The Composition

It was in July 2004 that Pramukh Swami Maharaj blessed the land where the mandir is to be built.

Building a Mandir to traditional Indian designs may sound romantic but the requirements of India and Canada differ widely in many aspects. Traditionally, all the masonry of a Hindu Mandir is in itself load bearing, with no reinforcement from ferrous material such as steel, even in the foundations!

A difficult proposition but viable nevertheless. In order to make the Mandir as perfect as possible, and to meet the challenge of building a monument to last a thousand years, only the finest materials would have to be used.

Stone

It is in stone that many of the greatest achievements of the human spirit have been enshrined – from the Great Wall of China to the Egyptian Pyramids, from the Taj Mahal to Michelangelo's David. In the modern world, concrete, steel, synthetics and glass have replaced wood and stone as primary building materials. But there was a time when rock once ruled supreme – in India and around the world. The city of Mohan-jo-daro, the Peruvian Aztec temples, Cambodia's Angkor Wat and even the hieroglyphic language stone tables left to us by the Pharaohs, bear testimony to this.

Stone is strong, enduring and widely available. For these reasons many cultures, Indian, Aztec, Mayan, Khemer, Egyptian, Chinese, and even the Druids of Stonehenge chose stone to preserve and protect their spiritual ideals and traditions.

The oldest Hindu mandirs were solid rock carved out of mountains – with no real construction work being done, just carving and sculpting. The magnificent cave mandirs of Ellora and Kailashnathan are such masterpieces. In later years mandirs became free standing, yet retaining their mountainous dimensions and subtle artwork. Construction often matched the engineering miracle of the pyramids.

The most long-lived heritage of stone work comes from India, where even today the masters still live and carve.

From its very beginning the Swaminarayan tradition has had the Sompura master craftsmen design exquisite Mandirs of stone and marble with three soaring spires crowning the sanctum sanctorum.

Material Testing

So what was it to be in Canada?

A Mandir of marble or a Mandir of stone? If stone, what sort of stone?

The BAPS Akshar Purushottam Mandir in Gadhada, Gujarat, India on the banks of river Ghela had been constructed from marble (1951); the finished product is an awe-inspiring master piece. Much appreciated by both experts and laymen, a marble Mandir was definitely high on the cards.

And what about the royal pink sandstones quarried in Bansipahadpur which had recently been used to stunning effect for the Swaminarayan Akshardham Monument (2005) in New Delhi?

Yet, remember that this is not India. This is Canada, which is home to extremes of unpredictable changing whether of sunshine, rain and snow. To cater for the Canadian climate, a lengthy search for the most suitable quality stone was undertaken, a search that would take the team's architects and engineers to many different parts of the world.

Because of the heavy load of the Mandir and the question of reinforcement, selection of stone following strength tests for the structural masonry was crucial to the success of the project. As well as testing durability under exposure to snow, ice, rain and other atmospheric pollutants, extensive sophisticated tests for density, compression, flexure, rupture, water absorption, abrasion, freeze-thaw reaction and cement compatibility were carried out.

Experts recommended limestone from Turkey, suitable for Mandir exterior and Carrara marble from Italy and Indian pink sandstone for the Mandir interior. The stone and marble met required aesthetic criteria and proved durable enough to withstand harsh Canadian weather conditions and yet suitable enough for the delicate, intricate carvings.

Turkish Limestone

Turkey is the location of one of the oldest limestone mining sites with large natural stone reserves with a great variety of colours and textures.

Turkish Limestone is consistently very dense, fine-grained and creamy-white in colour. To ensure quality control, all quarried stone blocks were thoroughly inspected by the project team engineers visiting the quarries. The stone was selected on the basis of, amongst other factors, a crack-free surface and colour consistency. Following selection, the stone blocks were quaried and transported by rail wagons to the sea port for shipping to India.

Italian Marble

Carrara is a city in the Massa-Carrara province in the Tuscany region of North Central Italy and is famous for its fine marble taken from nearby quarries. Favoured for its consistent white colouration, smooth texture and strength, the rich marble is often used by modern sculptors and is similar to that used by Michelangelo for his sculptural masterpieces.

Of course, marble from Ambaji and Makrana in India is also considered rich, and noted for its snow-white appearance. Why then did the team opt to go to the Carrara mines and to the trouble of transporting the material to India for carving? The project had to be completed within 3 years and it was difficult to mine quality Ambaji marble in the size and quantity required in the short time period. The Italian marble was found to be soft for carving and was of a more uniform quality.

