Architectural Blossoming of the Lotus

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ARCHITECTURAL BLOSSOMING OF THE LOTUS

by S. Naharoy

The temples of the Baha'i Faith are well known for their administrative building; and the restrooms block. The
architectural splendor, and the Temple constructed in temple proper comprises a basement to accommodate the
Delhi is a continuation of this rich tradition. Before electrical and plumbing components, and a lotus-shaped
undertaking the design of the temple, the architect, Mr. superstructure to house the assembly area.
Fariborz Sahba, had travelled extensively in India to All around the lotus are walkways with beautiful
study the architecture of this land and was impressed by curved balustrades, bridges and stairs, which surround
the design of the beautiful temples, as well as by the art the nine pools representing the floating leaves of the
and religious symbols wherein the lotus invariably lotus. Apart from serving an obvious aesthetic function,
played an important role. He was influenced by this the pools also help ventilate the building.
experience, and in an attempt to bring out the concept The lotus, as seen from outside, has three sets of
of purity, simplicity and freshness of the Baha'i Faith, leaves or petals, all of which are made out of thin
he conceived the Temple in Delhi in the form of a lotus. concrete shells. The outermost set of nine petals, called
The temple gives the impression of a half-open lotus the 'entrance leaves', open outwards and form the nine
flower, afloat, surrounded by its leaves. Each component entrances all around the outer annular hall. The next set
of the temple is repeated nine times. Flint 8: Neill of nine petals, called the 'outer leaves', point inwards.
Partnership of London were the consultants and the ECC The entrance and outer leaves together cover the outer
Construction Group of Larsen 8: Toubro Limited were the hall. The third

set of nine petals, called the 'inner leaves',
contractors responsible for constructing the Temple. appear to be
partly closed. Only the tips open out,
The temple complex, as seen from the layout, consists somewhat like a partly
opened bud. This portion, which
of the main house of worship; the ancillary block which rises above the
rest, forms the main structure housing the
houses the reception centre, the library and the central hall. Near
the top where the leaves separate out,
nine radial beams provide the necessary lateral support.

Geometry

Since the lotus is open at the top, a glass and steel roof
The beautiful concept of the lotus, as conceived by the
at the level of the radial beams provides protection from
architect, had to be converted into definable geometrical
rain and facilitates the entry of natural light into the
shapes such as spheres, cylinders, toroids and cones.
auditorium.
These shapes were translated into equations, which were
Below the entrance leaves and outer leaves, nine
then used as a basis for structural analysis and
massive arches rise in a ring. A row of steps through
engineering drawings. The resultant geometry was so
each arch lead into the main hall (see Fig. 1).
complex that it took the designers over two and a half
years to complete the detailed drawings of the temple.
Fig 1. Top view of entrance and outer leaves An attempt is made below to
describe this complex
geometry in simple terms (see Fig. 2).

Entrance leaves and outer leaves.
The shell surfaces on both sides of the ridge of the
entrance and outer leaves are formed out of spheres of
different radii, with their centres located at different
points inside the building. There is one set of spheres for
the entrance leaves, some of which define the inner

Fig 2. Section through entrance leaf and interior dome
(Plan and section at crown of dome also shown)

1. Entance leaf
2. Outer leaf
3. Interior dome shell
4. Arch
5. Interior dome rib

The inner leaves enclose the interior dome in a
canopy made of crisscrossing ribs and shells of intricate
pattern. When viewed from inside, each layer of ribs and

shells disappears as it rises, behind the next, lower layer (see section on p. 29). Some of the ribs converge radially and meet at a central hub. The radial beams emanating from the inner leaves described earlier meet at the centre of the building and rest on this hub. A neoprene pad is provided between the radial beams and the top of the interior dome to allow lateral movement caused by the effects of temperature changes and wind.

surfaces, and others which define the outer surfaces of of adjacent arches, thus forming an intricate pattern.
the shells. The diameters of the spheres have been fixed Other radial ribs rise from each of these intersections and
to satisfy the structural consideration of varying shell all meet at the centre of the dome.
thickness. Similarly, for the outer leaves, another set of
Up to a certain height, the space between the ribs is
spheres defines the inner and outer surfaces of the shells.
covered by two layers of 60mm-thick shells. The intricate
However, for the outer leaves, the shell is uniformly 133
pattern of the interior dome is illustrated in section on
mm thick towards the bottom, and increases to 255 mm
page 29.
up to the tip, beyond the glazing line.

