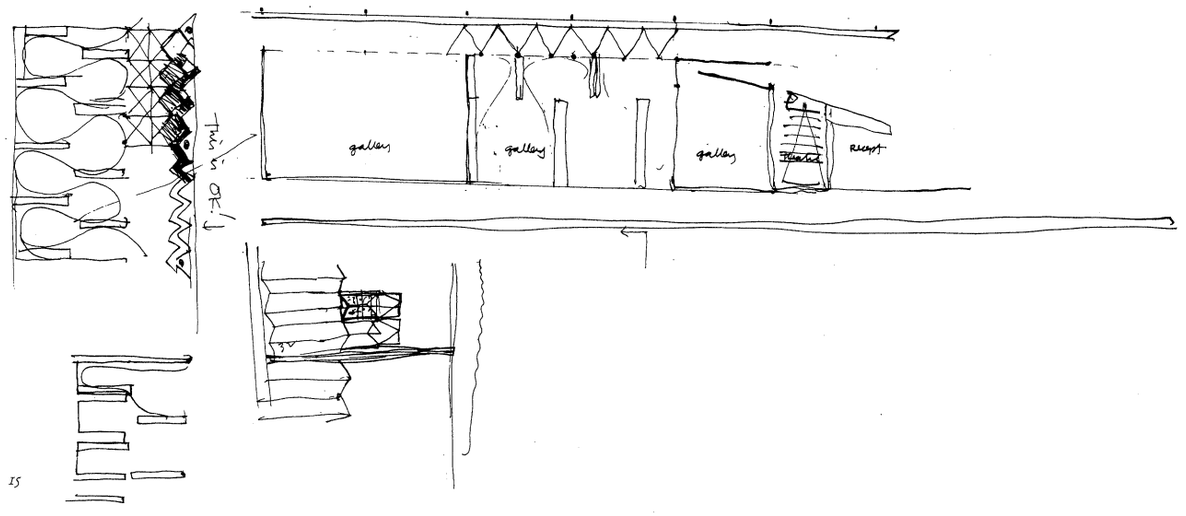

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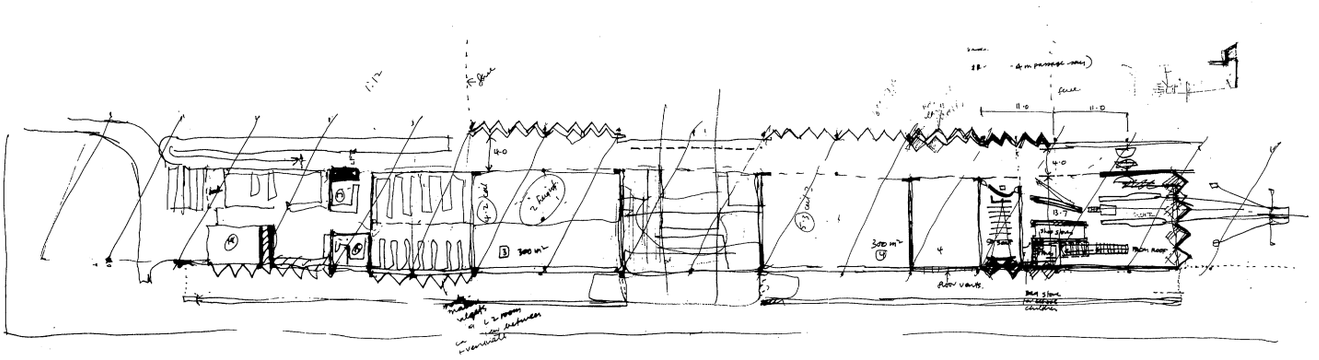
13 This section study shows a reevaluation of the plan, the width of which makes it nearly impossible for natural ventilation to work sufficiently. With the introduction of more windscoops and the reduction of the plan to a single-loaded corridor, prevailing breezes will pass across the width of the building. The tilted under-side of the shed roof produces sufficient negative pressure to augment the exhaust of those breezes at the back of the building. Earth berms buttress the winter side of the building.

