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# The Strutt House

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## Background and Project Team

This paper is based on a presentation delivered March 16th, 2013 at the Carleton Heritage Conservation Symposium. It provides a very brief overview of the life and work of the architect James W. Strutt, and describes the design and detailing of the Strutt House, in Aylmer, Quebec, just north of Ottawa, complete with an electronic simulation of its construction.

In 2011, the National Capital Commission purchased the Strutt House from the architect's daughter. In the fall of 2011, PTAH was asked by the Commission to undertake a comprehensive investigation of the structure. PTAH Consultants Inc., Architects is an architectural practice with a focus on heritage conservation and stewardship issues. The investigation culminated with the publication of a [250-page] report covering the historical context of the residence, its design and construction, a detailed review of its condition, and recommendations pertaining to its stabilization and conservation.The project team consisted of two lead PTAH Consulting Associates, Brian Hierlihy and Titania Truesdale, and a student architect, Golnaz Karimi. Dominique Thériault, another PTAH Consulting Associate, assisted in the analysis of the building structure and the computer simulation of its construction. The two lead investigators knew Jim Strutt personally for many years. Ms. Truesdale was a frequent guest at the House and is a recognized expert on the subject. She worked with Jim for several years prior to his death to document and catalog his architectural legacy, and assisted in the cataloging of the Strutt Fond for the national Library and Archives Canada collection.

## The Strutt House is Exceptional

Strutt knew Frank Lloyd Wright, and the latter's influence on his education is evident in the detailing of the building construction. The siting below the crest of the hill; the integration of the house with its site; the use of natural materials; and the core as hearth surrounded by service and served areas; these all reflect aspects of a 'Wrightian' influence. However Buckminister Fuller had a far greater impact on the building design and structure. The overall shape of the house results from the intersection of eight rhombic volumes, each based on a grid generated from the same geometry. This, and the minimal use of structural material, reflect the growing interest Strutt had regarding Fuller's work in geometry and weight efficiencies.

The building was built by a carpenter and helper in about six weeks in 1955. For the most part, it is not attached to its footings. It did not comply with applicable building codes when constructed, and does not do so today. The house is one of the first in Canada to utilize a 'curtain wall' as the building envelope. The wooden hyperbolic paraboloid roof was not only the first in Canada, but also the first of its particular construction anywhere. The building is a deceptively simple integration of structure, building science and planning.

The architect, Jim Strutt, is one of many that consider his own house to be a 'signature piece' of his long and distinguished career as a Canadian architect.In 2012, when we completed our six-month investigation, this remarkable structure was still essentially what was constructed in 1955, including the original fit-up and finishes.

Our investigation included a three-dimensional computer simulation of the building construction. The simulation exposed aspects of the design not evident by observation. It also provided a 'carcass' upon which fabric failures and related interventions could be 'hung'. It exposed the building as a highly-modular 'kit of parts'.

## James Strutt – Before Practice

James Strutt was born in Pembroke Ontario, January 8, 1924. His family moved to Ottawa while he was in grade school. He graduated from Ottawa Technical High School with a combined Academic/Technical Diploma. Directly out of high school Strutt was recruited by the Royal Canadian Air Force (RCAF) and served as a bomber pilot from 1942 to 1945 during the Second World War.

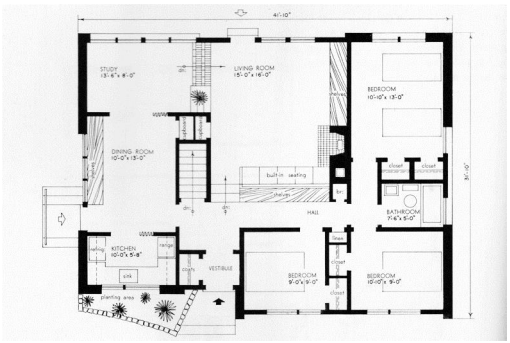
Strutt obtained his degree in architecture from the University of Toronto through the Veterans Rehabilitation Act of the 1947 Veterans Charter. His

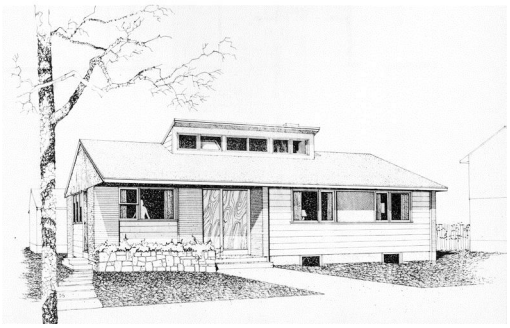
first choice, aeronautical engineering was full so he entered mechanical engineering. Bored shortly after enrolling, he changed programs after his first semester and took the last place left in the architecture school.