The entrance leaf is 18.2m wide at the entrance and
Setting out
rises 7.8m above the podium level. The outer leaf is
The setting out of the surface geometry posed a difficult
15.4m wide and rises up to 22.5m above the podium.
task. Unlike conventional structures for which the
The inner leaves. elements are
defined by dimensions and levels, here the
Each corrugation of the inner leaf, compnsmg a cusp shape, size, thickness, and other details were indicated
(ridge) and a re-entrant (valley), is made up of two in the drawings only by levels, radii, and equations.
toroidal surfaces. A toroid is generated when a circle of These parameters, therefore, had to be converted into a
a certain radius, 'r', is rotated around the centre of a set of dimensions in terms of length, breadth, height,
circle of much larger radius, 'R'. A cycle tube is a typical and thickness, easily understood by a site engineer or a
toroid. The shaded portion of the toroid is a part of the carpentry foreman. To achieve this, a system of
inner leaf shell. coordinates along x, y and z axes for every 40 degrees.
segment of the temple was worked out with the help of

The inner leaves rise to an elevation of 34.3m above
a computer. The problem was then further simplified by
the inner podium. At the lowest level each shell has a
working out from these co-ordinates levels and distances
maximum width of 14m. It is uniformly 200mm thick.

The arch. Fig
3. Station points for setting out of arch,
entrance, outer and inner leaves
All around the central hall are nine splendid arches
placed at angular intervals of 40 degrees. The shape of
these arches is formed by a number of plane, conical and
cylindrical surfaces. The intersection of these surfaces
provides interesting contours and greatly enhances the
beauty of the arches. The nine arches bear almost the
entire load of the superstructure (see Fig. 2 and 4).

The interior dome.
Three ribs spring from the crown of each arch. While the
central one (the dome rib) rises radially towards the
central hub, the other two (the base ribs) move away
from the central rib and intersect with similar base ribs
which a carpenter or a reinforcement fitter could easily
Fig 5. Setting out of surface

comprehend and then arrive at the surfaces and
z ~yel
boundaries. Eighteen reference stations were established
plum~T
B
outside the building for setting out the arches, entrance,
Stepped template
outer and inner leaves (see Fig. 3).
bob I

First, 18 radial lines were established from the centre
of the building (see Fig. 4). Along these lines, using
inclined and vertical distances, end points A and B for
surface (1) were established. By using a set of curved
templates, each of varying curvature, surface (1) between
y
these lines was developed. From this surface the other
surfaces of the arch were set out by using stepped
templates with respect to surface (1).
Sequences of construction
The stations shown in Fig. 3 were used to set out the The basement and the
inner podium were constructed
cusp, re-entrance and edge lines for the entrance, outer first.
Thereafter, for casting the arches and shells, the

and inner leaves. For example, to arrive at curve AB, structure was
divided into convenient parts, taking into
point A with coordinates XA, YA, ZA was defined with consideration
that when deshuttered, the portion of the
respect to O. AB was then established by a second shells cast
would be self-supporting until the remaining
theodolite and the curve AB determined by a stepped
shells were completed. The structure was divided as
template. Accurately made curved templates of required follows:
radii were then used to develop the surface between
these boundaries (see Fig. 5). Arch.
All 9 arches were cast one after the other in two lifts
Fig 4. Setting out of arch until the circle was completed. The
deshuttering of the
soffit of each arch was taken up after the adjacent arches
had attained specified strength (see Fig. 8).

Inner leaf, radial beams and central hub.
After the completion of all the arches, the structural
steel staging for the inner leaf was erected. Three shells,
120 deg. apart, were taken up at a time and cast in two
Building lifts, one after the
other, up to the radial beam level,
R ensuring always that the difference in
height between
the shells cast was not more than one lift (see Fig. 6).
The process was repeated until all 9 segments were cast.
\ Theodolite Casting of the
central hub was taken up as an
independent activity, and after all the shells were cast,
they were connected to the hub by casting the radial outer
leaves and followed by the intermediate entrance
beams. After sufficient curing, the inner leaf along with leaf. In
this manner the remaining leaves were
the radial beams were dewedged, leaving the central hub deshuttered
as and when the concrete attained strength
supported. The remaining portion of the inner leaf was and the
leaves adjacent to the shell to be deshuttered
then taken up (see Fig. 7). were cast.