The Italian marble was used for the interior of the Mandir, for load-bearing pillars, beams, walls and internal flooring.

Indian Pink Sandstone

The pink stone was extracted from the mines at Bansiphadpur in Rajastahan (North India) near Agra. The sandstone has been used in The Red Fort and other historic monuments of India, including the Swaminarayan Akshardham. Due to its strength, the pink stone was used in the ground floor on which tonnes of marble would stand.

The Craftsmanship

In India, there is an entire community of stone-masons skilled in traditional Indian carving who have been doing such work for generations. So to take the materials to India for carving was the ideal choice.

The process

Design – The chief design architect had to transfer the plans onto paper to design in stone. Each and every carved piece had its own full-scale drawing of the intricate designs that were to be etched on stone and marble. Metal stencils were prepared from these drawings.

Cutting – Following minning, shipping and unloading, the stone and marble was cut into rough shapes of pillars, domes or whatever the piece was destined to become. Precision electric circular saws were used for this fine cutting process. It was at the cutting stage that all

pieces were numbered. An in-house software designed and developed by the volunteers was used to record and track stone movement.

Contouring – A bare design was etched onto the stone. Then approximate contours were given according to the stencils cut out of metal sheets.

Detailing – The specialized craftsmen then took over. With a unique combination of skill, concentration and patience, they painstakingly carved out the required intricate designs and figures with a set of chisels in one hand and hammer in the other. Air-compressed pneumatic hammers were also utilized. Despite the availability of power tools, many of the craftsmen still preferred to use generations-old manually operated tools to execute their artistry. On site, blacksmiths were kept busy from dawn to dusk forging new chisels and sharpening blunt ones.

It would take 1 full-time craftsman, 310 days to intricately carve one 6 foot pillar on all 4 sides.

Polishing – After the craftsmen applied the final touches, an experienced team took over to arduously polish the stones using small pieces of emery (abrasive). All design work required manual polishing, which ranged from 'rough' to 'fine' polishing. The final stage of polishing involved cleaning the stone with water, to give it a shiny appearance.

Check – Each finished piece of stone or marble was then carefully examined by quality control supervisors. The craftsmen adding retouches if deemed necessary. Individually numbered, each piece became a part of a giant, 24,000 piece, 3-D, sculptural jigsaw puzzle to be assembled thousands of miles away in Canada.

Packing – For their long journey to Toronto, the carved pieces were packed properly to protect the intricate designs. Bearing in mind the carving and transport time involved, even one damaged pillar could cause unacceptable time delays. All packing was done on-site. Polystyrene was applied to any carved sides of the finished pieces. Then the whole piece was wrapped in special plastic. Metal strips held the protective cushioning in place. This was then transferred to made-to-measure treated wooden boxes for packaging.

Transport – The wooden boxes were then packed into empty containers and transported by truck to the port.

Shipping – Following transport to the port of Kandla (India), a crane loaded the containers onto a ship which was to be sent to Toronto. Over 24,000 pieces of carved stone and marble were shipped in less than two years. A total of 305 containers were transported. Each container took about 35 days to travel from India to Canada.

Naturally, a lot of co-ordination was required. The stone was carved in phases according to the layers of the Mandir. The first floor of the Mandir has twelve layers as does the second. Then came the dome and shikhar pieces. Each of the three main shikhars has 335 pieces, where the largest stone weighs 5.6 tonnes.

Despite the complex logistics involved, no major technical problems arose.

Transport route of Stones

Shipping Route

	Material	Route	Distance
A	Raw Limestome	: Turkey to India	4,000 Km
B	Raw Marble	: Italy to India	6,200 Km
C	Carved Pieces	: India to Toronto	12,800 Km

Foundation

As the concept of the structure approached finalization, investigations were carried out to determine the soil's capacity to support the weight of the Mandir. An unreinforced raft foundation was selected due to its excellent soil bearing capacity.

Once the type of foundation was decided, the following criteria for concrete-selection were adopted:

a. Environment
b. Compressive strength (30Mpa) with none or minimal cracking.
c. Workability (drying duration and thermal shrinkage barriers)
d. Economy

Trial mixes of cement and various fly-ash were performed over a ten month period at a local Material Testing Laboratory. These tests were conducted by two very experienced senior structural engineers under the guidance of Dr. P. K. Mehta, University of California at Berkley.

