CHAPTER - III

CONSTRUCTIONAL METHODOLOGY

Texts on Hindu architecture, prescribe an almost identical constructional methodology for building the houses of gods. These methods are traditional and orthodox in character and are based on long experience. All the procedures to be followed meticulously are described in these texts. However, one may find slight procedural differences between the texts. However, Kāśyapaśilpa provides a clear and coherent account of the procedure to be followed in the constructional methodology of the temples. Hence, based on the information given in Kāśyapaśilpa and also on the basis of existing ruins of the temples an account of the important procedure to be followed in the construction of temples is explained briefly here.

The first procedure to be followed in the construction of any building is the fixing of the orientation\(^1\). The procedure to be followed here is the fixing of the gnomen\(^2\). This has to be done at sunrise. On the prescribed auspicious day\(^3\), in the morning, the gnomen should be erected. It should remain in place till the evening. The gnomen should be erected always on a perfectly leveled ground. The ground should be at least four cubits wide (6 feet) on all the sides. With the help of the shadow of the gnomen all the different directions of the area are to be marked till the evening.

The Text mentions two types of soils i.e., *snigdha* (hard) and *asnigdha* (soft)\(^4\). If the soil is hard the foundation pit of about three feet has to be dug. If the soil is soft, the pit has to be dug till the hard ground is reached. The foundation pit should be always six feet bigger on all the sides than the structure to be built. But the general practice followed is to dig to a depth of six feet, irrespective of the nature of soil found. After the pit is dug, thick or coarse sand should be filled to a height of about one foot and it should be beaten well with rammers and should be neatly leveled like the surface of the mirror. On this
leveled ground, the six important contour lines of the drawing of the building should be marked on the ground. These lines are called ‘śūtraśatka’ (the six lines)⁵. These lines are concentric lines. They are –

i) **mānasūtra**: The line that corresponds to the line of the wall above.

ii) **vinyāsasūtra**: The line that corresponds to the projection of the upper most line of the plinth.

iii) **adhiśṭhānasūtra**: The line that corresponds to the projection of the lowest moulding of the plinth.

iv) **upapīthasūtra**: The line that corresponds to the upper most and the lowest projections of the plinth.

v) **hōmasūtra**: The line that corresponds to the outer line of the bed slab below the upapīṭha.

vi) **pratyavasānasūtra**: The line of the trench.

Over this ground marked with lines, a layer of bricks has to be laid. This brick course is called **prathamēṣṭaka**⁶. The bricklayer should extend over the entire area of the building, including the outer line of the vinyāsasūtra. The brick should be raised in courses like a hand-wall covering the area between the mānasūtra and the hōmasūtra all-round the building thus making two clear-cut divisions in the foundation pit. The outer portion of the brick wall should be filled compactly with boulders of different sizes. The lowest one normally contains bigger boulders, while the size gets reduced gradually towards the upper portion of the pit. The inner part of the brick wall has to be filled by sand or similar mixed material.

Before filling the inner portion of the brick wall clear-cut locations of the pillars are to be fixed in the interior⁷. In these marked places, **nikhāṭastambhas** should be erected. Nikhāṭastambhas are hidden (buried) stone shafts which stand as support for the bases of the pillars found in the centre of the hall or the
pavilion. The height of the *nikhātastambha* corresponds to the level of the paved stone slabs of the floor of the interior. The surrounding places of the *nikhātastambha* (pl-258a) are to be filled by sand or similar material.

*Bhadraka* pillars (engaged columns) partly embedded in the wall are made to stand on the upper most slab of the plinth. In case the plinth is also built out of bricks, the *bhadraka* pillars are also provided with *nikhātastambhas*. *Bhadraka* pillars invariably possess a monolithic shaft. But shaft of *bhadraka* pillar made of two pieces of stones placed one above the other is also noticed\(^8\) (pl-259).

Over the surface of the hand wall of the bricks, bed slab is placed. This bed slab covers the area between the inner line of the *mānasūtra* and the outer line of the *hōmasūtra*.

Another method of preparing the ground for the construction of the temple is also noticed in the area of our study\(^9\). Here, the temple is built over a sheet of bedrock. As the upper contour of the bedrock is not uniform, the surface of the rock itself is cut and dressed, to make it uniformly flat all-round (pl-260). Over this surface the *janman* (bed slab) is placed and the plinth is constructed. Above *janman* the mouldings of the plinth, according to the lines of the *sūtras* are placed.

