CHAPTER - 9

THE FINDINGS

General

Certain postulates or inferences are derived/arrived at the end of each chapter.

Such inferences or postulates are incorporated and abridged to arrive at the findings.

The chapter wise findings are given in subsequent paragraphs.

9.1 Findings from the Review of Literature (Chapter:2).

(a) The wide range of the knowledge pertaining to *vistuvidyā* are spread over *vedas*, *upavedas*, *vedīngas*, *samhitās*, *śstras*, *śstra*, *itihiṣas*, *purṇas*, specific *vistu* texts by various authors, translated works, commentaries, compilations, interpretations, research works.

(b) *vistuvijstra* considers the planning, design, technological aspects and methodology of constructions. It integrates the aspects, orientations, aesthetics
and artifacts. Vśtu constructions are done as per proper dimensions and proportions with the intrinsic rhythm, grammar and aesthetics.

(c) There are well-established procedures for the identification of the need, jeyya-vara, selection of location and site, considerations of various alternatives in the decision-making, design, planning and execution.

(d) The temples are classified in several ways by various authors based on the plan shapes, sizes, number of storeys, built forms, interiors, decorations, materials of construction, magnitude and artifacts. The shapes of Kerala temples are limited to the regular shapes of square, rectangle, circular, octagonal, elliptical and apsidal. The numbers of storeys are restricted to three though there are descriptions in text upto 16 storeys.

(e) There are wide ranges of flexibility in-built in vśtuvidyā in the concepts, canons and principles in the planning, design and execution affording uniqueness to
temple ārikovils. The forward and rearward integration of the elements is evident in temple constructions.

(f) The concepts and cannons on the designs of various elements are variant in different textbooks, requiring further references. The facts given element wise, in tabular form provide easier comprehension in a comprehensive way, helping students and teachers.

9.2. Findings from the Chapter-3 (The Hindu Temples - a glance).

(a) The Hindu Temples are buildings built for installing the presiding deity for worshipping according to the āstras by application of various proportionate measurements and standards. The ārikovil also known as prāśīda has unique exteriors and interiors, which please the eyes and souls of both gods and men. It utilises gainfully the energy, talent, skill and leisure of the members of the community. Prāśīda is of Aryan origin and Vimyna of Dravidian origin. Prāśīda
indicates the ērikovil around the garbhagṛha. Vimśa indicates palatial
building, may be main ērikovil, prākṛtas or gopuras.

(b) The temples served as places of worships and also helped in developing the
knowledge, skill and sets of concepts and cannons for planning, design,
construction and maintenance.

(c) Kerala temples differ from the temples of other parts of India in few ways.

The number of storeys is limited to three. Īgamic and tantric cannons and
culture dictate the temple designs. The plan shapes are restricted to few regular
shapes. The decorations are simple and few. Only one ēkhara with sloping roof
is provided. The interiors are scantily decorated. The locally available and durable
materials are used. Invariably finales are provided over the roof. The garbhagṛha
is small, mukhamandapa is optional, ēripita a must, upapeta is optional and
adhisēja a must. Pranīla and sopīna are invariably provided.
9.3. Findings from Chapter- 4 (The Structural Spaces and Built Forms of Temple àrikovils of Kerala).

(a) Evolution of structural spaces and forms. Temples were built and were existing in Kerala much before Christian era. In the early phase (800 - 1000 AD) the temples were built on square, rectangle, circular and apsidal ground plans. Both nirandhara and sandhara types were in vogue. Sarvatobhadra type existed. In square temples mukhamandapas were projecting out. In circular and apsidal àrikovils the space in front of garbhagṛha served as mukhamandapa. The decorations were with recesses, niches and projections. During the middle phase (1001 to 1300 AD) the interior arrangements like antarbhitti, garbhagṛha as miniature vimyna, garbhagṛhas having square shapes, except in apsidal àrikovils, and instalation of consorts of main idol in the same àrikovil. The construction of mata àrikovils gained importance. Many temples of this period
revealed the Dr\'ida traditions and fusion with Kerala traditions. The elliptical plan shape was provided to grikovils during this phase. During the late phase (1301 to 1800 AD) the emphasis got shifted to outside the grikovil to gopuras, dAvajas, balikkal puras and ancillary constructions. Copper sheeting over timber roofs gained popularly. In the modern phase (1801 to 2000) large number of renovations and new constructions took place. Use of cement concrete, reinforced cement concrete, plaster of paris and other modern materials came into existence. Architecture of prast\'ra came into existence.