While a student, Strutt re-drew Wright's portfolio of existing works, and arranged for Wright to attend the school for a series of lectures/workshops. Following the review of student work, Wright is quoted in the Toronto paper as saying about Strutt: "this young man is going far."

## ***James Strutt – the Young Architect***

Upon completion of his studies, Strutt returned to Ottawa and worked with Cecil Burgess and then with the firm of Lafort & Gilleland. Bill Gilleland became Strutt's mentor and friend, and in 1951 they formed the partnership of Gilleland & Strutt.



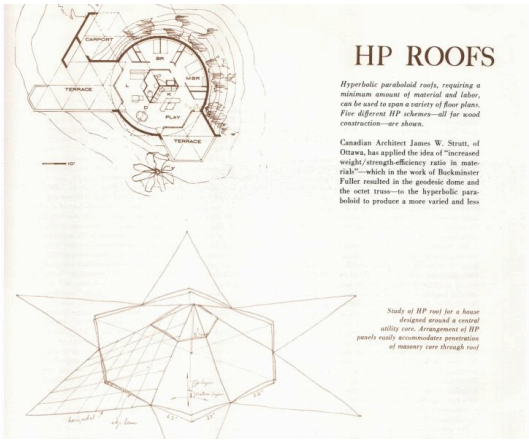
'1957 Small House Designs' Canada Mortgage and Housing 1957

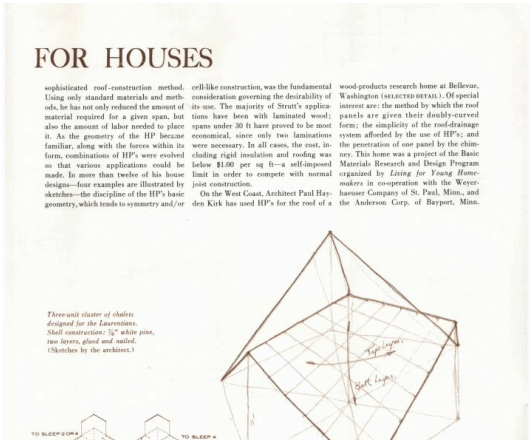
This project is an example of Jim Strutt's more 'traditional work during this period. Notwithstanding the outward appearance, we can see many of the 'signature' elements of his approach to design. In 1960 Gilleland retired to Toronto and Strutt formed a partnership with his former classmate Inigo Adamson. Strutt and Adamson were partners for the next six and a half years.The work of Jim Strutt during this period is considered to be one to the two primary factors introducing Modern architecture into the Capital Region. He was receiving press attention throughout this period. One architectural professor who has studied this matter noted in an interview with the *Globe and Mail*:

"I articulate two strands in this modern domestic tradition in Ottawa, You had James Strutt, who was really interested in construction innovation, and then you had Paul Schoeler, Brian Barkham [and] Matt Stankiewicz, who were more in the Miesian tradition of refining the box [and] the whole poetry of dimension." Janine Débanné, quoted in Dave LeBlanc, "'A confluences of circumstances' brought modernism to Ottawa," *The Globe and Mail*, May 5, 2006.

In 1959 Strutt became the youngest architect to hold the position of President of the Ontario Association of Architects. It was common for Strutt and his young wife Audrey (formerly Lett) to be included in the social columns of the local newspapers.

His church work in the greater Ottawa area was receiving local press attention. By 1962, James Strutt had become a 'Canadian worth knowing' according to the *Star Weekly Magazine*. He had designed more than 100 private residences in the Ottawa-Gatineau area in addition to his work on public structures. And he was regularly asked to speak or author papers for events or publications, both within and without, the profession.





