Australian Institute of Architects ACT Chapter

Register of Significant Architecture

RSA No: **R115**

Name of Place: **GIO Stadium Canberra & AIS Arena Precinct**

Other/Former Names: Bruce Stadium & National Indoor Stadium Precinct
National Athletics Stadium & National Indoor Sports & Training Centre

Address/Location: 30 Battye Street & 26 Leverrier Street BRUCE ACT 2617

Block 26 Section 8 of Bruce

Listing Status:	Registered	Other Heritage Listings:	AIA National List, 2011
Date of Listing:	2003	Level of Significance:	National
Citation Revision No:	1	Category:	Sporting
Citation Revision Date:	2017	Style:	Late Twentieth Century Structuralist

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Date of Design:	1974 (Bruce Stadium) 1979 (Indoor Stadium)	Designers:	Philip Cox & Partners, Architects Bond James Laron Murtagh, Engineers
Construction Periods:	1976-7; 1980	Client/Owner/Lessee:	NCDC/AIS
Completion	1977; 1981	Builders:	Leighton Holdings (Bruce Stadium)
Date of Additions:	1997 (Bruce Stadium)		John Holland (Indoor Stadium)

Statement of Significance

The GIO Stadium Canberra, 1979, and the AIS Arena, 1981, originally the National Athletics Stadium and the National Indoor Sports and Training Centre, both by Philip Cox & Partners, form a precinct of nationally significant architecture which is valuable as an educational resource.

The two buildings are very good examples of the Late Twentieth-Century Structuralist Style (1960-), with their compression masts and cable stays (both buildings), the GIO Stadium Canberra's reinforced concrete supporting structure and cantilevered concrete beams, and the AIS Arena's internal triangular steel supports to the roof. The stadium and arena are important for the technical achievements of their complex structural systems.

The architect Philip Cox has played a significant role in Australia's cultural history. He is one of Australia's most important architects of the late twentieth century. These are important buildings in his career in terms of their early date, size, prestige and because they express clearly the principles on which his architecture is based. Philip Cox was awarded the RAIA Gold Medal in 1984 and was made an Officer of the Order of Australia in 1988.

The precinct is important for the aesthetic value of its related pair of large structures which are integral parts of the landscape. The form of the GIO Stadium Canberra has a harmonious relationship with the land and its grandstand is an aesthetic feature expressing strength and boldness. The AIS Arena has a strong architectural expression, due to the catenary roof with an uplifting sweep, supported by a cable system strung from dominant steel masts, which signal the presence of the arena. Both buildings demonstrate Cox's belief that there is no division between architecture and structural engineering.

The stadia are of much significance to Canberra and the nation, specifically for their associations with national and international sport, because many of Australia's elite sportspersons have trained there and because the projects resulted from the sound and far-sighted vision of the National Capital Development Commission. They also have close associations with Australia's premier sporting institution, the Australian Institute of Sport.

The buildings of this precinct can contribute to the education of designers in their understanding of late twentieth-century architectural styles, being the earliest, largest and most significant examples of the Late Twentieth Century Structuralist style in Canberra.

Description
The two buildings were designed by the Sydney architects Philip Cox & Partners [1] and their consultant structural engineers Bond James Laron Murtagh; the GIO Stadium Canberra in 1974, completed in 1977 and the AIS Arena in 1979, completed in 1981, both for the National Capital Development Commission.[2] The buildings are examples of the Late Twentieth-Century Structuralist Style (1960-) with their compression masts and cable stays (both buildings), the reinforced concrete supporting structure and cantilevered ends of concrete beams of the Bruce Stadium, and the internal triangular steel supports to the roof of the AIS Arena.[3]

The precinct, which is located off Leverrier Crescent and the end of Battye Street in Bruce, includes the original structures of the two stadiums, the landscaped area between and adjacent to them and their natural setting. It does not include the Gymnastics Facility, the third building by Cox at the Australian Institute of Sport (AIS).