**WALLS:** The walls of the temples of south India are built in a particular method, which appears quite strange in the light of the modern technology. The texts mention that the walls should be constructed using stone or wooden *phalaka* i.e., stone or wooden slabs. Texts do not mention that they should be built of stone blocks. The wall is built in two parallel layers maintaining a specific thickness (pl-261). The thickness of the wall is more in the *garbhagṛha* portion as it is required to support the heavy weight of the *prāśāda* built above. The inner face of the wall is generally plain and simple. It consists of slabs neatly dressed on its face and four sides, while its back portion is normally undressed and rough. These slabs are generally long enough to cover the inter spaces between the two
bhadraka pillars. The slabs are placed horizontally, one above the other, without leaving even a little gap in between.

While placing the stone slabs in courses all-round the structure, the architect adopted the swastika pattern, to join the slabs at the corner (pl-262). The swastika is one where the slabs at the corners are laid in such a way that the end of one slab is kept against the side portion of the side slab. In this joinery, always the clockwise direction is maintained. This procedure is followed throughout the inner surface of the temple and sometimes also on the outer surface.

Inside the garbhagrha and antarāla shelf slabs are also placed at the required height according to necessity. The outer face of the wall is generally made of thicker slabs. They are also placed horizontally one above the other. Necessary carvings of pilasters and relief sculptures are generally made after placing the slabs in their place in the wall. The outer slabs also have rough surface on their backsides. Two parallel rows of stone slabs, for inner and outer faces of the wall, are kept leaving some empty space in between. This empty space is filled compactly by a mixed material (saṅkīrna) like mud, sand, lime, mortar or any other type of structural debris. To prevent the separation of two parallel slabs of the wall, at required places, particularly at the doorway portions, niche openings, etc., stone slabs common to both the faces of the wall, as locking stones to hold the inner and outer layers together, are also used (pl-263). After building the wall to the required height, a horizontal slab covering the entire thickness of the wall and the ceiling is placed above thus finally holding the two parallel lines of the wall together. This slab is called as the pracchādana slab. This is placed above the course of kapōta. This is also the ceiling slab of the building. The exposed face of the ceiling slab, on its sides will not be uniform throughout. Therefore, to make it appear uniform another piece of dressed and decorated stone is kept, all-round the course of the ceiling slabs of the structure. This is found all-round and above the kapōta. This slab is called by the name
prachādanasya āṣya i.e. the face of the ceiling slab. The architectural term for this slab is vājana.

Occasionally, walls constructed out of a single layer of slabs are also noticed. In such cases, in the interspaces of the bhadraka pillars, stone walls are built. The slabs thus kept are generally plain and devoid of any carvings. This type of a wall is built for structures, which lack liberal patronage (pl-264).

JĀLAVĀTĀYANA: Jālavātāyanas are architectural components of the temple fixed into the wall (pl-265) or any other portion of the building as required by the architect. Jālavātāyanas provide dim light and air in to the interiors of the temples. jālavātāyanas are called by the names jālaka and gavākṣa. Though no constructional methodology is found used in the preparation of the jālavātāyanas, it is necessary here to write a few sentences about them, as there is no uniformity followed in their preparation. Jālavātāyanas are fixed into the structure at the places specifically provided for them. Generally square or rectangular openings are made in the wall while building the temple. This opening is common to both the inner and outer layers of the wall. Therefore, the core of the wall is also neatly covered with dressed stone. Into the opening made in the wall a jālavātāyana, carved out of single stone slab, is firmly fixed into the central part of the section of the wall without leaving any gap in-betwenn. As decorative foreground, for these jālavātāyanas, architectural designs are carved on the wall surface of the bhitti in the form of a tōraṇa. Sometimes, without the tōraṇa also the jālavātāyanas are fixed in the opening.

The Nolamba artists were experts in the carving of the jālavātāyanas. They took the inspiration from the Badami Chalukyas, modified and improved certain aspects of the jālavātāyanas, and prepared some of the best-known jālavātāyanas. Rajendra Chola, a great connoisseur of art, took away, as war trophies, several of the Nolamba jālavātāyanas from the Nolamba temples and one of them is still found installed in the Brihadishwara temple at Tanjore.
In the carving of the *jālavātāyanas*, the Nolambas adopted two different methods. They are:

i) The slab consisting of the *jālaka* in the middle with all the decorative details of an architectural niche carved in the slab itself.

ii) *Jālakas* with an ordinary frame without any architectural decorations.

