

Circular structures and buildings associated with vernacular farm architecture and folk engineering

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The rondavel has become a typical feature on farmsteads but it is not the only building with a circular floor plan. Several other structures also have a circular floor plan. In Western architecture we have become accustomed to the domination of the square and rectangle as spatial form giving element in architecture in the West. Even though a circular building is not more complicated than the square or rectangular counterparts, the construction of a cylindrical structure needs some special design and construction precautions to prevent it from disintegrating and cracking in the long run. In some way we perhaps negated the fact that the occurrence and use of the circular shape as solution for space problems has been a strong element in South African folk architecture for centuries. The application and use of the circle in vernacular architecture is not a measure to determine how civilized a community is but rather an example of 'contact architecture' that was born from a need and combined with the local building traditions. Over decades this shape was adopted to serve the spatial and aesthetic needs of an individual or family. The construction of a circular building and structure relies on the construction skills of the responsible craftsperson and has played a significant role in defining the character of South African vernacular building typologies.

Key words: rondavel, circular shaped buildings, circular floor plans

Sirkelvormige strukture en geboue wat geassosieer word met volks plaasargitektuur en volks-ingenieurswerk

Die rondawel het 'n tipiese element van plaaswerwe geword, maar dit is nie die enigste gebou wat 'n sirkelvormige grondplan het nie. Verskeie ander konstruksies se planvorm is aan die sirkel verwant. In Westerse argitektuur het ons gewoon geraak aan die gebruik van die vierkant en die reghoek as dominante planvorm om ruimtebenuttingsprobleme vir die ontwerp van geboue op te los. Alhoewel die sirkelvormige plan nie meer ingewikkeld as die vierkantige plan is nie, benodig sirkelvormige konstruksies beide ontwerp- en konstruksievernuw om te verseker dat die struktuur nie oor die lang termyn verswak en kraak nie. Die rondawel en ander sirkelvormige geboue en strukture het mettertyd 'n belangrike rol in die geskiedenis van Suid-Afrikaanse volksargitektuur gespeel. Die gebruik van die sirkelvormige grondplan in plaasargitektuur is egter nie 'n barometer om vlakke van 'beskaaftheid' te bepaal nie, maar eerder 'n voorbeeld van 'kontakboukuns'. In sommige gevalle kon dit selfs om estetiese redes verkies gewees het.

Sleutelwoorde: rondawels, sirkelvormige geboue, ronde planvorms

Contrary to what may seem to be a common perception that vernacular architecture on the farms of white landowners in the northern part of South Africa is only represented by rectangular or square floor plan buildings, structures with circular floor plans were also common, such as the rondavel typology. However, circular floor plans are mostly associated with engineering structures and not with residential buildings with the exception of the 'rondavel'. Rondavels and rondavel houses are common but in terms of using this form giving formula as dwelling type it remains the exception rather than the rule. This may be the reason why the circular floor plan has almost been negated and excluded from earlier vernacular dwelling typologies and publications regarding early European vernacular architecture.

This study is part of an investigation into early vernacular dwelling typologies that have existed among white pioneer settlers who moved into the area north of the Vaal River after 1840. The investigation takes as premise that both the circular and rectangular floor plans entered the region and co-existed as vernacular architectural traditions among white farming communities and early frontier settlers in the region. One assumption is that the circle was part of the mental map and an archetype that was brought into the region when white settlers arrived during the period 1840 to 1880. Concomitantly, the circle was a common spatial form used by local indigenous peoples at the time and even long before white pioneers entered this geographic area.

One assumption is based on the '*form follows function*' principle: the circular floor plan shape being the result of activities executed and dependant on a circular motion in order to be productive and effective. However, the use of the circular shape as a floor plan for a dwelling does not follow this logic. A second assumption is based on the principle of '*form follows tradition*': the circular floor plan for small dwellings, such as rondavels, was applied as a useful type among early white settlers in the region north of the Vaal River during the frontier years as they have been exposed to it sometime in their past or in the areas and districts from which they originate. A third assumption is based on the '*form follows local knowledge*' principle: white settlers used the local black residents to erect rondavels based on their local know-how. In this way no building plans had to be drafted and building specifications could be kept to the minimum.