(b) **Antiquities of temple grikovils.** The antiquities of 7345 grikovils spread over seven districts (Kasargod, Kannur, Kozhikode, Vayanad, Malappuram, Palakkad and Trissur) could be obtained. It appears that maximum percentage of temples was constructed between 200 to 600 years back (55.2%). About 14\% of grikovils are more than 1000 years old.
(c) **Horizontal spaces of temples.** The square ērikovals are in majority followed by rectangular and circular ones, apsidal ērikovals are few and so are the other shapes. The square ērikovals have square garbhagráhas and mukhamandapas projecting out. In circular ērikovals, the garbhagráhas are mostly square and rarely of circular shape. Mukhamandapa are adjusted with in ērikoval itself in most of the cases. Few cases of mukhamandapas projecting out are also observed. Corridors are provided in big ērikovals, especially when there are upper storeys. Most of the apsidal ērikovals have garbhagráhas of the same plan shape, yet, square garbhagráhas are also observed. The formulae for various ground plans are verified with modern geometry and the percentages of errors are found to be negligibly small (maximum upto 0.56%).

(d) **Vertical spaces.** The effects of vertical spaces come from the developments in Z axis over horizontal spaces in X axis and Y axis. The elements considered for the
vertical developments are foundation, Adadhïra, upapeta, padmapi'du'ka, adhiséjina, height of wall of örikovil and their divisions, roof, finale, ceiling, prastara and so on. Most of the cannons are based on the am¿akrama derived from the pris'da dandu, height from pi'du'ka to finale (both inclusive), uttaradandu and wall height. Yoni concepts are also prescribed in certain texts.

Out of 6435 örikovils which account for nearly 47% of total numbers of temples in Kerala built as per temple vistu, the maximum percentages are single storeyed (88.3%), double storeyed coming next (11.4 %) and three storeyed only 0.3%. The levels at which öripitas installed are mostly at the floor level. Variations are there with the öripita at higher levels, lower levels or even at an elevated storey, creating variety and uniqueness.

(e) Structural forms. The mouldings, the projections, niches, openings, decorations of various categories and the elevations constitute the elements considered under
structural forms which give the looks, aesthetics, expressions of the temple architecture, uniqueness to the ārikovils, the exquisiteness and grandeur. Many of the elements constituting the structural forms serve as secondary structural members contributing towards stability, strength and sustainability of the ārikovils. The cannons given in tabular form in very brief reveal the flexibility, varieties created in horizontal and vertical spaces and forms. Amākrama is used for proportioning of elements. Aesthetics, conveniences and beauty have their roles in the development of structural form apart from amākrama. Wall decorations are progressive in nature. Small ārikovils have simple and few Wall decorations like bhittikal, gha, advara and vedikas. As the ārikovil sizes increase more decorations are added progressively with out clustering. The Kerala temple architecture is adopted for the decorations. It is simple, elegant and expressive.

9.4. Findings from chapter- 5 (Apsidal forms of Kerala ārikovils)
(a) The knowledge about the apsidal form was existent from 2\textsuperscript{nd} century AD as observed from archeological evidences. The basic ground plan shape prescribed in most of the texts is a square with semicircle at the back. Mayamata only indicates elongated square with elongation in the length. However, the apsidal ¿rikovils in Kerala are basically square with semicircle at the back. The detailed descriptions are very few in textural works on the apsidal forms.