FOR HOUSES

sophisticated roof-construction method. Using only standard materials and methods, he has not only reduced the amount of material required for a given span, but also the amount of labor needed to place it. As the geometry of the HP became familiar, along with the forces within its form, combinations of HP's were evolved so that various applications could be made. In more than twelve of his house designs—four examples are illustrated by sketches—the discipline of the HP's basic geometry, which tends to symmetry and/or cell-like construction, was the fundamental consideration governing the desirability of its use. The majority of Strutt's applications have been with laminated wood; spans under 30 ft have proved to be most economical, since only two laminations were necessary. In all cases, the cost, including rigid insulation and roofing was below $1.00 per sq ft—a self-imposed limit in order to compete with normal joist construction.

On the West Coast, Architect Paul Hayden Kirk has used HP's for the roof of a wood-products research home at Bellevue, Washington (SELECTED DETAIL). Of special interest are: the method by which the roof panels are given their doubly-curved form; the simplicity of the roof-drainage system afforded by the use of HP's; and the penetration of one panel by the chimney. This home was a project of the Basic Materials Research and Design Program organized by *Living for Young Homemakers* in co-operation with the Weyerhaeuser Company of St. Paul, Minn., and the Anderson Corp. of Bayport, Minn.

*Three-unit cluster of chalets designed for the Laurentians. Shell construction: ¾" white pine, two layers, glued and nailed.* (Sketches by the architect.)

TO SLEEP 2 OR 4 TO SLEEP 4

The images shown above is from an article by Strutt that was published in *Progressive Architecture*, in August 1961, and features his use of hypar roofs in housing.

His design for the Uplands Airport Terminal became a landmark work. The integration of art and technology with his inclusion of Louis Archambeau's sculptural columns and courtyard pieces, along with the innovative sloped glazing on the aircraft control tower set standards for both terminals and towers across Canada. [Globe 2008]

The unique character of the Strutt House continued to attract attention in the local press. The Strutt House was becoming famous. It would sometimes be included in articles about his other work.The Strutt House continued to enchant the public long after it was constructed. As article by Rhys Phillips was published in a 1997 edition of *Ottawa Magazine* forty years after the Strutt House was built.

Jim Strutt designed many well-known 'Modern' structures. Some notable projects:

- Geophysical Laboratory, Experimental Farm, Ottawa 1953
- Seven Islands Airport, Sept Isles 1954
- St. Peter's Anglican, 915 Merivale Rd, Ottawa 1955-61
- Halifax Air Terminal, Halifax 1956
- Neatby Building, Experimental Farm, Ottawa 1957
- Uplands Air Terminal, Ottawa 1958
- St. Paul's Presbyterian, 971 Woodroffe, Ottawa 1958-70
- Rothwell United, 47 Sumac, Ottawa 1960-62
- Trinity United, 1099 Maitland, Ottawa 1960-65
- Royal Trust Building, 55 Metcalfe Ave., Ottawa 1962
- Bells Corners United, Bells Corners 1962
- Northern Electric Advanced Devices Centre Moody Drive, Bells Corner 1963
- St. Paul's Anglican, 194 Prince Albert, Ottawa 1963-64
- LOEB Building, Carleton University, Ottawa 1964.

The variety of projects reflects the breadth of his practice. Some projects were associated with great national events or foreign locations. Many examples of his work with hyperbolic paraboloids exist in the greater Ottawa-Gatineau region. Five local projects now have formal heritage designations. These are:

- The Strutt House, 1220 Mountain Rd., Aylmer, Quebec 1957
- The Fischer House, 339 Pleasant Park Rd., Ottawa, Ontario 1962
- Westboro Beach Pavilions, Kitchisippi Lookout, Western Parkway, Ottawa, Ontario 1966
- Canadian Nurses Association Headquarters, 50 Queen Elizabeth Dr, Ottawa 1969
- St. Marks Anglican Church, 1606 Fisher Ave., Ottawa, Ontario 1954