Fig 6. Sequence of co nstruction of entrance leaf, outer leaf
Staging and !ormwprk
and in ner leaf
Deflection was an important consideration in the design
of the formwork. The maximum deflection was limited
to 3mm over a distance of 1m (including errors in
fabrication and erection).

The following aspects were considered in arriving at
the general arrangement of the staging supporting the
inner leaf and interior dome formwork:
a. The concreting of the shells should be taken up 3 at
a time, 120 deg. apart, so that the lateral loads on the
staging supporting the formwork were reduced as far
as possible.
b. Construction joints were to be avoided as far as
possible so that the exposed concrete surface did not
Interior dome. show
any lines other than the architectural pattern.
After de-wedging of inner leaf, the steel staging was For
the inner leaf, construction joints were to be
modified and two folds of shells of the interior dome
located above 24.8m level so that they did not show
taken up one after another. For each fold, three shells, from
the floor level. All other shells were to be cast
120 deg. apart, were taken up at a time and cast one after in a
single continuous pour.
another. For each shell the boundary ribs were taken up c. The
staging should support the radial and base ribs
first and then the shell cast in one single lift. The process
without interfering with the structural steel
was repeated until all the shells were completed.
members. After deshuttering of inner leaf, the
structure should be able to support the formwork of
Entrance and outer leaves.
the inner layers of shells of the interior dome with
The construction of the entrance and outer leaves was
minimum modification.
taken up as a parallel activity with the casting of the
inner leaves and interior dome. Two entrance leaves and From
the above considerations, a space frame
one intermediate outer leaf were taken up first. consisting
of 9 radial cusp frames and 9 re-entrant
Thereafter, the outer and entrance leaves were cast frames,
with circumferential and diagonal members
alternately, the outer leaf first and then the adjacent closely
following the profile of ribs and shells, was
entrance leaves. Deshuttering was started with a pair of considered
most suitable (see Fig. 7).
Fig 7, Inner lear and radial beams delihulterrd deflections due to
slippage of joints would be avoided and
with c~n!ral hub supported on staging
fabrication and ereclion would be comparatively easier.
The inner surfaces of all the shell s have a uniform,
bush-hammered, exposed concrete surface with

archit«tural patterns. For the inner leaves, these patterns were formed out of radial and venical planes intersecting the surface of the torus. For the outer and efilrdnce leaves, and the interior dome, the patterns were formed out of longitudes and latitudes of spheres. The form work was designed in a manner thai limber joists support the panels instead of the regular pauern of the structural steel supporting members of the space frame (see Fig. 8).
Full-scale mockups of the bottom surface of each of the shells were first made at ground level and the archi leclUra l patterns marked on this su rface. The fra me
Various alternatives were considered for the steel of each form panel was fabricated according to
staging. Standard pipe scaffolding was found to be calculated dimensio ns and cross-checked with
unsuitable, considering that the slippage of members at measurements from the mockUp. The fo rmwork pattern
joints would be uncertain and it would be difficult to is seen in the photograph on page 70.
compute and control the deflection, particularly due to The inner fo rmwork for every petal was fully fixed
lateral loads. Structural steel framework with boltedjoints from bottom to lOp and aligned accurately. After the
was found to be unsatisfactory, considering that a very form work was approved, the sheathing joints where sealed
high degree of accuracy in fabrication and erection of with putty made out of epoxy resin and plaster of Paris.
structural work would be required to match the boll holes and a protective coating was applied over the
at junctions of members meeting at different inclinations plywood surface, In the case of the interior dome shells,
in all three planes. Structural steel framework with welded the plywood sheathing was lined by fi ber-reinforced
joints was considered to be most suitable because plastic sheets and thejoinrs sealed with epoxy resin. After this, the locatio"n of each reinforcement bar was marked on Ihe fomnvork along latitudes and longitudes and the bars placed over (he markings. To avoid impressions of cold joints on the inner surface, the casting of petals of the inner leaf was carried out in three lifts, some of them 14m high. To facilitate placement of concrete and si multaneous compaction in each pour, the oUier form work was placed one row of panels at a time, and as the level of co ncrete rose, the next row of panels was fixed. These panels, therefore, had to be fixed in position and aligned
Vi~w showing n~wly concreted main archeli accurately in the shonest possible lime.