The final mix was 40% Portland cement Type 10 and 60% Fly-ash Type C (a by-product of a coal-fired power generating station). With the use of Fly-ash in the concrete mix, 315 tonnes of cement was saved from the projected amount. Not only did this method help reduce cost, but also helped reduce CO_2 emissions in the environment.

The strength of concrete mixed with fly-ash during the trials proved superior to its counterparts. The compressive strength of concrete in the region of 8,700 PSI at 60 days and 13,000 PSI at 90 days was much more than specified design strength of 4350 PSI at 28 days. Simply put, the mix would be three times stronger than conventional concrete.

Planning for an excavation of an area of 140′ x 80′ and 7′ deep were investigated and approved.

A volume of 140′ x 80′ x 7′ of soil was excavated and trucked away from the Mandir site.

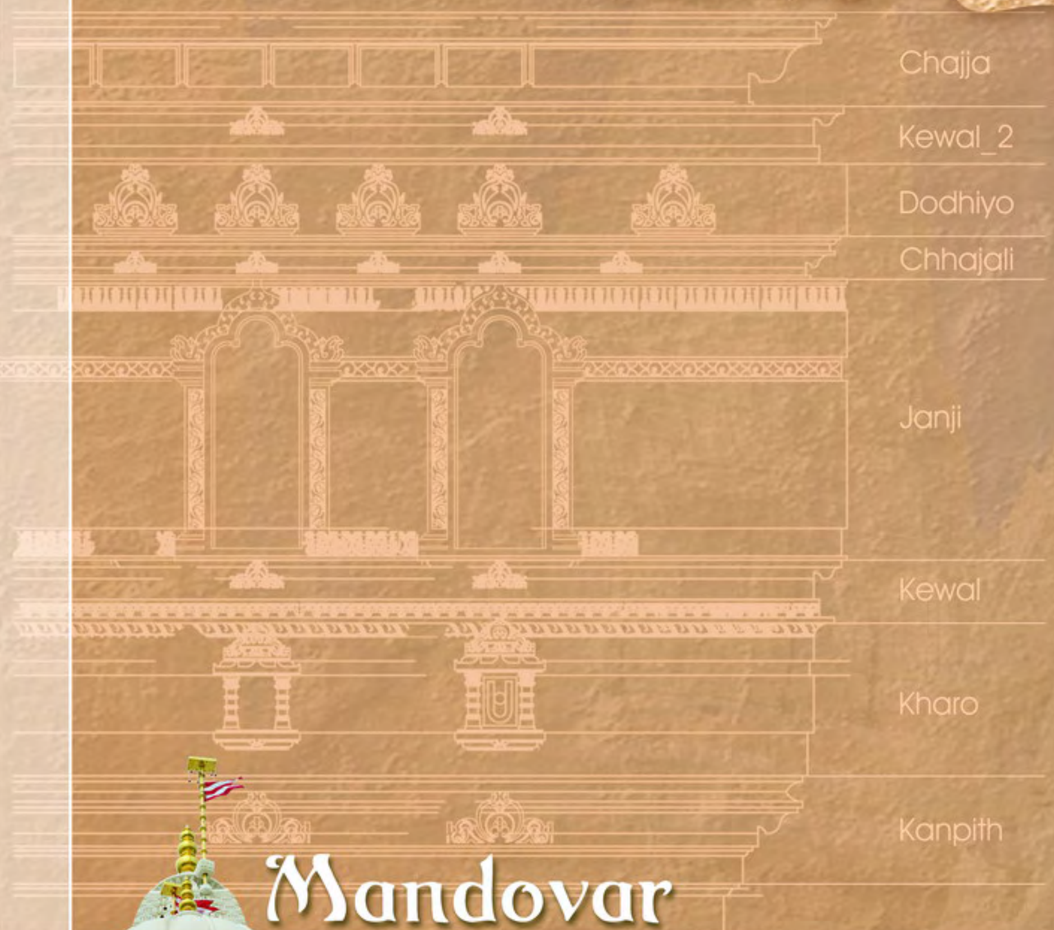
Pouring of 39200 (140x80x3.5) cubic feet of concrete was accomplished on Sunday May 1st, 2005, creating a "man-made" piece of granite weighing approximately 3000 tonnes.