(b) The percentage of apsidal ¿rikovils in Kerala is about 0.5. The total number of such ¿rikovils is around 30 out of which 28 are 'listed'. Two ¿rikovils mentioned in published works on verification at site were found to be of square plan shape.

(c) Out of 28 apsidal ¿rikovils, only two of them are in the category of mahiprśidhas and are three storeyed. Ten of them are two storeyed and the rest 16 of them are single storeyed. Out of 28 apsidal ¿rikovils, 13 of them are áiva temples, 10 of
them ājsta/Ayyappa temples and others like Vjmana, Sankaranārīyana, Subramania and Devi temples put together account only five.

(d) Maximum number of apsidal ėrikovils are in Trissur and Malappuram districts (8 and 9 respectively). Kasargod, Kannur, Kozhikode, Vynad districts have 3, 2, 2, 2 apsidal ėrikovils respectively. Palghat and Kottayam districts have one each.

Most of the apsidal ėrikovils are of very ancient and ancient origins. They withstood for centuries. Five apsidal ėrikovils are either renovated or being renovated.

(e) The roof of the apsidal ėrikovil consists of pitched roof over the square portion and half right circular cone over the curved portion. The roofing in curved cone portion with tiles is difficult. Often, the apex is in polygonal shape. Copper sheeting has no such difficulty.
(f) The axial symmetry in apsidal form exists only about Y axis. There is no symmetry about X axis and Z axis. The centre of gravity in the plan is about 0.7 of the length of the side from the front line. The planning, design and construction require special care.

(g) The back portion being curved in plan the bhittalankras at rear corners and curved portions need modifications.

(h) The garbhagahas are mostly of the same shape as of the rikovils. Yet, square shaped garbhagaha in apsidal rikovil also exist. Few small rikovils do not have separate garbhagahas and the walls of the rikovils merge with the garbhagahas as ghanabhitti.

(i) The mukhamandapas are provided except in very small rikovils within the rikovil itself. In very few cases tirthamandapas are provided in addition to mukhamandapas projecting out side.
(j) *Antarjlas* are provided except in small *árikovils*. The walls of *antarjlas* support the top storey in many cases. There are two *kêtas* and two *stêpis* invariably. In few cases one more *kêta* between the two main *kêtas* is provided.

(k) In the absence of textural descriptions in detail on the designs and constructions of apsidal *árikovils*, the rules applicable to square and circular *árikovil* (since apsidal is a combination) may be applied except in the plan shapes and sizes with logical modifications deemed necessary.

9.5. **Chapter- 6. Findings from Case studies of Apsidal árikovils.**

Out of 28 apsidal *árikovils* listed, brief case studies are carried out on 22 *árikovils* spread over various regions of the state. Twenty-one *árikovils* are considered for comparisons as one is found to be a bit odd. The diagrams of plans are prepared and presented to high light the variations. They may be useful as documentation on these *árikovils*. Most of the temples are photographed and presented.
Discussions on over all observations are made. Each case study has something special. The findings may be read in conjunction with the details given in the case studies. The findings in brief are given below:

(a) **Structural spaces.** The plan spaces for all ērikovils are apsidal with three sides straight with semicircle at the back of square. The elongation of the square in Y direction is absent. The majority of prṣidā widths ranged from 3 kol pariĀa to 15 kol pariĀa (alpaprṣidā). Only two ērikovils are found belonging to mahiprṣidās. About 70.5% of prṣidās belong to 3 to 7 kol pariĀa and 23.5% belong to 12 to 15 kol pariĀa. About 81% of ērikovils have separate garbhagṛhas, others being small ērikovils do not have separate garbhagṛhas. About 95% of the garbhagṛhas are of apsidal shape and 5% is of square garbhagṛhas. About 71% of the garbhagṛhas have either turavu or ceiling. About 76% of ērikovils have mukhamandapas and are inside the ērikovil. In two cases tirthamandapas
projecting out have been found. The presence of two antarjšas is indicative of higher storey. The mere presence of one antarjša is not indicative of upper storey. For small ərikovils, the antarjša may be considered as merged with the external wall. Two ərikovils are three storeyed, 10 are two storeyed (47%) and the balance 9 (43%) are single storeyed. The wall heights of single storeyed ərikovils vary from 140 to 180 cm. The wall heights of higher storeys appear to be \(0.5^{th}\) to \(0.8^{th}\) times of the lower storeys indicating reductions in heights at higher storeys. The əripitas are placed at the same level of the ərikovils in 12 ərikovils, 8 at higher levels and one at lower level. Texts do not mention the levels and yet, variations are found to exist. Nineteen ərikovils are having sopınas. One small ərikovil and another one with the əripita below the floor level do not have sopınas. There are 14 sopınas with straight flights, three from the sides and two having the combination of flights from the sides up in the top of upapeta and
then straight going to the ērikoval. Texts refer to the straight flights and from the sides only. The combination is a ground reality. The pranjalas are placed on the Northern wall for all ērikovils whether facing East or West. There is only one ērikoval having doors in all directions. There are three ērikovils which have two doors and second door faces the extra deity. Ghanadvīras are provided in the positions where doors do not exist in the respective cardinal direction. The door sizes vary from 56 to 106 cm in width and 125 to 212 cm in height. The width: height ratio is very near to 1:2. The amjākrama is not found existing in very small ērikovils, where the convenience may be taken as the logic. In bigger ērikovils, the amjākrama is nearly valid.

(b) Structural forms. Padmapduka is an optional element. It is found only in one ērikoval. Upapeta is also an optional element. Only five ērikovils are having upapetas. The projections of upapeta are found to be around 40 cm in four
cases. In one case the projection is 165 cm and it serves as a covered verandah.

Most of the ñrikovils (90%) have the adhisñjas of pancavarga type (p¡duka, jagati, kumuda, gala and pati). Only one small ñrikovil has trivarga type and in one case, it has pancavarga plus valaru and kapota over the top pati. The heights of adhisñjas vary from 36 to 140 cm. The off sets vary from 6 to 40 cm approximately. The proportioning of the heights and projection of the sub parts of the adhisñjas also vary. Almost all ñrikovils have vedikas around ñrikovil, mostly with six divisions. Few big temples have separate vedikas for the projecting bhittalank¡ras. The bhittalank¡ras are simple, progressive and as per texts. The projections vary from 1/8<sup>th</sup> to the full width of the exterior walls. The bhittalank¡ras apart from aesthetics strengthen the walls. In 48% of the ñrikovils grevas and 48% of the ñrikovils valaru and kapota are provided.

Grevas help in attaining height and valaru, kapota apart from aesthetics provide
additional space for accommodating the members of the ceilings. The roofs are of timber with tiles or copper sheet coverings in most of the cases. Combination of tiles and copper sheeting are also found. RCC roofs are found in 19% of ērikovils, which are found in renovated ērikovils. It appears that Vjstu experts and tantris are amenable to the use of modern materials. Out of 21 ērikovils three have no stēpis. The number of finales varies. There are one stēpi each (24%), two stēpis (5%) and three stēpis (57%) found on ērikovils. Almost all ērikovil roofs have elegant nīsikas except the nīsikas provided in RCC roof.

About 48% of temples have viṅkāambhas with level plates and bālakētas. Apart from architectural beauty these members provide supports to the overhangs of the rafters. In 4 ērikovils wooden trellise works out side the outer walls were found which function as protection to the murals and serve as depamīla and
alankira. The trellise works also support the overhangs of rafters as secondary function.

(c) **Construction materials.** Most of the temples (95%) have granite adhisñinas and parts below. The walls are of laterite in most of the ñrikovils and few are of brick constructions. About 24% of main doors are also found to be of granite. Bhittalankiras are provided with the same materials used for walls. Sopinas and prinalas are found to be of granite. Roofing materials are of copper plates (66%), or tiles (15%). RCC (19%) roofs were found in renovated ones. Ceilings are provided with timber. Turavus are provided by corbelling of stones/bricks.