Fig B. Formwork details of entrance leaf rv. The greater of dead load of concrete (or) liquid pressure at any point corresponding to the rate of

1 placement 0.45 m/hr and minimum temperature of 10 deg. C (during winter). Concrete pressure was calculated as per ACI publication - SPA.
Liquid pressure p = 7.2 + ([785Rl/[Tc + 17.8])
P = Lateral liquid pressure - KN/m2
R = Rate of placement - m/hr
Tc= Temperature of concrete in the forms deg. C
V. Basic wind pressure = 1000 N/m2

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Fig 9. Details of formwork in inner leaf

Through selected points matching with the architectural pattern, pipe supports were taken from the inner leaf staging. These pipes supported a structural steel grid closely
Detail of shaped member and back fonn

following the profile of the outer surface of the shells. The grid supported the outer formwork against the concrete pressure and also accommodated the working platforms at all levels. Through-ties connecting the inner and outer forms were provided at selected points so as to reduce the load on the steel staging and limit the deflection of formwork.
The longitudinal support members of the backform had accurately aligned shaped members, such that when the backform panels were placed in position and wedged, the outer surface of the shell was attained without further alignment (see Fig. 9). To ensure that the panels fitted exactly between the shaped members and there was no delay, the fixing of the panels for the entire shell was carried out in advance.
2. Inner form
3. Outer form
4. Outer steel staging
Loading 5. Working Platform
6. Concrete shell
The following loads were considered for the design of the 7. 10 mm thi ck rubber washer
B. 40 mm di ameter pipe
formwork:
9. 60 mm di ameter pvc sleeve
10. Shaped member
I. Dead load of formwork - 750 N/m2 of surface area. II. Back form panel

II. Self-weight of structural steel members. 12.
Longitudinal member
III. Live load 2000 N/m2 of plan area. 13. Wedg
es

For the inner leaf, various combinations of the above loads
Based on the above loads, a computer analysis for all
were considered for the following conditions (see Fig. 4):
possible combinations was carried out using SAP N
program. One cusp frame and one re-entrant frame along
Stage I Concrete from top of arch to +24.8m level
with inter-connecting bracings were considered as a unit.
Stage II Concrete from +24.8m to +38m level
Stage TIl Concrete from +38.8m to the top
A computer model indicating the loads due to one of
the combinations of loading for Stage II is shown in Fig. 10.
The combination of loads considered were:
Similar loading conditions were considered for the
entrance and outer leaves as also the shells of the
1. Self-weight of space frame (symmetrical)
2. Dead load of shutter
interior dome, the only difference being that all the
3. Live load + dead load of concrete Stage I (unsymmetrical)
shells were cast in a single pour.
4. Live load + dead load of concrete Stage I (symmetrical)
5. Live load + dead load of concrete Stage II (unsymmetrical)
6. Live load + dead load of concrete Stage II (symmetrical)
Reinforcement
7. Live load + dead load of concrete Stage TIl (unsymmetrical)
8. Live load + dead load of concrete Stage TIl (symmetrical)
The reinforcement used in the white concrete shells as
9. Wind load for full height (unsymmetrical)
well as the binding wires was entirely galvanized so as
to prevent the long-term effect of rusting of
reinforcement on the white concrete. Since galvanized
Fig 10. Computer diagram of nodal lo ads for inner lea f
reinforcement for concrete is seldom used in this
country, several tests were carried out to ensure that the
mechanical properties of reinforcement did not become
5.45 adversely affected due to galvanizing. Sandblasting was
1'1 3.61 carried out to reduce pickling time with a view to
15.83 778
/ avoiding hydrogen embrittlement. The bottom formwork
18.52
for one shell for each of the leaves was first erected and
aligned. The edge lines and surfaces of this formwork
were then used as a mockUp to decide the length and

shape of each bar in the shell. To avoid the impression of
cover blocks on the exposed surface of the shells, the
inner layer of reinforcement was held in position by
special steel spacers supported from the outer formwork.

