

XII. ENGINEERING

THE SOUTH INDIAN TEMPLE—MEDIUM OF CONSTRUCTION

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A study of the medium employed in the construction of ancient South Indian temples is an important aspect which has not hitherto received adequate treatment. The size of a temple is largely dependent upon the building materials used in it. The earliest rock-cut caves of the Pallavas at Mahābalipuram and a number of other places are small and not very deep, their plan being simple, and sculptural decoration kept to the minimum. This is in contrast to the Western Indian and other caves which are large in proportion, relatively elaborate in plan and contain more sumptuous plastic embellishment. The reason for this difference lies in the tractability of the material tackled; while the stone available in the Tonḍaimaṇḍalam area is hard granite, easily quarriable varieties of stone are available in the other regions.

When the Pallavas stopped the rock-cut technique and resorted to the structural medium, their choice fell on sandstone obviously due to the lack of sufficient competence of the workmen in stone cutting. Granite was used as reinforcement only in a part of the plinth. All the well-known Pallava edifices like the Kailāsanātha and Vaiḥaṅṭha Perumāḷ temples at Kāñcīpuram and the Shore temple at Mahābalipuram are built of sandstone. Ere long, however, all-stone temples make their appearance thanks to the beginnings made by the Pāṇḍyas of the deep south. A large number of small temples built entirely of stone in the Pudukkōṭṭai region of the Tiruchirappalli district are perhaps the earliest extant Pāṇḍya or Muttaraya temples. The Cōlas who replaced the Pallavas in the last quarter of the ninth century soon adopted the stone medium and by the beginning of the tenth century granite was the standardized material for the construction of temples. The Virattāneśvara temple at Tiruttai, built under the last Pallava ruler Aparājita, was actually constructed in the early tenth century and is built of a black variety of granite.

The Cōla rulers not only built temples of their own in granite but also rebuilt old brick temples in granite. Sembiyan Māhādevi is credited in inscriptions with the rebuilding of many such shrines. However, a few interesting examples of brick temples have survived to this day like those at Erode, Veḷḷalūr, Vijayamaṅgalam, Nāṅgūr, etc. Even when brick was dispensed with as a medium, its use for building the superstructure over the vimāna, the gopura and some other parts of the temple complex was continued. In the larger temples of the Cōlas like those at Paḷaiyārai, Tanjāvūr, Gaṅgaikoṇḍacōlapuram, Dārāsūram and Tribhuvanam granite is the medium proclaiming thus the technical competence attained in the use of hard varieties of stone for constructional purposes in the Cōla period.

Though architecture is broadly definable as a branch of fine arts having for its object the production of edifices pleasing to a cultivated and artistic mind, it falls primarily within the realm of science. The principles of

construction and engineering employed in building ancient temples and the way in which these structures were designed to support weight or counteract thrusts are capable of being categorized as scientific. In fact, the countless numbers of temple structures that dominate the landscape in many parts of India—and more particularly in South India—are as much marvels of civil engineering when considered in the context of their age as they are happy indices of their artistic nature. One of the factors that has got a vital bearing on the construction of these ancient structures is the material in which they have been constructed. This paper aims at a discussion in outline of the materials tackled or employed in the Tamil country in its architectural enterprises.

A study of the chronological sequence of the architectural monuments in the Tamil country when compared with those in other parts of India is indeed interesting especially when considered in the light of many ancient literary references to structures, both secular and religious in the area. The earliest extant known monuments in the Tamil country are the rock-cut caves excavated by the Pallava ruler Mahēndravarmaṇ I (A.D. 610–630) at Maṇḍagappaṭṭu, Pallāvaram, Mahēndravāḍi, Māmaṇḍūr, Tiruchirāppalli, Śiyamaṅgalam, Vallam, etc. It is held that the cave temple at Maṇḍagappaṭṭu is the earliest of this group wherein there is an inscription of Mahēndravarmaṇ (who bore the title 'Vicitracitta') running thus: 'This brickless, timberless, metalless and mortarless mansion of Lakṣita was caused to be made by king Vicitracitta for Brahmā, Īśvara and Viṣṇu.'¹ This inscription has been interpreted to mean that Mahēndravarmaṇ was the initiator of the rock-cut technique in the Tamil country as he declares himself to have deviated from the use of conventional building materials like brick, timber, metal and mortar. However, the rock-cut technique was already known to the Tamils of the early centuries of the Christian era as may be gleaned from literary references in the *Śaṅgam* classics like the *Neḍunalvāḍai*² and the *Ahanānūru*,³ though intriguingly the extant examples do not antedate the reign of Pallava Mahēndravarmaṇ.