14 A plan study presents the effects of these developments. An earth berm runs the length of the southern wall, and a pool of water on the northern, sunny side of the building aids evaporative cooling. The zigzagging lines along the corridor connect the points of support for the triangular windscoops that line the corridor along the exhibition spaces. Programmatically, the various spaces are now in their future positions, with exhibition spaces at the entry end of the museum. Administrative and maintenance spaces at the center and opposite end of the building sandwich a public cafeteria, which is connected to the display areas by a ramp.

15 A series of plan sketches of the first-floor exhibition areas shows the substitution of rammed earth walls for the earth berms, which allows the building's container to take on the triangular forms of the windscoops above. This suggests that the windscoops be integrated into the structure of the wall rather than punching through the plane of the roof. A small sketch of the elevation of the wall expresses this development on the building's exterior. The formal alteration of the windscoops is followed by a functional one, in which they are transformed into malqafs, *based on the Egyptian architect Hassan Fathy's interpretation of traditional design principles. Air is to be drawn down and over a bed of charcoal and water, ensuring a high degree of evaporative cooling.*



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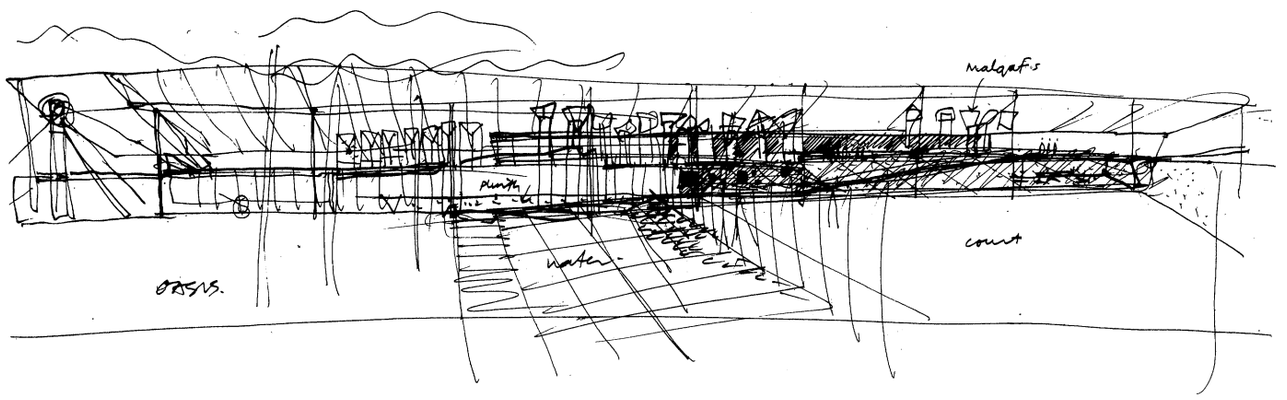

17 VIEW FROM NORTH.

The drawings for the second presentation to the museum's board outline the proposed building.

16 A final plan shows the headframe and hoist as the first objects to be exhibited at the museum's entry. The grid of columns and the roof trusses above it are racked so that the roof will extend beyond the building, providing a cover for the loading dock at the private end of the museum and an awning at the entrance. This move also mitigates the bluntness of the building's end elevation. The thin elongated plan with its single-loaded corridor facilitates a two-stage building schedule by allowing the first built stage to appear as a completed composition, and optimizes exposure to Broken Hill's constant but light breezes.