About 40,000 cubic feet of concrete was used for the Raft Foundation.

The concrete for the Raft Foundation was a single continous pour, making it the largest-single day pour in Canada.

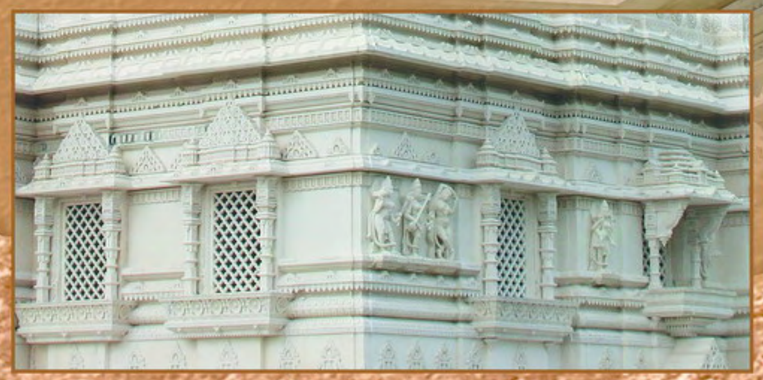
To achieve optimal results, meetings were held with the concrete supplier, the general contractor, Mandir personnel and testing laboratory Technicians. To avoid delays in continuous concrete delivery from traffic congestion on highways. It was decided to pour the concrete on Sunday May 1, 2005.

The concrete pour was started early on Sunday morning (6:00am) at the north end and was completed in the evening (7:15pm) successfully as planned at the south end. Initially, thermal blankets were laid to protect the concrete from adverse Canadian weather conditions followed by a layer of moist burlap, later on.



Mandovar

The mandovar (decorative outer wall), is made up of eight different types of stone design, with the base stone called Kanpith and the top three modules called Chajja, Kewal and Kangra. The Janji level consits of 170 sculptures welcoming visitors into the complex, from which 42 are 40 inches in height, 64 are 18 inches in height and 64 are 11 inches in height. It also consists of 15 stone windows, 3 roop chokis and 6 zarukhas (small galleries). These structures encompass the grand mandovar, built of Turkish limestone.



Mandapam

The first floor consists of 132 torans (archways), 101 ceilings and 2 ornately carved mandapams, each arcitecturally unique. The innermost mandapam consist of a 16-sided 12 layered dome made of 815 pieces. The centre piece of the dome, "the key", is the largest one-piece marble chandelier in Canada. It weighs 3.5 tonnes.

The "welcome mandapam" consist of a tapered ceiling (saucer shaped ceiling). It is the first of its kind outside India. The ceiling has a total of 184 statues to welcome all visitors and is made up of 134 pieces of 'flat' stones. The key which holds the ceiling together by transferring the load onto the pillars is made of 5 pieces weighing 3.3 tonnes. The ceiling is 21′ 9″ in diameter. The welcome ceiling in the front entrance (roop choki) is made up of 434 pieces.

Types of Ceilings:

- 17 Plain
- 9 Shrine
- 12 Roop Choki
- 12 Pradakshina
- 36 Corridor
- 8 Triangle
- 7 Large rectangle ceilings at the entrance

Time it takes 1 craftman to complete:

- a plain celing - 2 weeks.
- flat ceiling with attachments - 6 weeks.
- depth ceiling - 4-5 months.
- swirl style ceiling - 6 months.
- rectangle wave ceiling at the front entrance - 6 months.

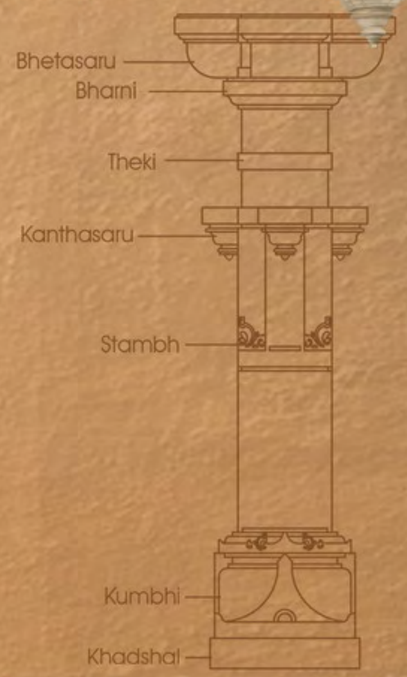
Pillars

A Pillar is made up of 7 different types of stone design, called khadshal, kumbhi (base stones), stambh, kanthasaru, theki and the bharni and bhetasaru to support the beams. Each piece interlocks with one another. The pillars play a very important role in transferring the load of the structure to the foundation. Since no structural iron is used, numerous pillars are required to support the heavy load of the stone ceiling. Each floor has 170 pillars.