The subjects of the *jālakas*, of the Nolamba art, are varied in nature. Generally, they are of two types.

The first type is the one where, the subject of the *jālakas* is meandering creeper scrolls. The loops of the creeper scrolls are filled with tender leaves, sprouts, flowers, fruits and also the tiny figures of the musicians and dancers, etc.

The second type is the one, where the subject of the *jālakas* is either divine or worldly. Sculptures of divinities like Brahma, Vishnu, Shiva, Durga, Kārtikēya, Ganga and others carved. The spaces left out of the figures carved on the slab were perforated for ventilation.

For the carving of the *jālakas* the Nolamba artists used greenish blue basalt, a fine-grained stone. The carvings made out of this stone are not only attractive for its colour but they are also ideal for intricate and crisp carvings.

*KAPŪTA*: The *kapōta* (dripstone) slab is placed projecting from the plumb line of the wall. *Kapōta* is formed of a thick slab, sometimes hollowed in the lower portion from the point it projects out. *Kapōta* is generally formed of one slab and no additional course of stone slab is used to form the *kapōta*. However, in rare instances additional pieces of stone are used above the *kapōta* to carve the *kīrthimukhas* above the *nāsis* on the *kapōta*.

In the dravidian architecture two types of *kapōtas* are noticed. The first type is thick and heavy, sloped on the top and flat or hollow at the bottom. The
section of this kapōta is like a quadrant or quarter circle. The common type of decoration found on this type of kapōta is the nāsi, carved at regular intervals. This type of kapōta is found all-round the structure wherever the bhitti is found, in the pre-12th century temples. This type of kapōta is used even for the mukhamantpas. This type of kapōta is described as the kapōta of the first type.

The second type of kapōta is broad and slim and it is double flexured. Its section looks like the shape of the elongated English letter S. Its soffit is often decorated to appear like the under part of the wooden framework of a tiled roof. This type of a broad kapōta is regularly used for the open pavilions of the temples of the medieval period, though occasional use of this type is noticed in early temples also.

CEILING: The ceiling of the temples and pavilions are constructed variedly. Generally they are built out of stone slabs, dressed neatly at the bottom and at the two sides. Horizontal slabs are placed neatly above the architraves side by side without leaving any gap. The upper portion of the stone slabs is filled by lime mortar to make the ceiling waterproof. The early method of making the ceiling waterproof, as seen at the Ladkhan temple at Aihole, is not noticed anywhere in the area of our study.

The second type of ceiling generally noticed is called as the nābhicchanda roof. Nābhicchanda means a roof that looks like the formation of the ‘nābh’ (naval cavity). In this construction, slabs of smaller lengths are placed diagonally to the lower square of architraves, so that each course of stone slabs placed, covers a portion of the corner of the lower square. Layer-by-layer, the lower square opening is covered. Finally the central portion is covered by a coping, which sometimes is shaped like a funnel hanging like a pivot in the centre (266-269). This pivot is decorated variedly to suit the surrounding carvings. This is also called by the name lantern roof in European architecture.
During the Vijayanagara period, due to the influence of Islamic architecture, construction of buildings in brick and mortar became popular. In the construction of the temples also, the brick and lime mortar were used extensively. This resulted in the construction of brick prásādas above the grabhagrhas and the gateways. Some of the ruined temples of Hampi have clear evidence of the use of mixed material like stone for the structure, and brick and mortar for the prásādas. The use of brick and mortar, gave the architects a free hand to construct with ease lofty towers, without much labour. These constructions were quite strong to sustain the ravages of time and weather for quite a long period. Therefore, in the construction of low budget temples, brick and mortar were liberally used. The versatility of the soft medium also allowed it to be used along with the stone. Therefore, one can see the construction of part of the nābhicchanda made of stone and also of brick and mortar.