Only time tested, strong and durable materials are used in the constructions of ñrikovils. RCC has been a new trend. Use of time tested, strong and durable materials may be one of the reasons for the long life of ñrikovils.

9.6 **Findings from Chapter- 7 (Presentation of Data, Analysis and Inferences).**
The findings are grouped under the different headings.

9.6.1 Interviews with tantris and Vjstu experts.

There are number of common information from tantris and Vjstu experts.

The findings are clubbed together to avoid over lapping and repetitions. The weighted averages are adopted in the findings. The findings are:

(a) The percentages of ērikiṟvils with Viṭu, áiva and āakti pratiñātas are very nearly equal, 28%, 26% and 32%. Others account for 14% indicating existence of no separate cult. However, tantris expressed the views that the circular ērikiṟvils are dominated by áiva and apsidal ērikiṟvils by áiva and āasta.

(b) The weighted averages of 7345 ērikiṟvils (Table 4.1) and 2837 ērikiṟvils (Table 7.2) indicates that 14% of ērikiṟvils are more than 1000 years old, 36% between 500 and 1000 years old, 39% less than 500 years old. The antiquity
of about 11% of temples is unknown. The indication is that majority of the temples are five or more centuries old.

(c) The weighted averages of the plan shapes of 7226 ārikovils (Table 4.12), 2837 (Table 7.3.2) and 3251 (Table 7.4.1) are found to be (i) square 76.8%, (ii) rectangle 11.4%, (iii) circle 11.1%, (iv) apsidal 0.5% and others 0.2%. Nigara type (square and rectangles) dominate with (about 88%). Vesara type (circle) about 11%. Other types are hardly 1%.

(d) The weighted average of 2837 ārikovils and 3251 ārikovils (information from tantris and vjstu experts) regarding the shape of garbhagāhas are (i) square 98.3%, (ii) apsidal 0.5% and (iii) only 0.2% are different from these.

(e) The weighted averages of 6435 ārikovils (table 4.12) and 2837 ārikovils (Table 7.2.4) workout to be (i) single storeyed 86.3%, (ii) two storeyed 13.4% and (iii) only 0.3% three storeyed.
(f) The bhittialankiras are progressive in nature from simple bhithikkal to complex alankiras according to the sizes of the ñrikovils.

(g) The main reasons found for the long life of ñrikovil by the two groups in common are: accurate designs, adherence to Vjstu principles, peculiar plan shapes, gradual and careful constructions, proper proportioning, use of strong materials, strong constructions and timely repairs. Some more reasons given which evoke thinking are çradha in every aspect, the stalamahítmya, belief of devotees, routine worships, festivals and the protections given by príkiras.

(h) The principles adopted in the planning, design and construction are based on the Vjstusastra, the tradition, local practices, guru upadśa and logic. However, the desire of the owner, the capabilities of the çilpins and the culture of the society also play dominant roles in the temple architecture.
(i) The influences of other states in the structural spaces and forms of Kerala ĵrikovils are limited to borders of Tamil Nadu and Karnataka. The influences are in the form of garbhagžha, ĵikhara and alankýras. Many Vįstu experts are in favour of certain adoptions with in principles of Vįstusįstra and ğgamas.

(j) The general state of maintenance of ĵrikovils has been graded as poor, fair, good and very good in the order of ranking. Temples with poor income are generally ignored.

(k) The plan shapes and spaces provide the base for the structural spaces and forms. The styles in pure and combinations reflect the culture and form of worship.

(l) The peculiarities of apsidal ĵrikovils are basically the plan shape, the three dimensional aspects, alankýras, predominantly same shaped garbhagžhas,
difficulties in construction, lack of axial symmetries in the vertical and lateral directions and dominated by áiva and áasta pratiÁtas (case studies confirm these peculiarities)

9.7 Findings from the Interviews with Engineers.

(a) Engineers expressed thoughtful and pragmatic views, yet showed reverences to the concepts and principles of vystusastra, especially in the case of temple Árikovils.