It is accepted that the small circular floor plan dwelling may have fitted into an evolution of floor plans of the earliest pioneers and adventurers and these dwelling types served as temporary shelters for either individuals or groups of individuals (individuals without their families). These shelters can therefore not be considered 'dwellings' in the real sense of the word. At the same time referring to the rondavel as a circular building type, it seems that this building was not merely part of a phase in the history of early frontier settlement but it continued to be erected well into the 20th century (1950s) and even became quite common on farmsteads long after the pioneering phases of settlement (1840 to 1900) north of the Vaal River have past.

Most of the circular structures are also associated with activity areas where processes were practiced and had to be accommodated either indoors, outdoors or in some kind of sheltered space. However, this paper merely explores the occurrence of the various activity areas, buildings and structures that have a circular origin, those that were practiced in a circular action or that were constructed using the circle as basic form.

Motivation for the study

This study forms part of an investigation into the history and origins of the rondavel as a typical form type in the history of both vernacular architecture and folk engineering in the northern part of South Africa (the study does not cover the entire South Africa as the area is too vast). Most of the examples mentioned and investigated are located in the northern part of South Africa. The investigation into the origins and continuous use of the rondavel form type cannot be considered to be merely a simple sequential timeline from some prototype that originated at a particular geographic point, expanded around the globe and then continued into the 21st century. One of the key questions remains why the circle is selected as suitable spatial form solution to create floor plans for residential units as the rectangle and square have already proved to be a practical solution.

The viewpoint of this paper is that the occurrence of the circle as a spatial design solution to accommodate activities of a circular nature is logic and the applicability and practicality of circular structures as containers have proved their validity as architectural and engineering solutions.

It seems as if the circular floor plan has become commonly associated with the architecture of the local and indigenous black people while the rectangular floor plan became associated with the vernacular and designed architecture of Europeans. Closer scrutiny of the early rural vernacular architecture and even later architecture on farmsteads in the region north of the Vaal River suggests that both forms were rather common. Even though the circular form seems to be impractical - at first glance - it has survived and even became a common solution solving

certain spatial problems in the architecture usually associated with farm architecture (not as an engineering solution though).

The search for the origins of the circular floor plan and in particular the history of the rondavel typology of the cone on cylinder inevitably resulted in a search for other buildings and structures with a circular or similar (related) floor plan and this is the principal motivation for this article. The preliminary investigation into the occurrence of the circle in the vernacular architecture and early smaller folk structures in mostly rural traditions (especially farm building) resulting in a division between buildings and structures; buildings being works with roofs and structures being mostly engineering related construction works (those works without a roof).

A study of early farm engineering works has not been done to date and this study is also not focused on this type of investigation. The creation of a category such as ‘vernacular’ farm engineering is merely incidental, though essential for the discourse. This study is aimed at determining some tradition or patterns in the typologies of floor plan types that can be associated or classified as vernacular building types, form types or functional types.

Buildings and structures

Four broad categories of manmade spaces and construction works occur on farmsteads in order to serve the needs of the productive farmer: (a) ‘buildings’ for the protection of people, produce and equipment; (b) ‘structures’ for manufacturing processes and utilitarian uses such as storage and manufacturing; (c) ‘infra structural elements’ and (d) ‘activity areas’. For the use of this paper and logic of the discourse, the sequence is altered, starting with activity areas.

Circular construction

It is assumed that circular buildings and structures are the result of a very logical process based on activities with a circular motion. This is only partially true for the construction of the vernacular circular buildings on farms. This would have been a scientific approach to the erection of these structures but in the early rural Transvaal, farmers were neither exposed to the disciplines and domains of the agricultural sciences nor to civil engineering until the first agricultural colleges were established. The thoughts generated and promoted at these institutions only reached the farming community after the results of their research and experimentation were published – first in scientific reports and later popularized in several agricultural journals.