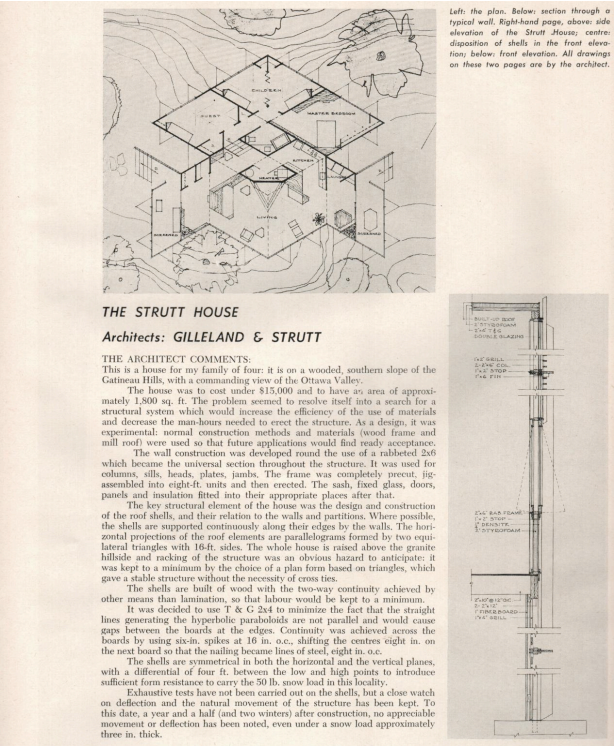
## ***Legacy***

More than 5,000 archival holdings are held at Library and Archives Canada, and more than 500 archival holdings at the Strutt Foundation, both in Ottawa. A majority of his project drawings and photos are now housed in the national archives and a significant number of documents are still being conserved and/or documented by the Strutt foundation archives.

Strutt continued to receive recognition by his peers late into his life. In 2008, he received the Ontario Association of Architects G. Randy Roberts Service Award for outstanding and selfless service to the profession. The nomination read, in part:

"an active practitioner of architecture from 1949 to the present, Strutt is one of Canada's most creative and prolific producers of Modern Canadian Architecture. ... He was a man at the forefront of his profession and the bulk of his life's work ... now forms part of the permanent collection of Library and Archives Canada."

## ***The Strutt House – conception***



Left: the plan. Below: section through a typical wall. Right-hand page, above: side elevation of the Strutt House; centre: disposition of shells in the front elevation; below: front elevation. All drawings on these two pages are by the architect.

THE STRUTT HOUSE

Architects: GILLELAND & STRUTT

THE ARCHITECT COMMENTS:
This is a house for my family of four: it is on a wooded, southern slope of the Gatineau Hills, with a commanding view of the Ottawa Valley.

The house was to cost under $15,000 and to have an area of approximately 1,800 sq. ft. The problem seemed to resolve itself into a search for a structural system which would increase the efficiency of the use of materials and decrease the man-hours needed to erect the structure. As a design, it was experimental: normal construction methods and materials (wood frame and mill roof) were used so that future applications would find ready acceptance.

The wall construction was developed round the use of a rabbeted 2x6 which became the universal section throughout the structure. It was used for columns, sills, heads, plates, jambs. The frame was completely precut, jig-assembled into eight-ft. units and then erected. The sash, fixed glass, doors, panels and insulation fitted into their appropriate places after that.

The key structural element of the house was the design and construction of the roof shells, and their relation to the walls and partitions. Where possible, the shells are supported continuously along their edges by the walls. The horizontal projections of the roof elements are parallelograms formed by two equilateral triangles with 16-ft. sides. The whole house is raised above the granite hillside and racking of the structure was an obvious hazard to anticipate: it was kept to a minimum by the choice of a plan form based on triangles, which gave a stable structure without the necessity of cross ties.

The shells are built of wood with the two-way continuity achieved by other means than lamination, so that labour would be kept to a minimum.