GIO Stadium Canberra.
The original in situ concrete grandstand on the western side of the existing stadium has a metal-framed roof supported by a lightweight tensile suspension structure. The structural system of pre-stressed grouped high-tensile steel cables was chosen to minimise the use of materials as well as to make an architectural statement. There are five tapered box steel fabricated masts each with nine attached suspension cables that support the steel-framed roof beams, three per beam. The metal-framed roof deck has a concrete ‘over-deck’ adding weight to prevent uplift and in form tilts 12 degrees towards the playing field.[4] The roof forms a robust curved element in the undulating landscape setting.

The dominating steel masts extend from pin-joints at the ground level forecourt concourse adjacent to the rear of the grandstand, the point of entry for the spectators, up to support the rear perimeter highest part of the curved roof. Double steel sections tie the columns back to the upper curved seating perimeter concrete frame, just below the mid pin-joint. The masts then elbow out to provide the connections and supports for the suspension cables that take the load of the roof. Each grouping of nine suspension cables are attached to the tops of the masts where the tensile force is then taken by a pair of longer, thicker cables that extend down to concrete anchors set further out from the grandstand in the forecourt concourse placing the masts in compression. Each cable is attached to a steel block, which is in turn bolted to an anchor using an oversized U- bolt.

The lateral stability for the roof is provided by a combination of circular and boxed steel members at each end that extend back to an in situ concrete buttress. The buttresses are integral to the structure in that they also add support to the end of the upper curved perimeter concrete seating structure that reads as a perimeter edge beam.

The grandstand seating is a curved concrete structure, both in plan and elevation, providing a relatively steep profiled seating arrangement that was designed for optimum sight lines and accessed by stairs and ramped pathways. Viewed from the forecourt the structure is expressed, creating an architectural effect similar to the theories of ‘Constructivism’ of the 1920s, with large tapering concrete blade columns supporting sloping beams that in turn support the exposed stepped seating slabs. The beams cantilever out to support the upper perimeter curved edge and seating structure. The analogy with constructivism is further enhanced in the protrusion of cubic blockwork and concrete elements associated with circulation and service facilities.

The lower seating structure is now partially obscured by in-filled areas and an office area that has been added to the rear with extensive dark glazing. Viewed from the playing arena the original grandstand open seating extends across the upper half with the lower areas given over to commentary facilities and more recently installed corporate boxes.

The original upper level seating structure to the side of the main grandstand, with its random stone faced walls remains. However, the original seating that continued beyond this and was set into

earth-berms has been removed. The form of this perimeter seating set into the grassed banks was an important design theme that enabled the seating structures to gently curve around the northern and southern perimeter evolving into grass bank seating.[5] The total form of the stadium blended in with the undulating landform. All of the remaining original concrete seating has been fitted out with fixed plastic individual seats.

The present unroofed seating (the bowl) extends the full perimeter of the stadium around to a smaller roofed grandstand to the eastern side. This eastern grandstand was constructed in a similar aesthetic to the original western stadium. Below the original main stadium spectator seating are housed the change rooms, administration offices and equipment stores providing separation of the spectator from the competitor/entertainer.

The form of the original grandstand is one of strength and boldness that is fitting for its purpose and an aesthetic feature. The large lighting posts that now dwarf the original steel columns, the eastern grandstand and perimeter seating do not form part of this citation.

AIS Arena.
This rectangular building is to the north west of GIO Stadium Canberra on the eastern side of Leverrier Street. The full height of the structure is seen from the western elevation with the remaining sides of the building semi-recessed approximately four metres into the site. The roof supporting cables and masts are dominant elements. The catenary roof is supported by a 100 metre long tensile cable system strung from twelve angled tapered boxed steel masts, six each to both the western and eastern sides. The pre-stressed grouped high-tensile steel cables run at both the upper level of the roof directly supporting the 50 mm thick 6x3 metre precast concrete roof panels, while thicker cables run at the lower level well below the roof. These larger cables that have a greater sag, support internal steel roof struts and three main bracing roof truss members that run perpendicular to the cable structure providing lateral support.[6]