It is uncertain what the impact of early agricultural publications such as *Farming in South Africa*, *Hulpboek vir Boere*, *Farmers Weekly* and *Landbou Weekblad* had in promoting the construction of circular buildings and structures. These publications were established between 1915 and 1920 – prior to the great depression. It can only be assumed that the recommendations and suggestions indicated and set forward in the articles by professional individuals who were linked to the various agricultural colleges and universities were not ignored by young and dynamic farmers who wanted to expand their farming activities and profits by reassessment of their farming paradigms and methods using contemporary and tested technology. It can also be assumed that the circular buildings and structures already existed prior to the existence of the publications. The information in the publications only confirmed and defined the potential of and parameters for circular structures such as larger dams, water reservoirs and silos. Later editions of these publications were also instrumental in the introduction of circular prefabricated containers and the use of prefabricated materials such as corrugated iron that could be used for the construction of large circular structures.

The *functionality* of the circular floor plan for any human activity reflects the presence of some paradox. Most large circular activities on a farm occur and are practiced outside a building. This leaves other activities such as storage and dwellings as spatial activities to be defined within the circular confines of walls – such as silos and rondavels.

In terms of storage of fodder the circular building becomes a cylindrical storage facility. The outward pressure on the walls increase as the cylinder is filled. This is where the circle becomes very efficient as the pressure is distributed equally onto all the sides. The same principle is true for using the cylindrical shape as a water reservoir.

In terms of the rondavel no such logic exists. Furniture is designed and constructed according to fit the cube form and does not relate or fit smoothly into a circular or cylindrical building. In this sense the rondavel is impractical and irrational.

The first motivation for the erection of a circular or cylindrical building would relate directly to any *circular activity* that had to be executed within a defined and confined space, some even indoors. When assessing the circular buildings on farmsteads it is found that few activities inside circular buildings are of a circular nature and so are the furniture used in these buildings.

Another circular building type that became common during the Anglo-Boer War was the small circular fort. The logic of applying the circle is based on the 360 degree visibility along the entire horizon. However, these buildings were not erected on farms and can therefore not be considered part of the vernacular farm building typologies.

Activity areas

Identifying activities that are based on circular actions seems to be the most logical point of departure when investigating the occurrence of circular buildings and structures. Few of these activities can still be found on contemporary commercial farms. However, on farms where traditional activities were practised or where activities were executed with manual labour, the occurrence of areas of a circular shape is quite common. In this case activity areas relate to the work place and the circular character of the floor or production area.

Wagon-builders smithy

Prior to prefabrication and mass production of iron products, later considered essential on a farm and critical in the construction and maintenance of a wagon, blacksmith work was done by the farmer and his workers. This activity was usually located near the *waenhuis* or sheds where the farmer kept all vehicles. Smithing was done either on the ground but often a small hearth was constructed (elevated area of about 600-700 mm high) on which a fire could be kindled. The height of such a structure (hearth) was determined by the blacksmith as it served as a work surface. Blacksmithing included the manufacturing of a variety of homemade tools and objects that could be used in buildings (such as hinges, locks and window stays) and the construction and maintenance of wagons and agricultural implements.

Compared to the area where general iron work is done on a farm, the shortening of wagon tires had to be done outside a formal smithy (the building in which the hearth is located and where the tools are stored). The area where wagon tires were finally laid over an existing (old) or a new wheel (wooden structure) was done outside where the wheel was bolted to a rim and mounted in the ground. To ensure that the work area was slightly elevated from the ground, it was sometimes constructed with stone forming a small circular paved area (figure 1).



Figure 1
Circular paved stone area where a hot iron tire is placed over the wooden rim of a wagon wheel
(photograph: M. Naudé).

Threshing floor

Threshing of wheat is an old farming activity and the oldest example of a threshing floor being preserved in South Africa is located directly adjacent to Mostert's Mill in Mowbray, Cape Town (figure 21).¹ Threshing floors and mills used to be constructed adjacent to each other as the one activity merely precedes the other in the process of refining wheat to an edible product.



Figure 2
Reconstructed threshing floor at the Pioneer Museum site in Silverton, Pretoria
(photograph: M. Naudé).