Concrete
Forces a re in Kn
All the ribs and shells up to radial beam level are in
3.1(1"0.84
1.09 CuSp frame Re-entrant frame
white concrete. To avoid crazing and shrinkage cracks, a
(Out of plane horizontal load
mix of M 30 grade white concrete was designed
In Plane/ l ' "
horizontal load ' " Out of plane
considering that the cement content should be below 500
Vertical load
horizontal load
I """
Vertical load
In plane horizontal load
kg/m3 and the quantity of water reduced to a minimum.
Tests carried out on Indian cement revealed that the constructed in
in-situ concrete using formwork on both
strength and other properties varied considerably and faces.
Considering that each shell had to be cast in a
the colour did not meet the architectural requirement. single pour, the
fIxing of formwork and reinforcement,
Trial mixes also showed a higher cement requirement of as also the
placement and compaction of concrete
430-450 kg/m3. The entire quantity of white cement was between two
faces of formwork only 60 mm apart, posed
therefore imported from Korea. With the imported serious
problems. Not only was the formwork diffIcult to
cement, it was possible to produce concrete having 28 align so as to
accurately produce the complex, doubly
days cube strength of 55-60 N/mm2 with a cement curved surface
and the intersections, but also the
content of 380 to 400 Kg/m3. A mix of 1: 1.44:3.36 and closeness of the
petals, one fold behind the next, caused
w/c ratio of .42 was adopted. To achieve a high serious problems
of work space for fIxing formwork,
workability, slump 1-120 mm, super plasticiser, .5 to reinforcement
and concreting.
.75% by weight of cement was used.
Specially graded dolomite aggregates were procured
Quality assurance

from the Alwar mines near Delhi and white silica sand
Based on the sequence of construction envisaged, the
from Jaipur. The maximum temperature of concrete at
assumptions made in the design of the formwork, the
the time of placing was limited to 30 deg. C. During the
procedures developed from mockups, and the tests
summer months, when the ambient temperature was as
carried out on materials, detailed method statements and
high as 45 deg. C, the temperature of the concrete was
criteria of acceptance were established. Checking of
controlled by adding a measured quantity of ice and by
workmanship was done at each stage to produce the
the precooling of aggregates in air-cooled aggregate
required quality and accuracy and also to ensure that
storage bins. To avoid cold joints due to stoppage of
there was no deviation from the conditions of loading
work during heavy rains, as also to protect rain water
assumed in the design of the formwork. A full-fledged
entering the forms, the entire concreting area was
concrete laboratory carried out mix designs for different
covered by tarpaulins.
grades of concrete and exercised strict control on the
After removal of the outer forms, the surface of the
quality of concrete.
concrete was covered with hessian and cured for 28
days by keeping it wet continuously by a sprinkler
arrangement fIxed at the top of the shells.
Marble cladding
The outer surface of the shells, as also the inner surface of
the arches, are cladded with white marble panels fIxed to
Trials and mockups the concrete surface with
specially designed stainless steel
The shells of the interior dome were initially 50mm thick brackets and
anchors. 10,000 sq.m. of marble was quarried
and proposed to be cast by in-situ guniting. Full-scale from the Mount
Pentilekon mines of Greece and thereafter
mockups were used to study the problems of working sent to Italy,
where each panel was cut to the required size
space and accessibility, and it was felt that due to limited and shape to
suit the geometry and architectural pattern
space available between the shells, the working before
transporting them to the site in Delhi.
conditions for guniting operations would be diffIcult. As After
waterproofIng of the top surface of each shell,
an alternative, the shells were therefore proposed to be timber templates
of the same size as the marble panels
were used to define the location of the bottom-most rows

that the marble fixing could be carried out without any
of marble panels first. The geometry of the cusp re-entrant
hindrance from the supports of the staging.
and edge lines was then accurately checked with respect
It may be interesting to note that all the marble work
to these panels, and the marble pieces were fixed in
was carried out by carpenters who learned the skill of
position from bottom towards top and cusp towards re-
marble fixing within a few weeks, and were able to
entrants and edges. Edge holes were drilled at ground
complete the work, to the required accuracy, two months
level for each marble panel before the panels were placed
ahead of the scheduled completion time.
in position. Holes were drilled in the concrete to
accommodate the anchor fasteners of the stainless steel