Ground floor:
154 - Pink stone pillars
16 - Marble pillars

Upper floor (all marble):
12 - supporting pillars (main dome)
12 - supporting pillars (taper ceiling)
52 - perimeter pillars
30 - pillars in Roop Chowki
6 - shrine pillars
58 - plain supporting pillars

Totalling 340 pillars of which 112 are intricately carved. On average it takes 1 craftsman 310 days to intricately carve a 6 foot pillar.



Labour of Love

Behind the Mandir is a story of unique labour and sacrifice of countless devotees.

When God acquires a new house it calls for rejoicing. More so as the Mandir in Toronto, Canada, is no ordinary Mandir. The most significant facet of the Mandir is the way it was built – with love and affection of many volunteers.

Mandirs may be miracles, but they certainly don not appear out of thin air. A Mandir requires land and materials, and so patrons and donations are required. Devotees learned to cutback on unnecessary expenses and luxuries. They shed away habits that would have otherwise robbed them of wealth and character. Whatever was saved was offered to be used for the Mandir.

The Mandir inspired young and old to contribute in whatever ways possible. Often, the young unexpectedly emptied their piggy banks to augment the fund. Others gave up favourite snacks and treats, and thus pledged to donate what was saved. Some of the volunteers took extened leave from their jobs to participate in the Mandir project, others cut their week-end holidays and newlywed couples cancelled their honeymoon trips. Teams of volunteers organized fund-raising activities to raise money amd support from the local community. Most of the donation were by the devotees themselves, who saw this project as an investment for our future generation.

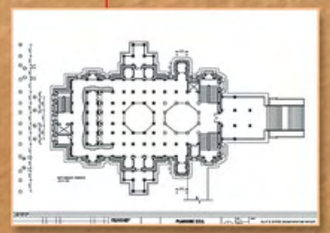
This is a sampling of the 'Magnificent Tycoons' that made the Mandir possible. Students, engineers, doctors and elders worked hand in hand in this extraordinary labour of love to please their guru, Pramukh Swami Maharaj. The impossible was accomplished, with the rapid construction of the Mandir.

This labour of love does not cease as the construction approaches completion, rather it increases daily. Young and old who have seen the creation of the Mandir have pledged to continue their volunteer services in maintaining the life of the Mandir as long as they live.

Timeline

- Sep. 2004 Blessings from Pramukh Swami Maharaj.
- Nov. 2004 First purchase of stones from Turkey and Italy.
- Jan. 2005 Carving work began in India.
- May 2005 Start of Construction work of Mandir in Canada (the foundation).
- July 2005 Arrival of the fist batch of artisans from India.
- Aug. 2005 First consignment of stones arrives to Toronto.
- Nov. 2005 Stone completion in the ground level.
- Nov. 2005 Work at halt due to harsh winter, Artisans return back to India.

July 2004 | Aug 2004 | Sep 2004 | Oct 2004 | Nov 2004 | Dec 2004 | Jan 2005 | Feb 2005 | Mar 2005 | Apr 2005 | May 2005 | Jun 2005 | Jul 2005 | Aug 2005 | Sep 2005 | Oct 2005 | Nov 2005 | Dec 2005 | Jan 2006



- Mar. 2006 Work resumes as the artisans return back from India.
- Nov. 2006 Completion of the first floor walls and the roof slab.
- Nov. 2006 Work at halt due to harsh winter, Artisans return back to India.
- Mar. 2007 Work resumes as the artisans return back from India.
- Apr. 2007 Start of shikhar (pinnacles) work.
- May 2007 Last Consignment of carved stones shipped to Toronto.
- Jun. 2007 Shikhar work completed.
- July 2007 Inauguration in a record-breaking time of only 18 working months (from foundation to inauguration).