Threshing floors used to be common on farms in regions where wheat farming is common. A circular area was cleared of grass and bushes; the surface leveled, moistened and compacted until it was hard enough for animals to walk on without destroying the surface. In its most simple form it is an open-air activity that is practised during a certain time of the year (figure 2).

According to Küsel,² the threshing floor on the farm Lakenvlei (Belfast district, Mpumalanga Province) is the best preserved example of such a structure in the entire region (formerly known as the Transvaal). The farmstead has been redundant for more than 12 years and the buildings and structures have slowly disintegrated due to vandalism and loss of materials eventually leading to structural failure of the buildings.³

This is another typical folk activity that can only be defined as an activity area and not as a ‘structure’ as it consists of very little construction work. It is a clear example of an activity area where ‘form follows function’ as threshing was done by training horses or donkeys to trample over cut wheat along a circular trajectory. The circular shape of the structure is a direct result of the movement of the animals. Horses are held together with a leash by a person in the centre of the floor (or circle) while the animals move around him. Wheat is thrown on the hardened surface and the hooves of the animals trample the thick layer of stems in order to separate the grain from the chaff. However, in some parts of the country, threshing was also done indoors and sites have been recorded in the northwestern part of the Northern Cape by researchers of the National Cultural History Museum (now: Ditsong: National Museum of Cultural History).⁴

Kneading thongs

In this case the activity of kneading thongs (Afrikaans: ‘riembrei’) according to historic tradition has no relation to any structure or architectural element but is merely an open air activity that normally takes place under a tree. It is not a permanent activity and can be considered a dying folk tradition.

In most cases the kneading of thongs using this method does not need the construction of any structure as the thongs are merely suspended from a mature tree branch with a weight tied to the bottom end of the bundle of raw thongs.

A pole is pushed in between the thongs and a winding action is started by a person walking around the central axis. When tightly wound, the pole is pulled out and the thongs unwound themselves. Due to the continuous circular strolling of the operator a large area with a circular shape becomes visible.



Figure 3

Informal circular activity area created by the kneading of thongs – turning them around continuously (photograph: M. Naudé).

Circular structures

Structures are usually those construction works that have no roof and could have been constructed as an activity area or a storage facility. Usually these structures were erected to accommodate a production process and as storage facility. In the case of the latter function the walls or sides of the structure play a significant part in containing physical forces relating directly to the kind of storage it was built for such as water or fodder.

Lime kilns

Lime kilns are also known to be circular in shape but even though little is known about the first and oldest lime kilns in South Africa, an example of such a kiln was proclaimed a National Monument (now referred to as a Provincial Heritage Site) in 1980. Two kilns are located on the farms De la Rey and Jacobskraal, about 5 km outside the town of Yzerfontein (along the Cape West Coast) (figure 4).

They are about 2.5 m high and were stacked with mussel shells and wood. A fire would be made at the lower compartment of the kiln while the shells are placed on top of the wood. Air was forced through the oven using billows. The final product would be ‘quicklime’ that was collected from a pit at the bottom of the kiln.⁵ This is a well-constructed structure and seems not to be of a temporary type.

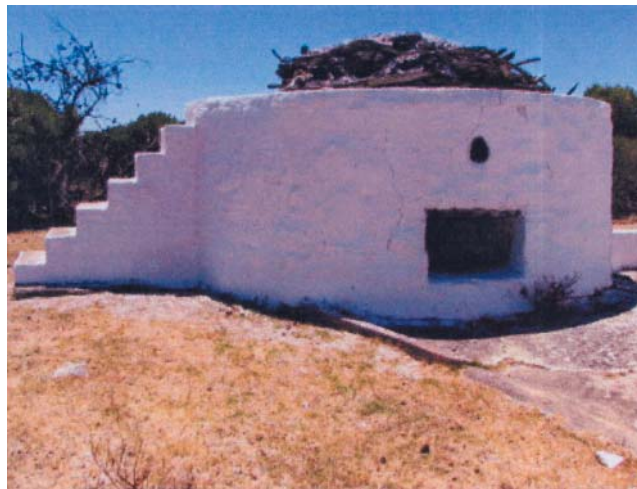


Figure 4

Lime kiln near Yzerfontein in the Western Cape Province where lime was manufactured from shells (photograph: www.yzerfontein.info/history/lime_kilns.html).