Each steel mast is connected to the ground by a pin-joint and supports four upper cables and two lower cables. Short length trussed ‘spreader’ members that are discontinuous and independent of adjacent cables align the cables at the roof perimeter. The roof cables are then anchored into the ground via double cables that extend from the tops of the masts further out from the building. Along the northern and southern sides the cladding and glazing abutting at the level of the lower cables, reinforcing the catenary forms of the structure. Circular hollow steel struts of varying lengths support the roof overhangs along these elevations extending from the lower cable system to the upper end cables.[7]

The secondary forms of masonry corner toilet cylinders and central concrete coned rainwater collectors do not extend to the full height of the building expressing clearly that they are non-structural. Their large solid forms contrast with the light tensile members. Combined with other curved solid wall elements, the space framed glazing supports, glazed doors and sidelights, they provide an interesting play of ‘positive and negative’ rhythm to the façade creating an overall cubic form softened by curved elements.

Originally spectators entered the stadium from the upper level via stairs at the western entry or directly from ground level to the east. A new northern entry has been constructed at an angle to the original building providing a major lobby and cafeteria space. The architecture of the new entry is in contrast with the original building and was designed by Daryl Jackson Alastair Swayn Architects. Internally the stadium is provided with a relatively steep perimeter seating arrangement that was designed for optimum sight lines and is accessed from the upper continuous concourse and new entry from the north. The seating can accommodate up to 5200 spectators. The playing area is primarily based on a basketball court but allows for many sporting activities as well as concerts and functions.

The stadium has a ventilating and air circulating mechanical system that is assisted by the recessing of the building into the ground and circulates cooler air under the seating, maintaining a relative constant temperature except during extreme weather conditions. The lightweight roof structure is of its very nature minimalist, with the three large bracing trusses being the more dominant structural form. The non-structural steel truss-framed moveable service gantry spans

the width of the space with tracks located along the concourse. The precast panel roof soffits are lined with ribbed metal panels.

The Indoor Sports Stadium “is a consistently unified building in which the functional, structural and mechanical, and landscape considerations are in support of each other.” [8]

The sculpture to the western forecourt, ‘The Gymnasts’, is by John Robinson.[9]

The two stadia were designed and built within a short time of each other and are linked both aesthetically, with the use of similar materials and structural systems, and physically via the connecting manmade landscaped lawns and plantings. The same architecture firm designed both structures.

The two tensile structural systems can be compared. The GIO Stadium Canberra roof is hung from steel cables while the AIS Arena is supported on long span cables. They are both good examples of large structures integrated with the Australian landscape.

The key architectural elements characteristic of the Late Twentieth-Century Structuralist Style (1960-) displayed by these buildings are their compression masts and cable stays (both buildings) and the GIO Stadium Canberra’s reinforced concrete supporting structure and cantilevered end of concrete beams, and the AIS Arena’s internal triangular steel supports to the roof. [10]

The freestanding buildings, the landscape setting (both created and natural), the curved masonry forms and lightweight infill materials of the indoor stadium, and the original detailing and finishes are important to the buildings as a whole.

Condition and Integrity
The buildings are well maintained, in good condition and intact apart from the main grandstand of the GIO Stadium Canberra being altered by deleting the lower seating to included corporate boxes and the addition of a ground floor office to the rear. The AIS Arena has been altered with the addition of a new entry and public facilities to the north side of the complex.

Background/History
Architects who designed buildings in the Late Twentieth-Century Structuralist Style were seeking an alternative to the heavier concrete architecture of the post war period and were often designing for specialised functions that required very large column-free structures. These structures were also claimed to be less expensive to construct since the materials, usually steel, were used in tension and thus required minimal amounts of material. The steel cables, however, were made of more costly high tensile steel and the connections were more labour intensive resulting in the economies not always being achieved.

The use of metal cables in long span tensile structures was first achieved in England during the mid 19th century in bridges such as the Clifton Suspension Bridge, by Brunel, which spans 214 metres over the River Avon.

It would appear that the use of steel suspension tensile systems for buildings was first explored at a small scale by Buckminster Fuller in the late 1920s with his design for the ‘Dymaxion’ house project. The radially planned house had a central vertical core that included all services and extended well above the roof. Tension cables extended out from the top of the core to the perimeter supporting the roof and elevated floor. [11]

The earliest examples of tensile structures in Australia are in Melbourne and include the Olympic Swimming Stadium, by Borland, McIntyre, John and Phyllis Murphy, 1952-56, the Sidney Myer Music Bowl, Melbourne, by Yuncken, Freeman Brothers, Griffith and Simpson, 1956-59, both with Bill Irwin as the structural engineer, and at a domestic scale Robin Boyd’s second house for himself, 1957.