17 View of north elevation.

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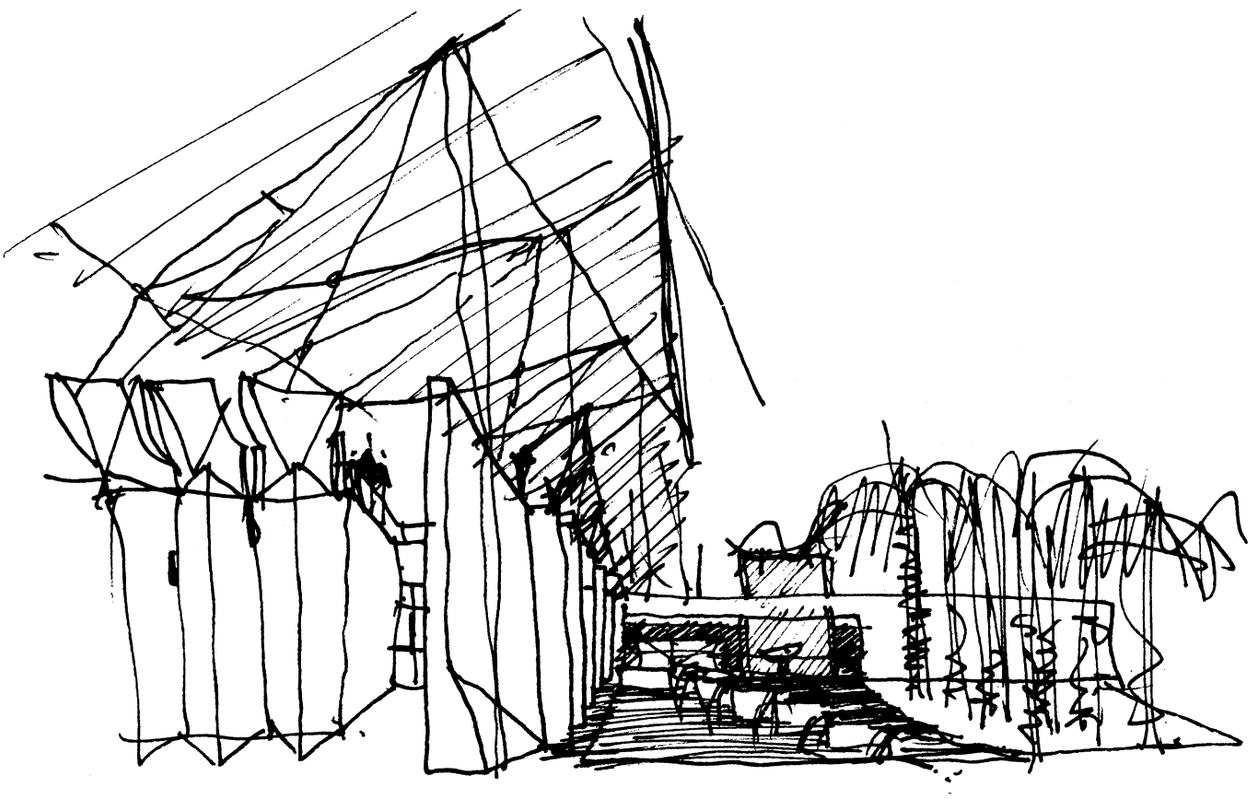
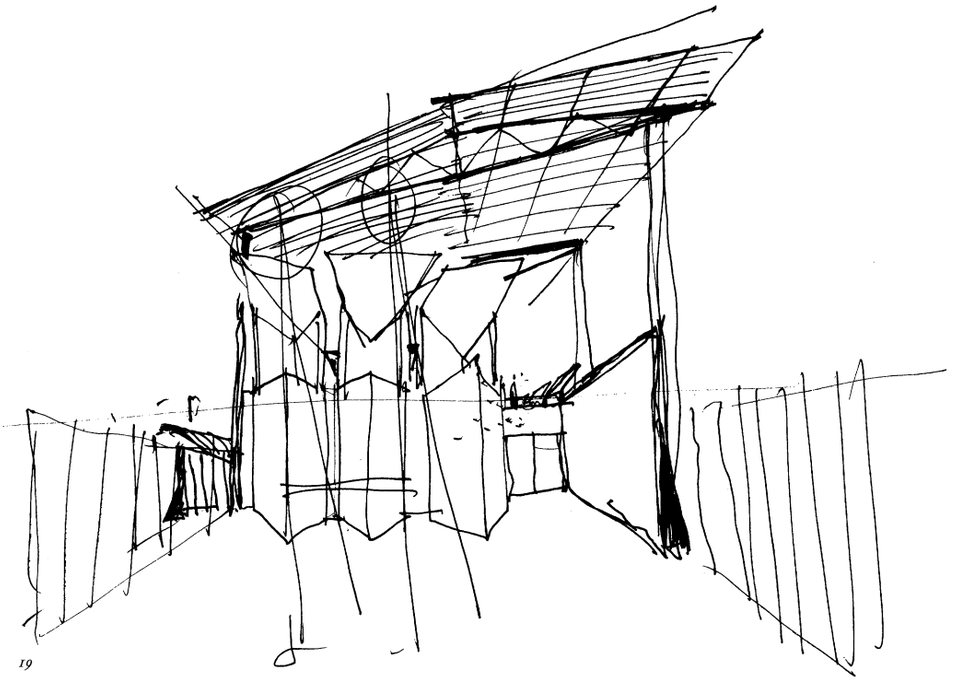