Figure 5

Low circular outdoor bake oven in the Waterberg (photograph: Ditsong: National Museum of Cultural History, Pretoria).

Detached outdoor oven

Only in exceptional cases, an outdoor oven will have a circular floor plan but during the pioneering years and especially while on trek, large ant heaps were used as (‘ready-made’) bake ovens. Technically, it is not a manmade structure but merely the result of the ingenuity of

someone who exploited the latent potential of an ant heap that has become useless and offered an appropriate void for this purpose. The ant heap only had to be cleared from the inside, a front entrance and back draught-hole had to be created and the oven was ready to be used.

Research in the Waterberg has revealed evidence of a simple outdoor bake oven that was constructed in a circular form in almost the same size and shape of an ant heap.

However, there is little relation between the outdoor oven and the development of the rondavel. Hearths and fireplaces do not normally occur in rondavels and were not added to the exterior walls. The development of the outdoor bake oven is closely associated to the occurrence of the outdoor cooking area and the outdoor or detached kitchen – more often the semi-open cooking screen.

Cooking screens

The cooking screen (Afrikaans: 'kookskerm') has become associated with the arid and semi-arid regions of South Africa. It is assumed that the cooking screen originated during the years when people lived a relative nomadic lifestyle and food was prepared on an open fire on the ground. A kitchen could not be located inside the tent or the 'matjieshuis' (reed hut) as these semi-permanent abodes were too small. When a more permanent dwelling was erected, it was either too small and the 'kookskerm' was preferably detached from the dwelling in fear that sparks from the fire may light the thatch roofs or would add more heat to the interior of the dwelling. The best solution was to keep the fire outside and create a small but functional facility that could operate firstly as a detached kitchen but also as an informal place to socialize.⁶

As a farmer would settle at his base or principal farm (Afrikaans: 'blyplaas'), the 'kookskerm' remained a functional and practical solution for preparing food. These first dwellings remained small and served only in the basic needs for privacy and accommodating the family's essential spatial needs for sleeping rather than serving other needs such as a bathroom, kitchen and toilet. Whether the decision to retain this structure was the result of economic reasons (cheaper to exclude such a luxury from the dwelling) is unlikely and tradition (a difficult habit to break) may have been a more appropriate explanation.⁷

It was located a short distance (within 30 m) from the dwelling and operated as an 'instant', outdoor or detached kitchen. The 'kookskerm' is a circular or oval-shaped structure with a single entrance, usually facing away from the direction of the prevailing winds, irrespective of the location of the back door of the dwelling. Even in these circumstances and in such an almost desolate natural landscape the dwelling had a front and back façade with the 'kookskerm' being located in the backyard.

In regions where this structure is common, rain is an almost incidental occurrence and an open fire in an area where food was prepared had almost no possibility to be washed out. Direct sunlight, heat and wind were the only possible hazards to cope with when preparing food outdoors⁸. No real need for moving food preparation into the dwelling existed and secured the survival of this household outdoor activity. Therefore, it remained an outdoor activity. It is inevitable that when food was prepared on an open fire outside the dwelling that the longer the same setting is used, some refinement to such an important activity area will result in several changes and led to the introduction of appropriate additions that would at least protect the fire against prevailing winds.⁹

The standard way of preparing food was on an open fire in three-legged and flat base iron pots. To retain a consistent source of heat, the flames had to be protected against winds and breezes. The 'kookskerm' was erected mainly for this purpose – to keep the wind out. For the same reason these screens were not high enclosed spaces and in some cases they were merely

between 500 mm to 1 m high. However, the screen erected around this household activity also had other purposes such as defining the space as if it was a separate annex to the dwelling. Often the space included an outdoor bake oven, sometimes even more than one. Food preparation consists of more than just leaving food on the fire or bread inside the oven. Additional space had to be provided for the pre-preparation of some dishes while one or more individuals had to tend to the fire, stirring and mixing food. The space had to be large enough to accommodate one or more seats, a table to work on or even small wooden boxes in which kitchen utensils and porcelain could be kept. Iron hooks and pokers were used to manipulate the fire and baking pans inside the oven and ample working space had to be created inside the screen for this activity without falling or tripping over the fire, hitting furniture or cooking utensils.¹⁰