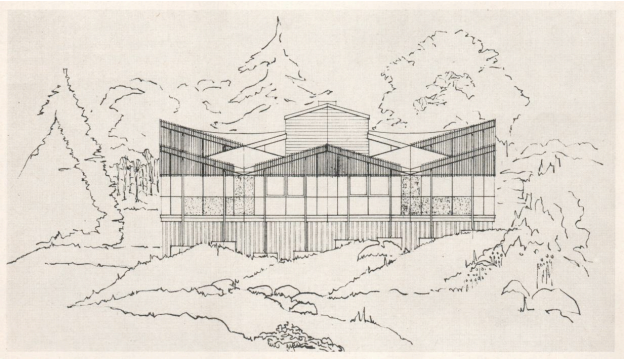
It was decided to use T & G 2x4 to minimize the fact that the straight lines generating the hyperbolic paraboloids are not parallel and would cause gaps between the boards at the edges. Continuity was achieved across the boards by using six-in. spikes at 16 in. o.c., shifting the centres eight in. on the next board so that the nailing became lines of steel, eight in. o.c.

The shells are symmetrical in both the horizontal and the vertical planes, with a differential of four ft. between the low and high points to introduce sufficient form resistance to carry the 50 lb. snow load in this locality.

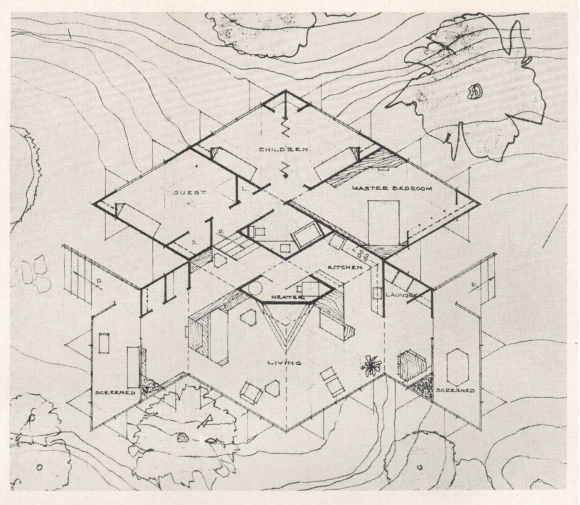
Exhaustive tests have not been carried out on the shells, but a close watch on deflection and the natural movement of the structure has been kept. To this date, a year and a half (and two winters) after construction, no appreciable movement or deflection has been noted, even under a snow load approximately three in. thick.

This article on the Strutt House appeared in the *Canadian Architect*, June 1958. In his own words, Strutt sums up the basic intent and technical concepts of the house.

In his design drawings for the Strutt the discipline of strong geometry and structure are self-evident, although maybe not easily understood. There are very few drawings related to the construction of the building. Below is an elevation of the house.



Below is a design drawing of the house plan. The final scheme is essentially identical to this drawing.




The drawing does not really express the 'design intent.' The building may be described as: non-orthogonal twelve-sided rhombi with interconnected hypars over. Alternatively, it might be described as a back-split wood structure with a concrete block service core. If you understand the geometry of the Strutt House and the way the construction is detailed, you need very few drawings to build it. It is not a conventional structure. It does not comply with the building code today, and did did not comply with the building code when constructed.

## ***The Strutt House – Construction***

The main structural elements (foundation, platform, wall panels and hyperbolic paraboloid roof) allowed for a staged construction process. The site preparation entailed pouring of the concrete core foundation, and the 29 footings. The foundation was completed over the previous summer. The foundation posts, that elevate the platforms, connect at the intersections of the grid within the floor plate for both levels.

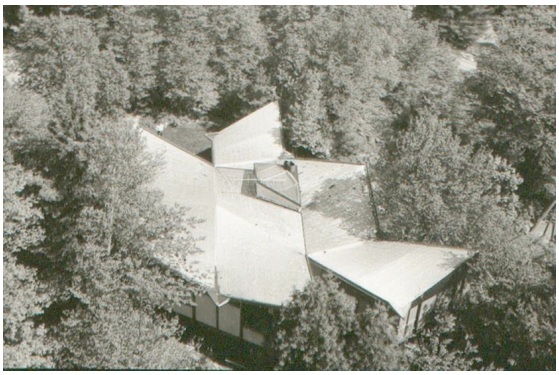
The walls are modular panels. The eight foot wide panels are constructed using 2" x 6" rabbited studs creating two 'four foot cells' in each panel section. The joint where the two panels meet results in the double stud column that help support the weight of the roof, except at the protruding corners which are structurally cantilevered or 'floating'. The absence of framing at the corner is not permitted in conventional house construction. The construction tolerances for the panel sections are similar to that used in cabinetwork.