18 View of courtyard and pool from entrance. Air, cooled and moistened by evaporation of the pool's water, will pass into the malqafs, *which stand at the water's edge.*



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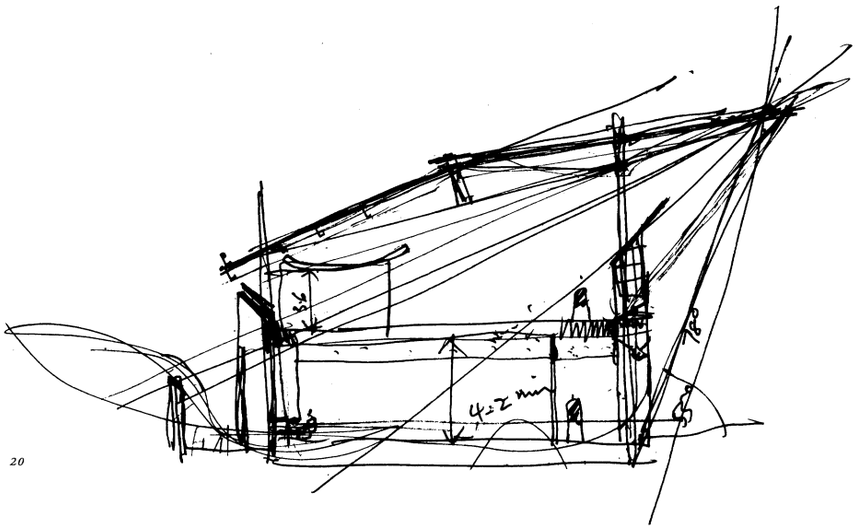

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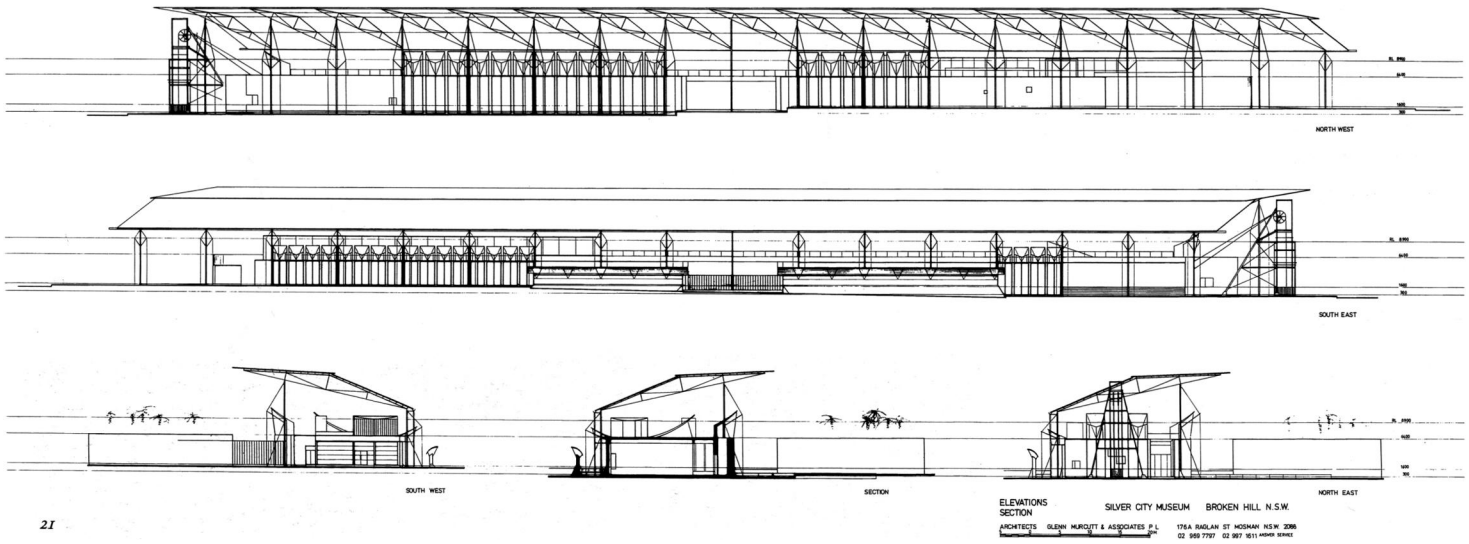
19 View of entrance. The shed canopy has become a shallow gable roof, tipped up to the north to capture the sunlight reflected from the pool. The resulting steepened pitch at the back of the roof's underside increases the negative pressure on the second-floor deck so that more air is drawn into the malqafs *and passes into the interior first-floor spaces.*