Jan 2006 | Feb 2006 | Mar 2006 | Apr 2006 | May 2006 | Jun 2006 | Jul 2006 | Aug 2006 | Sep 2006 | Oct 2006 | Nov 2006 | Dec 2006 | Jan 2007 | Feb 2007 | Mar 2007 | Apr 2007 | May 2007 | Jun 2007 | Jul 2007 | Aug 2007

Interesting Facts

- 4 Savaran (stone crown)
- 5 Shikhars (pinnacles)
- 1 Ghummat (large dome)
- 2 Taper ceilings (saucer shaped dome)
- 11 Ghummtis (small domes)
- 84 Chhat (decorative ceilings)
- 132 Torans (archways)
- 112 Intricately carved pillars
- 340 Total pillars

- The heaviest stone weighs 5.6 tonnes and the smallest stone 50 grams.

- Main central Shikhar (Pinnacle) consists of 335 pieces.
- Welcome Ceiling in the front roop choki consists of 434 pieces.

- 2,638 tonnes of Turkish Limestone.
- 2,260 tonnes of Carrara Marble.
- 1,487 tonnes of Indian Sandstone.

- Over 24,000 pieces of hand carved stones. More than 95,000 cubic feet of stone.

- 305 containers shipped with carved stone modules from India to Toronto.

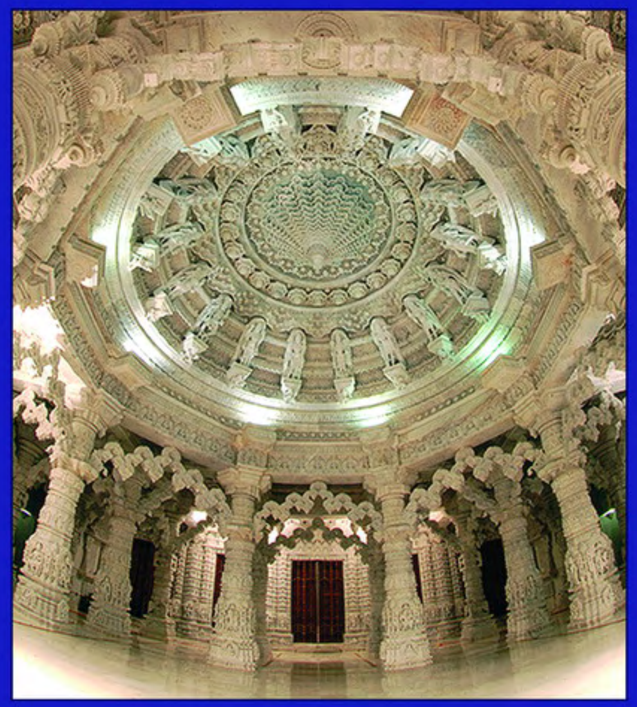
- Dimensions of Mandir:
  height - 72 feet
  length - 151 feet
  width - 108 feet

- At peak, over 1800 craftsmen were involved in the Mandir work at 26 different sites in India.

- 400 BAPS Volunteers from Toronto gave their services for the Mandir project on site

- Time available for the stone work in Toronto:
  2005 - 6 months
  2006 - 8 months
  2007 - 4 months
  Total - 18 months

Mandir in Toronto



Commenced: May 2005
Inaugurated: July 22, 2007

An amazing combination of ancient Indian architecture in marble and stone that will offer a sanctuary of peace and tranquility.

Built to last 1000 years
Conceived, carved & created entirely according to the ancient Hindu Shilpshastra
- the sacred texts of architecture

Entirely intricately hand carved.
2,638 tonnes of Turkish limestone
2,260 tonnes of Carrara Italian marble &
1,487 tonnes of Indian sandstone.
More than 95,000 cubic feet of stone carved in India and shipped to Toronto to be assembled like a giant jigsaw puzzle.
No use of structural steel.
1,800 craftsmen and 400 volunteers.

Features:
Savaran (stone crown): 4
Shikhars (pinnacles): 5
Ghummat (large domes): 1
Saucer shape dome: 2
Ghummati (small domes): 11
Torans (archways): 132
Chhat (decorative ceilings): 84
Stambh (pillars): 340

Labour of Love

The creation of the BAPS Shri Swaminarayan Mandir in Toronto is a result of the spirit and efforts of many dedicated and devoted volunteers. Many hands, hearts and talents of all ages have come together to offer selfless service to build this beautiful Mandirwith a common bond, common vision and a common purpose.