On the way to Hampi from Hospet, in an open field is the ruins of a temple. Only the sanctum part is remaining (pl-262). Though in a bad state of preservation, it is helpful for the understanding of certain aspects of constructional methodology. The outer layer of the stone wall of the sanctum is destroyed. However, the existing inner layer gives a clear picture of the method of construction of the inner wall and its joinery at the four corners, wherein the swastika pattern of joinery is achieved.

In the construction of the garbhagrha, nābhicchanda mode is used in the first two courses, using stone slabs (268). For the final and the central slab instead of a stone slab, brick and mortar slab is used. Only the remnants of this slab are noticeable at the corners. This is a deviation noticed in the constructional methodology and the use of saṅkīrṇa (mixed) material in the building of the same part of a structure.

The third type of ceiling is generally referred to by the name bhuvanēśvari in Karnataka architectural idiom. This is a type of ceiling built differently by
different architects. The first type is the one in which the ceiling is constructed in the nābhicchanda method using more courses of slabs. After constructing this, the inner portion of the nābhicchanda ceiling is designed and decorated like a dome with varied types of carvings. Though the Hoysalas ruled the region of our study, and built temples in the region, no specimen of a bhuvanēśvari is found.

One other method of constructing the roof is also noticed. But this is also not from the area of our study. However, as the method of construction is unique, it is described here. In this method, the ceiling is domical, but it is not constructed in the nābhicchanda method. Instead a series of rib like stone pieces broad at the base and pointed at the top are arranged side by side to form a dome. The outer portion is covered by lime mortar to make it water proof. The inner portion is carved with varieties of designs and decorations.

A very interesting and unique method of construction of the roof is noticed in the temples built at Hampi, the royal seat of Vijayanagara empire. Though these temples do not come under the region of our study, the fact that they are a part of the Vijayanagara style of architecture, itself is enough to get noticed here. Huge mantapas and similar halls constructed to the Achyutaraya temple (1530 A.D.) (pls 270,272) and the Pattabhirama temple at Kamalapura have this type of a roof. In the construction of the roofs of the broad central nave of the halls, this method is used. In this method the two colonnades that flank the nave support huge stone beams, placed above the opposite pillars across the nave. These stone beams are huge and sectioned like the inverted english letter 'T'. The two lower flanges of the parally placed beams, act as supports for the short stone slabs placed in-between the two beams. To maintain a uniform flat surface for the ceiling, these stone slabs are also sectioned in the shape of the english letter 'T'. The projecting flanges of the slabs sit on the correspondingly shaped flanges of the beam and the suspended part of the slab is leveled to suit the lower level of the T beams. The upper surface of the roof was made
waterproof by using lime mortar, and the lower part was plastered and even possibly painted with frescos.

This method of construction of suspended roofs is ideal for the spacing of wide naves of the temple halls. This method is nowhere noticed in the Texts on Hindu architecture, and the precedent to the use of this method is not found anywhere during pre-Vijayanagara days. Even huge halls of the Vijaya Vithala temple and Krishna temple at Hampi do not have this type of a roof. The date of construction of the halls of the temples, where this roof is constructed, is the middle of the 16th century. By this time, Karnataka had established contacts with the west, through European travelers. It is possible that this technology might have come from the west, where the architectural technology was in a more advanced state. If the surmise is proved right, it is to be appreciated that the Hindu architects were quite open minded to receive good ideas always, whatever be the source of their origin.

One more technology adopted by the Hindu architects is the use of arches in the construction of Hindu religious buildings. The use of arches, known sparsely in the ancient Hindu architecture, was a technique mastered by the Muslim architects. Muslim rule in India, popularised on Indian soil, the building of arches and domes, along with the use of fine quality lime mortar known to science of those days. Vijayanagara builders, influenced by the Islamic architectural technology, no doubt, liberal used arches and domes in the secular buildings they designed. But it was generally believed that this influence was limited to secular architecture only and was not adopted in the design of Hindu religious buildings. But the survey made by the author has revealed that Hindu architects who understood the advantages of arches, like easy method of construction, strength, stability, durability, economy of cost, etc., adopted the use of arches in their religious structures. The eastern gopura of the Vijaya Vithala temple at Hampi, built about 1445 A.D. has vātāyanas on both sides of its faces (pl 273). These vātāyanas are square openings made for ventilation of the tiers of
the gopura. The vātāyanas are provided with a stone lintel to take the load of the structure above. To reduce the load on these stone lintels, the architect has also built a shallow arch of brick, above the lintels for additional safety. From the said instances it becomes clear that Hindu religious architecture was influenced by both western as well as Islamic architectural technology, during the period of the Vijayanagara empire.