20 A final section study establishes the correct geometries for the building's optimal exploitation of natural light and ventilation.



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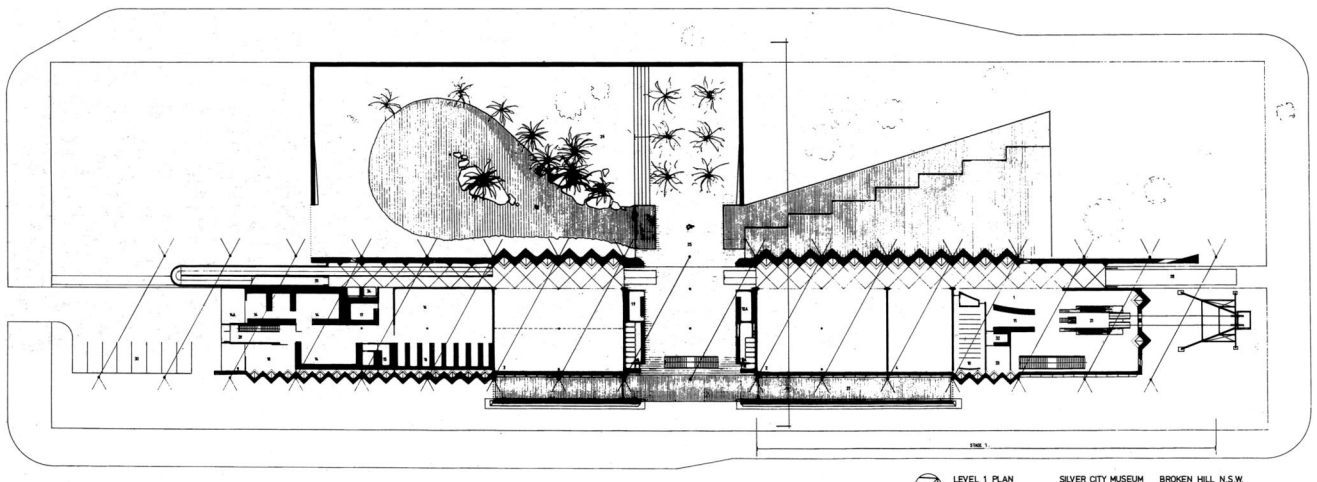