The cells in the panel grid are filled with one or a

combination of: a solid panel (insulated), glazing (no window frame required), or a door (no frame required). This design approach is very similar to that used in modern 'stick built' curtain walls.

The photo above shows the installation of some solid panels within the 'curtain wall' frame. Panels were made of an interior and exterior 1⁄2" thick panel of Densite, sandwiching a two inch Styrofoam panel. The contractor, Bill Dawson, was a life-long friend and the owner of Douglas Bremner Construction of Montreal and Ottawa. Donald Baldock, the local manager/ part owner of Bremner also spent time on the project with some additional weekend help from Strutt and friends. Both Dawson and Baldock lived in houses designed by Strutt. The house was, for the most part, erected by site foreman/ carpenter Guy Castonguay over a period of six weeks.

The photo above shows the construction of the hypar roof, with the two double posts and the un- supported corners. The hypars are self-supporting except at their perimeters.



The image above shows the full form of the distinctive hypar roof. The service core projects through the centre of the roof and it is topped by a skylight. Strutt noted on several occasions that the carpenter's ability with an adze was the reason for the short construction period, especially due to his skill chamfering the tongue and groove boards used to create the hypar ceiling/ roof.

Strutt may have been too modest in this comment. By his own admission in an interview, the wooden hypar roof design was not only the first in Canada, but as a first among wooden hypars in general, to be built quickly and at a very low cost.

The house was a distinctive structure in the Gatineau Hills, from the front or back. The view from the living room is to the south, towards the Ottawa River. In the winter, Parliament Hill was just visible from the living room. In summer the foliage surrounds the home, the city is seen only as a horizon line between the leaves.

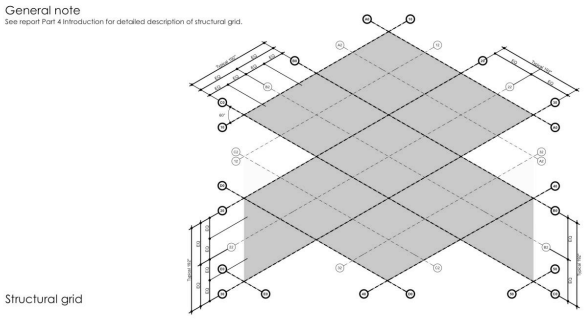
Strutt designed the dresser in the master bedroom to accommodate a Lett Family heirloom mirror, as seen below. Note the open ceiling plane to the exterior.

## ***The Construction Details***

This part (of the talk) included some views of the building as it exists today. Almost all of the finishes in this building are as constructed and are now over 55 years old. The primary materials are concrete, concrete block, red cedar, spruce (hypars and floor framing), plywood (floors and casework), and Transite panels. Rigid insulation was used in the walls.

## ***The Simulation***

As noted earlier, there are few construction drawings. The key to the building is understanding how the system works. This is a drawing of the basic building grid. Only one dimension and the angle are essential.




In 1958, two years after construction, *The Canadian Architect* published a feature on the building. The article includes a passage called "The architect comments". It is the most succinct description of the structure identified in the course of this investigation and it states (in part):

"The wall construction was developed round the use of rabbetted 2x6 which became the universal section throughout the structure. It is used for columns, sills, heads, plates, jambs. The frame was completely precut, jig-assembled into eight-ft. units and then erected. The sash, fixed glass, doors, panels and insulation fitted into their appropriate places after that.

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The shells are symmetrical in both the horizontal and vertical planes, with a difference of four ft. between the low and high points to introduce sufficient form resistance to carry the 50 lb. snow load in this locality. "The Strutt House," *The Canadian Architect,* Southam Press, Toronto, 1958.

These same themes are repeated in an interview for a local paper the following year. On that occasion he told the reporter:

"My style is based on a study of techniques, materials and methods of construction which exist today. It embodies getting down to basics - basic ideas of construction and design. I aim for the most economical use of the materials available and achieve this by creating my home around forms which themselves are naturally structural." Paul M. Dunn, "Strutt's Touch is Transforming Gatineau Hills," *The Ottawa Citizen*, May 15, 1959.