**PARAPET:** The parapet of the temple may be built out of either stone or brick and mortar. It is an optional member of the building. Generally the parapet is designed like a chain of miniature pavilions having śāla, kūta and pañjara canopies. Each of these miniature pavilions may be carved out of single blocks of stone and arranged in a row, or may be masonry in nature. All the architectural and sculptural details of an ornate pavilion are found carved on the outer face of the parapet. If it is of brick and mortar, the parapet is built out of bricks, plastered and decorated with lime stuccos suitably.

**PRĀSĀDA:** Above the sanctum of the temple, a superstructure in the Dravidian idiom is often constructed. This superstructure is called by the name vimāna or prāsāda, in the dravidian idiom. It is built in multiple tiers. The tower may be hollow or solid depending upon the choice of the architect. The medium of construction of the vimana also depends on architect’s choice. The tower consists of the following parts:

- i) tala/talas
- ii) vēdi
- iii) grīva
- iv) šikahara
- v) stūpi

In the hollow type of prāsāda, two varieties are noticed. The first one is the prāsāda, where hollow talas (tiers) are built one above the other in receding
size. A very good example to this type is the Vaikunthaperumal temple at Kanchi where three cellas of receding sizes are built in the three tiers of the prāsāda.

In the second variety, the prāsāda above the sanctum is built hollow from the ground level up to the bottom of the coping thus creating a big void inside. The Brihadishwara temple at Tanjore and Anantashayana temple at Anantashayanagudi (Karnataka) are notable examples to this variety of prāsādas. The second variety of prāsāda is difficult to construct and also difficult to manage because of the tall inaccessible interior wall surface. Therefore they are a few in number. The Texts also prescribe that if the prāsāda is built completely hollow inside, jālavātāyana should be provided at the grīva below the śikhara. The Anantashayana temple at Anantashayanagudi has two jālavātāyanas provided at the apex on the two narrower sides of the grīva. However, in the area of our study no prāsāda built hollow inside is noticed. As the hollow prāsādas are tapering in their interior also, corbel arch method is adopted in its construction (pl-274).

Vēdi is constructed like any other constructions in stone or brick and mortar, above the final tala of the prasada. The vēdi is a platform to support the grīva and the śikhara. Vēdi, on plan, always corresponds to the plan of the grīva and the śikhara. Exceptions to this rule are also noticed. The grīva and the śikhara are built above the vēdi. Grīva and śikhara may be monolithic or masonry. Above the śikhara a globular stūpi is placed. This stūpi is firmly placed at the top of the shikara with the help of a stone or metal dowel or tenon.

PRANĀLAS: Water drains, water chutes at required places, which are sometimes conventional or artistically decorated, are found fixed into the parapet wherever necessary to allow the rain water to drain out.

PRĀKĀRA: Prākāra wall of the temple is normally quite a massive structure. Because of its height, the base of the wall also will be broader. The prākāra wall
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is also constructed in two parallel layers, the interspace of which is filled with lime mortar or debris. The section of the wall is generally slightly battered. The prākāra is finally covered by a suitable coping. Instances of construction of prākāra solidly with blocks of stone are also noticed. Prākāra sometimes, served as defensive walls during the medieval period. they were also provided with moats on their outer side.

**GOPURA**: The method of construction of the gopura is almost similar to the construction of the main shrine of the temple. Here also, from foundation to the entablature, the method followed is one and the same. Gopura, in almost all cases, is provided with an upapitha. Occasionally double upapitha is also provided. Above the upapitha, the adhisthāna of the gopura is constructed. Generally, the pādabandha class of adhisthāna is preferred. Above the adhisthāna, the bhitti is built. This bhitti will have all the decorations found on the regular bhitti of the shrine. The bhitti may be single-storeyed or double-storeyed. In the double-storeyed base the lower storey is called adhōjaṅga and the upper storey, the ūrdhvajaṅga. In case the bhitti is single-storeyed, a prastara is built above the bhitti. In case the bhitti is double storeyed, above the bhitti of the first storey, a heavy kapōta of the first type is placed. Above the kapōta, vājana, gala and prati are built. Above this the bhitti of the second storey is raised. Rare instances of second storey having the details of full-fledged adhisthāna are also noticed.