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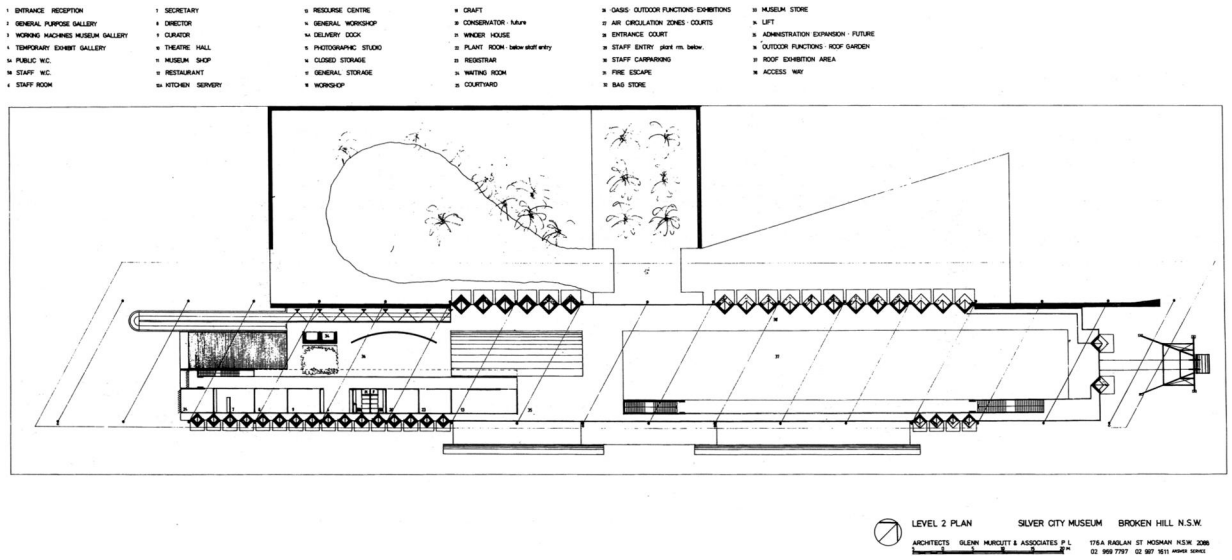

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The Mining Museum of Broken Hill

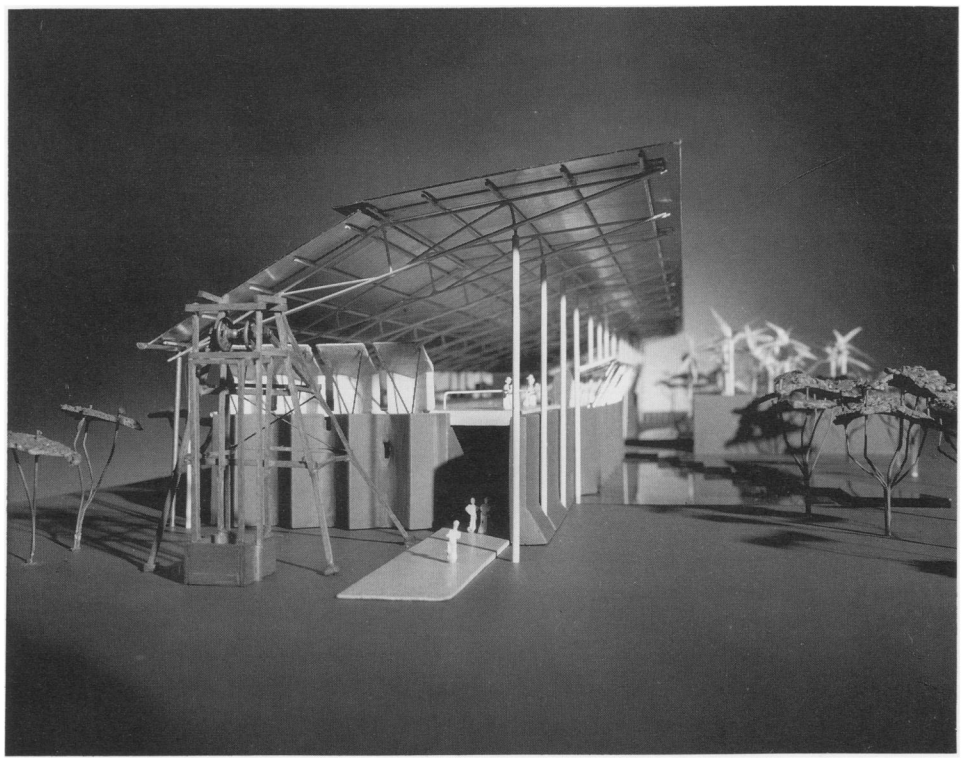
21 Mining and Minerals Museum, Glenn Murcutt, Broken Hill, New South Wales, Australia.
a. northwest elevation
b. southeast elevation
c. southwest elevation
d. section
e. northeast elevation