The real importance of the Maṇḍagappaṭṭu inscription lies in its enumeration of the varied materials employed in building. In the absence of surviving examples, we have only to presume that in the ages preceding the ascendancy of the Pallavas of the Mahēndra line, brick, mortar, timber and metal were the primary building materials, the use of stone being confined to funerary monuments. In the *Śaṅgam* classics like the *Paṭṭiṇappālai*, *Maduraiikkāñji*, *Perumbānūrrippaḍai*, *Ahanānūru*, etc., and in the much later *Śilappadikāram* there are descriptions of cities like Puhār, Maḍurai, Uṇṇaiyūr, Kāñci and Karūr mentioning temples (*Kōṭṭam*), palaces (*kōyil*), mansions (*māḍam*) and ramparts with tall gateways ornamented with painted stucco figures. Bricks, timber and mortar must have been extensively used in the construction of these huge structures. Brick in early times was perhaps a

more favoured medium rooted, as it was, in the early Vedic practice of making sacrificial altars. The smallness of its size and its amenability to variations in external mouldings were also significant factors. In the Śātavāhana kingdom in the region immediately north of the Tamil country the brick medium was adopted for Buddhist architecture as at Goli, Amarāvati, Nāgārjunakoṇḍa, etc. The Gupta brick temples at Bhitargoan and other places in North India are too well known. While the Gupta recourse to the brick medium in North India can be explained as due to the absence of adequate stone material in those regions, the persistent use of the same medium in Āndhradeśa which is rich in rock material is indeed rather puzzling. Probably this has to be ascribed to the influence of the traditional use of brick by the Buddhists in the region.⁴ Though no pre-Pallava monuments have survived in the Tamil country or at least in the Tonḍaimaṇḍalam it is not difficult to presume that what was true of Āndhra was equally true of Tamilnād. In fact, we have a description in the *Ahanāṅṅūru* of a dilapidated brick temple in which wood was used for rafters and perhaps also domes and vaults.⁵

Before the replacement of the brick medium by stone there was a short-lived phase of 'rock architecture'. The cut-in caves and cut-out monoliths are imitations of contemporary brick and wood architecture in all their intricate details. The logical extension of this simulation is seen in the faithful reproduction of every detail of the original brick and timber structures including those 'parts or members which in a monolith would be unnecessary and functionless, such as the ribbing below the cornices and caves, the nails with their boss-heads and the timbering and curved rafters below roofs, domes and vaults.'⁶ The centres of Pallava rock-architecture mentioned above represent this trend. However, there were a few centres outside the peripheries of the Tamil country where foundations of structural architecture with the stone medium were slowly being laid to be followed later with vigour at the expense of the rock-cut medium. Examples of this are to be found at Aihole, Nachna, Deogarh, etc., all of which are assignable to the sixth century A.D. There is no extant evidence to show that structural temples in stone were built under Mahēndravarman and his son Māmalla Narasiṃhavarman, though a few standing pillars in the typical Mahēndra style—and one of them with inscriptions of Mahēndra—have been found inside the compound of the Ekāmranātha temple at Kāñcīpuram. This along with similar pillars at Tiruppōrūr with inscriptions of Rājasimha (A.D. 685-728) attest to the prevalent mode of *maṇḍapa* type of structures for worship with probably a brick or wooden superstructure. It is possible that the so-called 'Rathas' at Māmallapuram are only rock-cut imitations of the already current structural forms. The Pāṇḍya monolith at Kaḷugumalai may also be classified with these.