Project management

brackets to suit the holes in the marble, after each panel
The complexity of the structure, and the very high
was aligned. After fixing of the brackets, the area around
standards of workmanship expected to be achieved,
the bracket hole was sealed with a special waterproofing
demanded a dynamic construction management with a
compound (see Fig. 11).
high degree of innovativeness, team spirit and quality
Fig II . Marble ftx in g deta ils consciousness on
the part of staff and workmen.
Anticipating problems in advance and solving them
through trials and mockups was an essential part of site
planning. Further, great emphasis was laid on the
completion of the project within the stipulated time and
cost. Resources were planned and physical progress
1.Stainless steel bracket monitored through constant review of
PERT/CPM
2.Stainl ess steel anchor fastene r
3.Waterp roof resin networks.
4.Marble panel
5.Mo ulded rubber cordon with
silico n sealant
6. Sili con sea la nt
7. 8 to IO mm joints between pane ls
8. Concrete shell
9. Curved surface

The alignment of the panels was adjusted at each
layer so that the surface geometry and pattern lines were
maintained. The pieces near edge, re-entrant and cusp
lines were cut to suit the boundary lines. Gaps 8 to 10

mm wide at the joints were filled with moulded rubber cordon, and the top of the joints, as also the holes in the marble, sealed with silicon sealant. The entire marble surface was, lastly, washed with a solution of 30% muriartic acid mixed in water, to remove dirt and stains. A specially designed structural steel framework was provided to accommodate access and working platforms. The platforms were free from the surface of the shells so

a. house of worship
h. ancillary building
c. public utilities
d. parking
e. main gate
a.- i. pool
j. outer podium
k. bridges
1. entrance
nl. inner haJJ

Ullder COllstructioll

Oh lotus in the heart!
Growing up from the soil
Of mother India.
Drawing deep springs
Up from the depths of Asia,
Rising a mighty fountain
Of mystic power unseen
Felt, almost heard,
As it overflows
From petals clasped in prayer
To carry the voices
Of the singers praising God
To be scattered far and wide
By the scattering angels-
Armfuls of prayer they carry
Like pan nie rs of invisible flowers
Scattering the Words of God
Scattering His Glorious Words
Up to the snow clad Himalayas
Down to the lapping edge of t he seas
A rain of perfume
A rain of blessing
It seeps into every crevice
Showers every jungle
Spatters the deserts' sands
Passes above every meadow "
Blows into every cavel
The scattering angels

Rank on rank, tile on file,
Deploying the promise
Of their Lo rd the Alm ighty.

Madame Ru~!yyih RabMni
Thr Shrinr of the Bab, Martyr-Herdld of the Baha'i Faith, on thr slopes of Mount Carmel. Haifa, Israel.

The Shrine of the Bab is one of the holiest places of pHgrimagr for thr followers of the Baha'i religion.
The monumental terraced gardrns surrounding it are commonly known as -Hanging Gardens of Mount
Cannrl-, and were designed by Farihorz Sahba, the architett of the Baha'i HOllsr of Worship in India,
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I
I NTERNATIONAL R ECOGNITION

The B:1 h:i'j lI ou~t of Wo~ h i p in New Delhi. India has hem rccog n i~cd :1' one of t h e maS\(Tpirn.'s of [W(,lH il'lh-
rt.' llI ury art hi lccltm', :md !la .. WOII ma ny award.. ind uding [Il(' following :

- rir..l lion our award from Ill(' 11I1l'rrailh Fonml on Rrligiouo; An and Arrhiu'Cl urC. Am li;HC or the American Instilut\' of Arch itl'I'IS. Wa\hi ngto ll. D.C .. in 1987

- Spl't:i'l l award from the InslilUlion of Slru('lUrai Enginccrs of Ihl' United Kingdom in 1987

- The P:lUl Wall:rhury Outdoor Light ing Dl'!>ig n Award- Spl'd:11 Ci lalitJI1. from tlw Ill um ina ting Engi nl'{'ring $ocie1Y or Non h Amcrica in 1988

- Recognition f rolll the Arl1l:riC;1Il CO IKn' tt l n~l i l utc:1:. one of the n lll" ! t'o rH.'r<'iC ~1n1(,lllr{'" of Ihl' worl d in 1990

- TIll' GlullArt AcadclIlY 2000 award for -promoting till' II nily a nd harmony or p~oplc or all 11:llion", religio n!> and !toria] Si rala, 10 an eX\('1lI unsurpassC'd by any Olhtr ,Irchil~clural 1II0nUlll l' Il I worldwidt-

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