22 First-level plan.

23 Second-level plan.

24 Model

25 Section.



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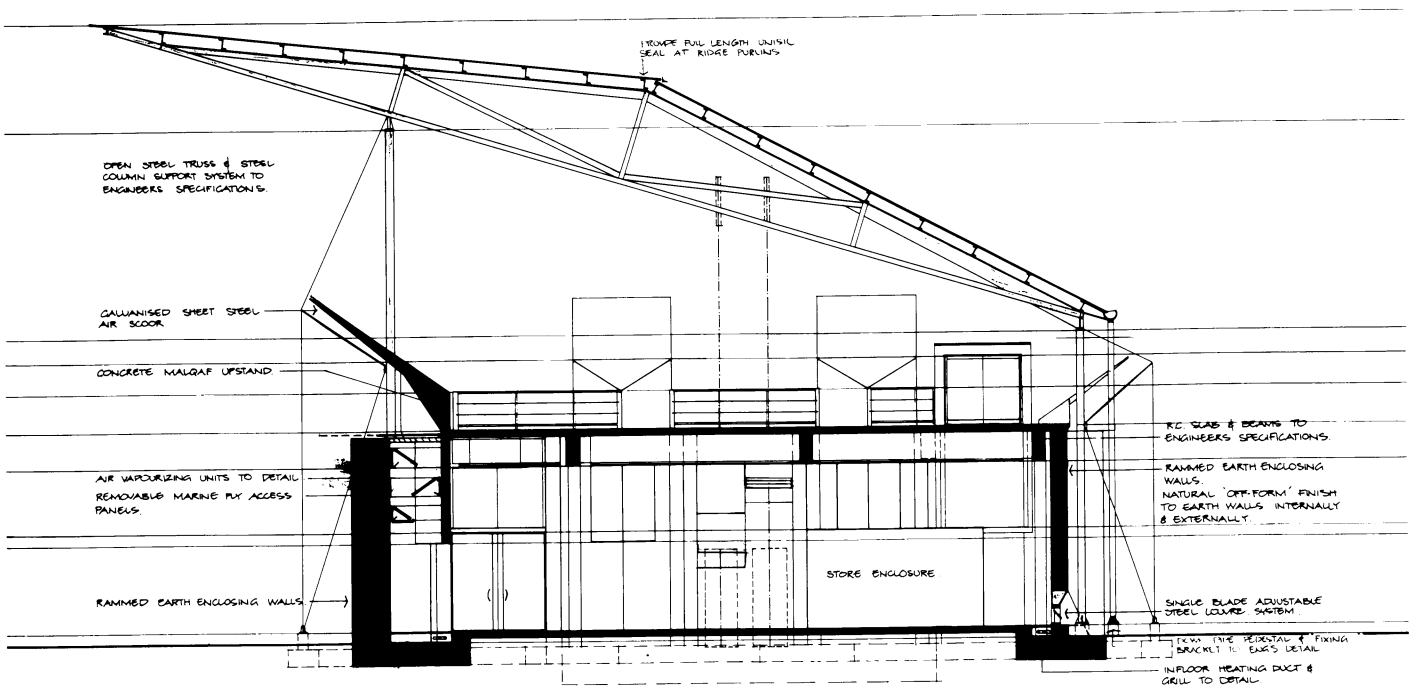