It is necessary to indicate here the technique employed in the excavation of rock-cut caves and monoliths. In the latter the excavation started, as was necessary, from the topmost member of the elevation and proceeded downwards. As the rock tackled was hard the materials used for scooping out were hammer and chisel. Unfinished excavations at some places are indicative of the method of excavation which has been described thus: Initially, the chosen face of the rock was cut into an appropriate depth till a vertical scarp of the desired height could be obtained; sometimes such cutting into the sloping face of a rock extended in depth to more than 12 to 15 feet at the bottom and a comparatively lesser distance at the top. In these rocks, which have a straight cleavage, this was perhaps done, as it is done today, by jumping with hammer and chisel a line of wedge-shaped holes about 1 in. square and as much deep at short intervals. A number of flat-edged iron wedges (*āppu* in Tamil) of the same thickness were inserted into these holes and driven in with a heavy hammer; thus the strokes made all the wedges in position. The pressure and, to some extent, the concussion of the enclosed air split the rock to a considerable extent downwards, which could thus be removed in sizable pieces. Having obtained the desired surface of suitable dimensions, the actual quarrying was made by blocking out the face of the prepared scarp into large squares of about 2 feet and cutting grooves all round the squares to a depth of about 2 to 3 in.; so that the squares themselves projected out as reliefs. The projecting material of these squares was then subsequently chiselled off by lateral and centripetal strokes starting from the grooves all round and reduced to the level of the peripheral grooves. This process was repeated.⁷ The excavators while quarrying left the positions of pillars to be worked later.

The rock-cut technique, started by Mahēndravarman and vigorously continued by his son and successor Narasiṃhavarman I, was soon given up in preference to the structural medium. The varieties of rocks available in the Tamil country such as granite, charnockite and gneiss are harder and relatively less tractable than those in other parts of India and this factor, more than anything else, contributed largely for giving up the rock-cut medium. Already in the seventh century this transformation to structural medium had begun as is implied in the Śīṅṅambākkam inscription of Paramēśvaravarman,⁸ the son and successor of Narasiṃhavarman I.

The spurt that was thus given to structural architecture not only spread wide but was to remain almost to the end of the Pallava period. Paramēśvaravarman's son Narasiṃhavarman II, also known as Rājasimha, built the famous Kailāsanātha temple at Kāñcīpuram, Tālagiriśvara temple at Paṇamalai and the Shore temple complex at Māmallapuram. It is noteworthy that in all these early structural enterprises sandstone was employed, the use of granite being confined to a part of the plinth. This is true of the

later Pallava temples like those of Vaikuṅṭhanātha, Mukteśvara, Mātangeśvara, Iravātaneśvara, Airāvateśvara, Tripurāntakeśvara, Piravātaneśvara at Kāñcīpuram besides similar small temples at Sumaṅgali near Kāñcīpuram and Tiruppattūr in the Rāmanāthapuram district. Though the architects of the Pallava period were able to quarry large blocks of stone and excavate caves and monoliths they had not attained even as late as the eighth century sufficient technical proficiency and experience in building structures in granite but only preferred the more easily workable sandstone. The Vīraṭṭāneśvara temple at Tiruttani, constructed during the eighteenth year of Aparājita, the Pallava tail-ender is, of course, a structure in granite but it is datable in the tenth century by which time the use of granite for building the entire structure from the *upāna* to the *stūpi* had already become sufficiently spread.

The earliest all-stone temples are those in the Pudukkōṭṭai region in the present Tiruchirāppalli district, many of which were until recently considered to be of Cōla origin but are now categorized as of Pāṇḍya or Muttaraiya origin. These include the shrines at Paṇaṅguḍi, Kaliyappatti, Tiruppūr, Viśalūr, Enādi, etc. All the temples are small in size and have only one storey (*ēkatala*). Side by side with these all-stone temples we also come across almost contemporaneous constructions in brick and stone. The Saptarṣīśvara temple at Lālguḍi is one of the best extant examples of this kind. In this stone is employed only in the ground *tala* and the superstructure over the entablature, whether it is square or circular in shape, is of brick. All these are datable in the second half of the ninth century which formed the most important period in the history of South Indian temple architecture as it witnessed very fruitful experiments in architectural models in the new and challenging medium of stone, and which laid the foundation for the architectural development of the succeeding centuries.