The base of the gopura is always built in two parts, that is to say, on plan it will have two separate units connected with each other by a solid vēdi, which is generally hidden under the ground. In between the two units, quite a broad, stone paved pathway is provided. To this pathway, heavily designed stone doorframe is provided. To this doorway, huge wooden shutters are fixed. The doorways provided to the pathways may be single or double. If there is only one, it is provided either in the front or in the middle of the pathway. If there are two, one at the front or one at the rear end are fixed.
The two opposite sides of the base of the gopura are provided with two rectangular cellas, facing each other on each side of the pathway. They are always found above the elevated plinth of the bases. They are often provided with sōpānas to climb up. The cellas are also provided with one or two pillars on their façade. If the base is of two storeys, these cellas are also of two storeys. Provision of a sōpāna to go to the upper storey of the gopura is made through the cellas.

Above the strong base of stone, a multi-storeyed prāsāda of the gopura is built. The medium used for the construction of different talas of this prāsāda is of saṅkīrṇa type. Brick, lime mortar, wood and stone are used in the construction depending upon their necessity. The exterior of the talas of the gopura are decorated with rich architectural motifs, preceded by sculptures. The architectural motifs and sculptures are all prepared in lime mortar in the stucco method. The outer surface of the gopura and the sculptures are painted suitably.

The interior of the talas of the gopura is often roughly finished. The ceilings of the talas of the gopura are normally supported by wooden framework. Wooden staircases are provided inside to interconnect the talas. All the talas are interconnected from inside. Each tala of the gopura is provided with a pair of vātāyanas fixed in the center of the longer side of the tala, opposite to each other. They are not provided with any shutters. The intention of this is to provide ventilation to the interior of the tala and also for the inspection and maintenance of the gopura.

Above the final tala of the prāsāda of the gopura, a vedi is constructed. Vedi of the gopura is also rectangular on plan. Above the vedi, the grīva and śikhara are built. The shape of the śikhara is always of the sāla type. It possesses a wagon-vaulted body with two semicircular ends, i.e., mahānāsīs. Above the mahānāsi, a huge kirtimukha is designed. Adjoining the kirtimukhas on their backs at the extreme ends of the sāla, a pair of ‘cow horn’ like motifs are raised,
because of which, in all possibility, the name gōpura has been given to this structure. The interspace of the ‘cow horn’ cresting, above the ridge of the śāla śikhara, stūpis are placed in a row. The number of stūpis range form one\textsuperscript{17} to eleven\textsuperscript{18} or may be even more. The exterior of the śikhara is also decorated with complicated designs made out of lime stucco. The longer sides of the śāla may also have a mahānāsi, one on each side at the middle of the longer side.

It is also possible that during the Vijayanagara days, these huge towers served as watchtowers. They also served certain strategic purposes like the observation of the enemies. There was one more intention of the Vijayanagara builders, behind erecting huge gōpuras in front of the temples. Vijayanagara empire, as is known, was established to protect Hinduism from the invasion of the Muslim power. These huge towers, actually, were built to declare the strength, power and prowess of Hinduism, established under the banner of Vijayanagara rule. The erection of such huge structures restored and also increased the morale of the Hindus and made them fight against the invasions of the Islam. These lofty gōpuras are traditionally called by the name ‘rāyagōpura’. The reason was that these towers were constructed in large numbers by the Vijayanagara rulers wherever they built temples. All the Vijayanagara rulers had the suffix ‘rāya’ to their names. These towers were named as rāyagōpura i.e. the gōpuras built by the rāyas. This name became a tradition and was applied to all the gōpuras built even after the Vijayanagara period.

REFERENCES

1 Kāśyapaśilpa - patała-1, verse-60
2 ibid, verse-61-62
3 ibid, verse-29-36
4 ibid, patała-4, verse-2b
5 ibid, verse-8b-10
6 ibid, verse-1-2a
7 From, hereon, the method of construction is based on the study of existing examples.
8 Amman shrine at Mallikarjuna temple at Tonkur, Pandavapura taluk, Mandya dist.
9 Shrines at Ardhanarishwara temple at Tiruchengodu
Fig 8. Śadvarga

Not to Scale