Later examples include the Sydney Football Stadium, 1985-88, (using struts rather than cables) and the Darling Harbour Exhibition Building, 1988, both by the same architects, Philip Cox Richardson Taylor & Partners.

Internationally the early major steel tensile systems included the two Tokyo Olympic Indoor Arenas, by Kenzo Tange, 1964, the West German Pavilion at the Montreal Expo 1967, and the Munich Olympic stadium and pool roof structures, all by the engineer Frei Otto, 1972.

Other examples of this style in Canberra include Stage 88 in Commonwealth Park, by Cox; the Canberra International Motor Inn, Dickson, 1981; and Rydges Capital Hill Hotel (formerly the Pavilion Hotel) Forrest, the latter two by Brian Dowling. All three vary from the Bruce buildings in that they are tensile membrane structures.

Philip Cox, the founding principal of the firm, graduated from Sydney University in 1962 and in the following year joined with Ian McKay to design various buildings for Presbyterian Colleges, the Tocal Agricultural Collage, Paterson NSW, 1964, being an important early example of the Late Twentieth-Century Sydney Regional Style. Cox and McKay jointly twice were awarded the RAIA NSW Chapter Sulman Medals and Diplomas for meritorious architecture: in 1963 for the college at Leppington and in 1965 for the college at Patterson.

Cox believes that “the architecture which emerged (from this early work) was the basis for all future work, that is, an architecture which pays respect for its immediate environment, essentially horizontal punctuated by simple massing,…” [12] He believes in his firm’s work that “we are dealing with fundamental issues and basic concepts of architecture such as mass, form, colour and textures, whilst recognising social, political and economic values.” [13] He is one of Australia’s important twentieth century architects and his firm has expanded with the name changed as partners have come and gone over the last 40 years.

Cox believes Australian landscape painting has influenced his architecture. [14] In the majority of his work he has attempted to relate the buildings to their settings, a task relatively easily achieved with his earlier Sydney Regional Style projects but more challenging in his later structuralist work. In his shift from a heavy ‘crafted’ regional aesthetic to the light industrial international aesthetic his work has not lost this relationship with the site, as is clearly evident in the two buildings at the AIS.

Cox believes that “the Sports Stadium and Indoor Facilities in Canberra (Bruce) are expressions of the philosophy that there is no division between architecture and structural engineering” “They are light, skeleton forms.” “They are buildings which pay homage to the landscape in which they are placed.” [15]

Philip Cox’s firms have completed a substantial body of work, much of which is exemplary. He has written extensively on architecture in Australia. In 1984 he was awarded the RAIA Gold Medal and was made an Officer of the Order of Australia in 1988. Some of the firms’ other important works include various inner city housing schemes including Woolloomooloo, 1979, the Yulara Tourist Resort, 1983, Uluru, the National Tennis Centre, Melbourne, in association with Peddle Thorp and Learmonth, 1988, the Sydney Football Stadium, 1988, and the Brisbane Convention and Exhibition Centre. The firm was awarded the RAIA NSW Chapter Sulman Medal and Diploma in 1989 for the Sydney Exhibition Centre, Darling Harbour.

The two buildings at the AIS, being the first major structures of their type the firm had designed, laid the foundation for the firm to gain larger projects. Each building was awarded the Institution of Engineers Excellence in Engineering Award, the National Athletics Stadium in 1977 and the National Indoor Sports Centre in 1981.

Other works in Canberra include Jerrilderie Court, Reid, 1975, (awarded the C S Daley award in 1978), Kambah Health Centre, 1977, (awarded the 1978 Canberra Medallion), the Embassy of Ireland, 1981, the ACT Family and Juvenile Courts, 1981, National Council of Independent Schools Headquarters, 1982, and Radford College, 1983. [16]

The Bruce Stadium was constructed to hold the 1977 Pacific Conference Games in Canberra prior to the establishment of the Australian Institute of Sport . [17] The National Capital Development

Commission chose for the site a relatively flat area west and north of the O'Connor Ridge, a dry sclerophyll nature park that extends south up to Black Mountain.