Cōla Āditya I, who ascended the throne in about A.D. 871, not only delighted in political conquests but also took care to perceive the contemporary trends in architecture. The Anbil plates of Sundara Cōla aver that Āditya covered the banks of the Kāveri along its course from Sahyādri to the sea with temples for Śiva.⁹ Many temples in the Cōla country with inscriptions of Rājakēsarivarman identified with Āditya were undoubtedly erected during his period, though it is possible that some of them were rebuildings of original brick structures. There are many inscriptional references to such rebuildings and the pious Śembiyaṅ Mahādevī, mother of Uttamacōla, rebuilt a good number of brick temples. By the time of the period of Rājarāja I (A.D. 985–1014) granite stone had completely replaced brick, though a few old brick structures were left as they were, without attempting to rebuild them. The best surviving examples of these are the Mahimaleśvara shrine at Erode and the temples at Vellaḷūr and Vijayamaṅgalam—all in the Koṅgu country built obviously by the Irukkuvēl chiefs. The temple at Nāṅgūr in the Siyali taluk,

Tanjore district, is an extant brick temple in the Cōlamanḍalam. The Gaṅgas ruling to the north-west of the Cōḷa kingdom specialized particularly in the all-brick tradition and continued that medium for a longer time than others in the south, evidently because of the absence of suitable stone in some of their areas.

The all-brick tradition was almost practically dispensed with in the Tamil country after the tenth century. However the use of brick for building superstructure, *gopuras* and other parts of the temple complex was continued. Technical competence in dealing with granite which was found wanting in adequate measure in the middle of the ninth century was attained in such a measure by the close of the tenth century that we find Rājarāja building the Bṛhadīśvara temple at Tanjore—a structure with a massive pyramidal *vimāna* rising to a height of about 190 feet over the sanctum. To be considered along with this temple in this respect are the Bṛhadīśvara at Gaṅgaikoṇḍacōlapuram, Airāvateśvara at Dārāśuram and Kampahareśvara at Tribhuvanam built respectively under Rājendra I (A.D. 1012–1044), Rājarāja II (A.D. 1146–1173) and Kulottuṅga III (A.D. 1178–1218)—all huge structures involving the use of large slabs of granite for all the six elevational limbs of the structure, viz. *adhīṣṭhāna* (basement), *bhitti* and *kudyaṣṭhambha* (walls and columnation), *prastara* (architrave), *grīva* (clerestory), *śikhara* (roof) and *stūpi* (finial). In the later Cōḷa and Vijayanagar temples which have wide *prākāras* and many subsidiary structures like *maṇḍapas* and a large number of secondary shrines and chambers, we find a logical extension of the use of granite already started in the ninth century and developed under Rājarāja I.

Mention should also be made here of the use of perishable materials like wood and stucco for the making of icons for worship in temples before the advent of stone for this purpose. Even today the principal images in many temples are made of stucco, e.g. the Raṅganātha in Śrīraṅgam and Anantapadmanābha in Trivandrum, or of wood, e.g. in the Viṣṇu temple at Tirukkoyilūr and the earlier icon of Attivaradar in the temple of Varadarāja at Kāñcīpuram. Perhaps the Āgamas were partly responsible for the making and worship of wooden and stucco images as some of them stipulate the use of such wooden images and give elaborate descriptions of them.

REFERENCES

- ¹ *Epigraphia Indica*, XVII, pp. 14–17.
- ² *Kuṅṅukuyiṅṅaṅṅa-ōṅṅunilāvāyūl, Neḅunalvāḅai*, 1.88.
- ³ *Varai-kuyiṅṅaṅṅa vāṅṅōy neḅunagar—Ahanāṅṅuru*, 93, 1.12.
- ⁴ Soundararajan, K. V., *Architecture of the Early Hindu Temples of Andhra Pradesh*, p. 2.
- ⁵ *Ahanāṅṅuru*, verse 167.
- ⁶ Srinivasan, K. R., *Cave Temples of the Pallavas*, p. 29.
- ⁷ *Ibid.*, pp. 26–27.
- ⁸ *E.I.*, Vol. XXXII, pp. 199–20; *ARIE.*, 1947–48, No. 83.
- ⁹ *Epigraphia Indica*, XV, p. 44.