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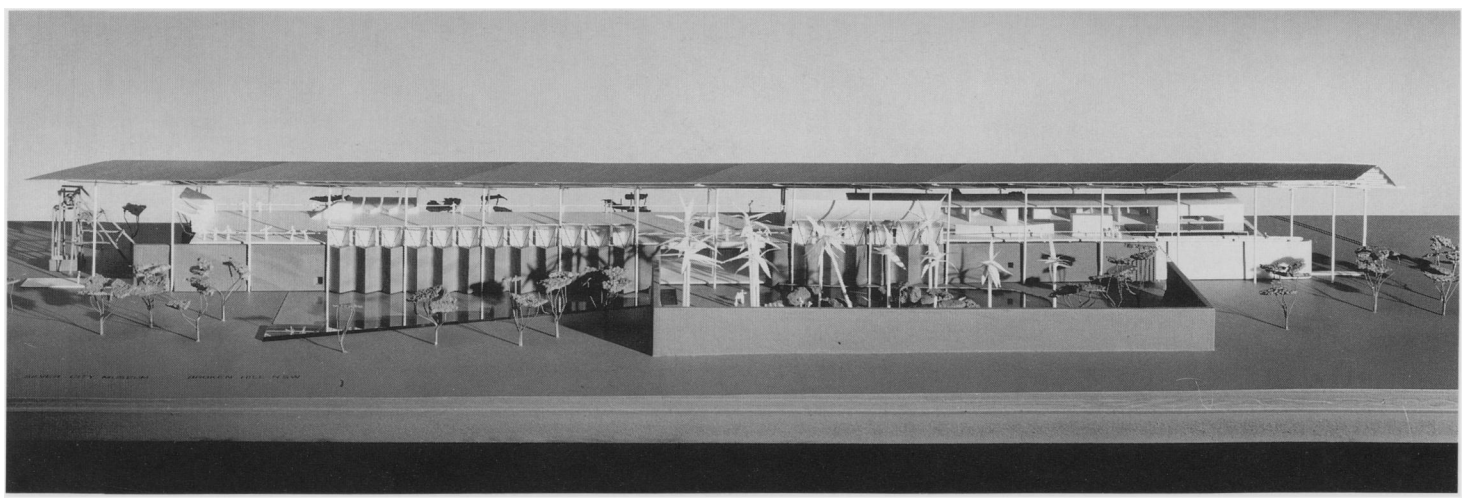
The proposed museum is more than 300 meters long and stands at the center of the city block, clearly a part of the monumental landscape, both man-made and natural, of Broken Hill. The site's high water table allows for native desert palm trees and pools of water. It is to be a reminder of the oasis in a desert environment, providing an analogy to the place of the mining industry in the life of this city.

A visitor to the museum enters the building at its northeast end, continuing past the mining headframe and into the compressed earthen spaces of the first-floor exhibition spaces, which lie beneath the huge, heavy mining machines on display on the second floor, which is open to the air and visible from the street. I like to think that the sense of that weight above, the material quality of the rammed earth walls, the dimly lit spaces where the only illumination to supplement the incandescent light of each display falls, with cool air, in repeated punctuation along the narrow corridor from the *malqafs* above, might all work to give the museum-goer some sense of the experience of travel down a mineshaft, where the vertical descent is marked by the periodic rush of air and light as the lift passes each ever-deeper horizontal tunnel.

The building has three discrete components. The gabled truss roof, split at the ridge and expressed as two distinct sheets of corrugated metal, hovers on slender steel columns above and separate from the base of the building. The floor slabs of the building are in concrete, a material used minimally in order to reduce the freight costs of trucking it across the desert. The red earth for the rammed-up walls, which provide the building's thermal blanket and form the bases of the *malqafs,* is to be gathered directly on the site.

Only in the spaces of the museum where certain temperatures must be strictly maintained, such as in the private spaces designated for restoration of artifacts, is air-conditioning used. The rest of the museum is cooled entirely by the *malqaf*-aided cross-ventilation and evaporative cooling of pools to the north, the summer side in the Southern Hemisphere. Later wind-tunnel testing has entirely confirmed early calculations based on the velocity of Broken Hill's prevailing breezes. The aerofoil section of the museum provides a steady but light flow of fresh air through the building which is continually adjusted by anemometers which are connected to a computerized gate in the throat of each *malqaf.*

The building responds to constraints of a tight budget in both immediate and long-term costs, fulfills the demands and needs of the clients, and, I believe, captures the essence of Broken Hill. I didn't design a low gable roof because it resembled the roofs of the huge machinery sheds at the mines, but because it presented an economical solution in terms of cost, through its simplicity, and function, by creating the desired shapes for efficient air pressure and wind flow. If that form ties the building to a vernacular building type, it is because the construction of the museum and the construction of those industrial buildings must answer to the same principles of economy. I didn't propose *malqafs* after arcane historical research uncovered an isolated precedent, but because they provided a necessary function and an inexpensive alternative to costly mechanical systems. If they provide the museum with an expression of the harsh climatic conditions of the place, and link it to the historical activities of mining at Broken Hill, it is not because of a romantic desire to mimic past forms but to use form to a rational end. I believe that if we accept the responsibilities of living economically on the land, of building articulately and legibly using current construction technology but with an eye toward the profound renewability of both principles and materials, we will necessarily build with a link to both the land and the traditions of building on the land.



26 and 27 Mining and Minerals Museum, model.

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