In his report, "The Role, Scope and Development of Recreation in Australia", commissioned by the Whitlam Labor Government in 1973, Professor J Bloomfield suggested that "...the Federal Government establish a National Institute of Sport...similar...to many others in European Countries." In September 1975 a study group was appointed by the government and reported in November 1975 that it recommended the Institute be established.[18]

In November 1975 the Federal Government changed and the attitude of the previous government, who believed in spending money on sport, but not for sporting elitism, profoundly changed to one that did not believe in spending government money on sport at all.

At the 1976 Montreal Olympic Games Australia did not win a gold medal and " found themselves amateurs in a world of professionals – possessing a sporting past but not a future…" [19]

The Fraser government attempted to prevent Australian athletes from participating in the 1980 Moscow Olympic Games as a result of the USSR intervention in Afghanistan. Some athletes withdrew and others competed in Moscow but were prevented from participating under the nation's flag or receiving Federal funding. Possibly as recompense, the Fraser Government announced in January 1980 that an Australian Sports Institute would be established. There was much debate about whether it should utilise existing state facilities or whether new facilities should be provided in one location, but in September of the same year the Federal Government announced that it would be located in Canberra.[20]

It was determined that the existing Bruce Stadium should be utilised as the track and field, and soccer facility, and that a new indoor arena would be built, for the opening ceremony, to house 4,000 spectators, administration offices and be the home base for Australia's elite basketball, netball, gymnastics and weightlifting teams. The Prime Minister Malcolm Fraser opened the new indoor arena in January 1981, just four months after the announcement to locate the facility in Canberra. [21]

A limited construction period was forced on the design team of the indoor stadium. The structural system devised allowed the roof to be constructed prior to or at the same time as the base building was being constructed. The steel truss gantry aided by the use of outriggers enabled the roof to be constructed independently of any walls.

It became obvious within a year that additional facilities would be required due to the number of sports using the indoor arena combined with commercial entertainment activities which resulted in training schedules not being fulfilled. [22] A gymnasium, tennis halls, swimming pools, basketball courts etc. were constructed over the following years to alleviate these problems.

The World Cup in Athletics was held at the Bruce Stadium in October 1985 and while this was well attended the overall use of the stadium as a spectator facility was limited. [23] In 1988 a political decision was made to relocate the Canberra Rugby League team, The Canberra Raiders from Queanbeyan to Bruce Stadium. This required the removal of the athletics track and adjustment to the perimeter seating. Some minor changes to the grandstand included glazing in the gap between the upper level seating and the roof in 1989. The track and field training was relocated to the nearby warm up track with enhanced facilities.

Prior to the Sydney 2000 Olympic games the Bruce Stadium was extensively altered with a new grandstand to the eastern side, the relocation of the playing field closer to the original grandstand and lowering its playing level, and the installation of new perimeter seating. Corporate boxes replaced the original stadium's lower seating. The roof and upper seating have been retained. The AIS "is one of the real Australian successes of the 1980s, an idea that was far ahead of its time in Australia, and badly needed if we were to be competitive in the international arena." [24]

The structural engineers for the two buildings were Bond James Laron & Murtagh, experts in masted structures, the partner responsible being Ken Murtagh FIEAust. The firm later designed the masted structures of the State Sports Centre in Homebush, Sydney in 1985. [25]

The two buildings, named at the time the Canberra Stadium and National Indoor Arena, were added to the Australian Institute of Architects list of Nationally Significant Architecture in 2011. [26]

Analysis against the Commonwealth Heritage Criteria

Criterion 2 Rarity
This is the only precinct in Australia which includes two buildings with differing tensile suspension systems, the GIO Stadium Canberra grandstand with its roof hung from steel cables and the AIS Arena with its roof supported on long span cables.