(b) There are definite relations with the horizontal shapes, structural spaces and forms of Árikovils, which contribute to the durability of temple Árikovils.

(c) The scientific designs based on the suitable shapes and spacial structures, gradual and strong construction, high quality control, close supervision, use of strong materials, use of time tested preservatives, periodic maintenance and
repairs contribute towards the durability of ěrikovils. The location and selection of site have bearing on the durability. Pṛkaras provide protection to ěrikovils.

(d) The special geometry, reduction of plan sizes and heights at higher storeys bringing the higher mass at the base, axial symmetries and strong foundation contribute towards the sustainability and stability of ěrikovils.

(e) Divergent views were expressed by engineers on the modernisation in the planning, design, construction, project management, methodology in construction and material selection. Few felt that the time-tested procedures are to be continued. Others are in favour of changing with the technological age and modernisation.

(f) The engineers projected strong views on the integration of vįstu concepts, cannons, principles and practices with modern engineering and technology. The temple ěrikovils are to be built with the aim of nearly zero maintenance. They
felt the need to train the traditional artisans in the state of art of temple constructions/maintenance.

9.8 Findings from the Site Visits and Discussions.

(a) There is strong need to document the temples including structural details.

(b) Varieties in the ğrikovils are attained through variations in the horizontal and vertical spaces and forms through the flexibility offered in the designs and constructions.

(c) Gajapraста ğrikovils represent the combination of Nāgara and Vesara traditions and combination of satva and raja gunas.

(d) There is a need to unify and standardise the many types of kols, preferably to the kisku (24 Angulas, 72 cm in length).
(e) The varieties brought uniqueness to each temple श्रीकोवि. Yet, among the
diversities the unity in the concepts, principles and expressions prevailed.

(f) The points emerged during site visits and discussions may read in connection
with the findings to know the range of views and varieties on ground.

9.9 Findings from the Engineering Discussions.

The engineering discussions add new dimensions in the approach to the study.

The discussion under the headings of structural spaces, structural forms, and
materials of constructions, factors contributing towards the sustainability,
strength, stability and durability of श्रीकोविलs, structural characteristics of apsidal
श्रीकोविलs and strengthening measures against seismic effects bring out the
engineering visions and foresights of the ancient विज्ञान experts. There are विज्ञान
concepts and principles, which coincide with the modern engineering. It appears
that certain concepts of विज्ञान are deductive and inductive as they are
interrelated. All discussions have their own relevance. Certain common findings are given below:

(a) The structural spaces, both horizontal and vertical through regular shapes, spaces, proportioning, sequential supports, axial symmetries, strong base and foundations, strengthening by lateral supports and secondary elements contribute substantially towards the strength, stability, sustainability and durability of ķrikovils.

(b) Selection and use of time tested strong and durable materials, gradual constructions, high quality control, use of preservatives, timely maintenance and repairs, proper up keep, constructional details avoiding irregularities and projections individually and in combinations help in the long life of ķrikovils.
(c) The elements of the form apart from providing architectural and aesthetic beauty and creating uniqueness in several cases serve as secondary structural members providing strength, stability and sustainability to ¿rikovils.

(d) The concepts and principles of designs and constructions to resist wind load and seismic effects are inherent in the designs and constructions of ¿rikovils.

(e) The apsidal ¿rikovils have all of the above features except the symmetries of the axes about the orthogonal directions.

(f) The system processes (sub system and system) and integration of the elements into the whole are evident in the design and construction of ¿rikovils. Pre-engineering the whole programmes of design and construction requires special mentions.

(g) The vįstujastra and vįstu experts are more or less amenable to the adoption of new technologies, methodologies, practices, project management and work
methods with in the frame work of the 

v\textit{stu} concepts cannons, principles and\n
practices. Engineering need to be integrated into the system and evolve unified

approach to the planning, design and construction with improved accuracy,

speed economy and splendor. It needs full appreciation for what has been done

in the past by our ancestors.