Criterion 4 Characteristic values
The two buildings have significant heritage value as outstanding examples of the Late Twentieth-Century Structuralist Style of architecture in Australia. The attributes that express the style are compression masts and cable stays (both buildings), the GIO Stadium Canberra's reinforced concrete supporting structure and cantilevered concrete beams, and the AIS Arena's internal triangular steel supports to the roof.

Criterion 5 Aesthetic characteristics
The precinct has a related pair of large structures which are integral parts of the landscape. The form of the GIO Stadium Canberra has a harmonious relationship with the land and its grandstand is an aesthetic feature expressing strength and boldness. The AIS Arena has a strong architectural expression, due to the catenary roof with an uplifting sweep, supported by a cable system strung from dominant steel masts, which signal the presence of the arena. Both buildings demonstrate Cox's belief that there is no division between architecture and structural engineering.

Criterion 6 Technical Achievement
The GIO Stadium Canberra and the AIS Arena are significant for their technically complex structural systems. The original in situ concrete grandstand on the western side of the existing stadium has a metal-framed roof supported by a lightweight tensile suspension structure. The structural system has pre-stressed grouped high-tensile steel cables. There are five tapered box steel fabricated masts each with nine attached suspension cables that support the steel-framed roof beams, three per beam. The metal-framed roof deck has a concrete 'over-deck' adding weight to prevent uplift and in form tilts 12 degrees towards the playing field. The AIS Arena has a catenary roof, supported by a 100 metre long tensile cable system strung from twelve angled tapered boxed steel masts, six each to both the western and eastern sides. The pre-stressed grouped high-tensile steel cables run at both the upper level of the roof directly supporting the 50 mm thick 6x3 metre precast concrete roof panels, while thicker cables run at the lower level well below the roof. These larger cables that have a greater sag, support internal steel roof struts and three main bracing roof truss members that run perpendicular to the cable structure providing lateral support.

Criterion 8 Significant people
The architect Philip Cox played a significant role in Australia's cultural history. He is one of Australia's important architects of the late twentieth century. These were important buildings in his career in terms of their early date, size, prestige and because they express clearly the principles on which his architecture is based. Philip Cox was awarded the RAIA Gold Medal in 1984 and was made an Officer of the Order of Australia in 1988. The structural engineers for the two buildings, Bond James Laron & Murtagh, are specialists in masted structures. Due to their expertise, each building was awarded an Institution of Engineers Excellence in Engineering Award, the National Athletics Stadium in 1977 and the National Indoor Sports Centre in 1981.

[1] *Australian Architects: Philip Cox,* RAIA 1984

[2] Jennifer Taylor, *Australian Architecture Since 1960,* RAIA 1990 & *Canberra An Architectural Guide To Australia's Capital,* RAIA(ACT), 1982.

[3] Richard Apperly, Robert Irving, Peter Reynolds, *Identifying Australian Architecture Styles and Terms from 1788 to the Present,* Angus & Robertson, 1989

[4] Taylor op cit.

[5] Ibid.

[6] Ibid.

[7] Ibid.

[8] Ibid.

[9] *Canberra An Architectural Guide To Australia's Capital,* op cit

[10] Richard Apperly, Robert Irving, Peter Reynolds, op cit.

[11] Reyner Banham. *Theory and Design in the First Machine Age*. The Architectural Press, London, 1977.

[12] *Australian Architects: Philip Cox,* op cit.

[13] Ibid.

[14] Graham Jahn, *Sydney Architecure,* The Watermark Press, Sydney, 1997.

[15] *Australian Architects: Philip Cox,* op cit.

[16] *Canberra An Architectural Guide To Australia's Capital* op cit & Taylor op cit.

[17] John A Daly, *Quest for excellence: the Australian Institute of Sport in Canberra,* AGPS, 1991.

[18] Ibid.

[19] Ibid.

[20] Ibid.

[21] Ibid. Clearly the design for the Indoor Stadium was begun some time before the announcement to locate the AIS in Canberra.

[22] Ibid.

[23] Ibid.

[24] Ibid. In the forward written by Robert de Castella.

[25] James Harris, Kevin Li, *Masted Structures in Architecture*, Routledge, 2012

[26] www.architecture.com.au Notable Buildings.