Figure 6

Circular cooking screen with low surrounding wall and a roof constructed with timber laths and patches of roughly thatched vegetation, in front of a small rectangular dwelling (photograph: Macdonald, W. 1913. *The conquest of the desert*, figure 2).



Figure 7

Field-cornet Snyman's house in the Roggeveld, ca. 1810 with rondavel-type outbuilding (in the centre) that probably served as a detached kitchen cum cooking screen (drawing: *Burchell's Travels*).

In some cases the cooking screen had a thatched or roughly covered roof supported by timber poles suggesting the form of a primitive rondavel.

Wells

Wells are usually circular shafts excavated to reach fresh water. They seldom have rectangular sides and to prevent the sides from caving in they need to be lined with stone, often smeared with a layer of cement plastering. In areas where artesian water sources exist, such as the drier parts of the country like the Kalahari and Namakwaland, the walls of these wells are lined with chunks of calcrete without plastering. Examples of these wells occur along the Auob River in

the Northern Cape (Kalahari region). Here the water was scooped out of the well by allowing a person to enter the well and lifting water from the water source with a bucket. Water was then poured into a trough where animals would gather for drinking. The fresh water was protected by a stone wall often an extension for the stone lining of the shaft inside. A small opening was left into the surrounding wall to allow the person scooping the water to enter the well using stone steps into the water.

Of particular interest is that the stone walling around the wells were not only constructed as a lining to prevent the walls from caving inwards, but projected above the surrounding ground surface in order to prevent animals and humans to fall into the well. An opening in this low wall defined the entrance towards primitive steps constructed by large stone boulders. They made it possible for the herder to enter into the well cavity. Poles were planted at the sides of the entrance and a makeshift gate had to be opened before entering. The type of construction relates to that of the rondavel but is different in that it is mostly subterranean (and more of a makeshift nature).

The well on the farm Hartebeestpoort (Pretoria) is covered with a square timber structure to prevent children and animals from falling in but has retained its circular shaft underneath the timber structure. Winding of water with a bucket on a rope is also done from such a platform, as the winder is mounted to this rectangular floor or 'cap'. On the farm Kaalfontein (Rayton district - Gauteng) the circular character of the well is exposed as the water is extracted with a 'bakkies-pump' that is fitted in the centre of the open shaft. The pump is driven by a donkey that strolls around the structure and then drives the pump, hoisting water by way of a 'chain' with tens of small scoops (Afrikaans: 'bakkies') mounted to the chain.



Figure 8

Circular well in the Kalahari, the retaining walls and small steps leading to the water, constructed with chunks of calcrete (photograph: Ditsong: National Museum of Cultural History).

Dipping tanks

Dipping tanks on commercial farms are associated with cattle dipping and the structures associated with this activity are elongated rectangles and not circular. Circular dipping tanks were used for dipping stock and pigs (figure 10).

A unique aspect of these dipping tanks was the use of sandstone blocks that were shaped (into a curve) to fit the circular shape of the final structure. More often, stone used for the construction of a circular building was merely positioned in such a way that they fit the circular

floor plan using the building mortar to fill the triangular gap created by swiveling the square or rectangular blocks to create a circular structure. In the case of rondavels, slabs or large bars of stone (used for lintels and window sills) were shaped to fit the circular shape of the exterior of the building and not the interior.



Figure 9

‘Bakkies pomp’ installed inside a well-type structure and operated by an animal strolling around a central pivot (photograph: M. Naudé).



Figure 10

Sheep dip on the farm Berseba in the Steynsburg district northeastern Cape (photograph: M. Naudé).

Dams and drinking troughs

The simplest dams constructed as reservoirs for cattle or stock farming are mere shallow dips in the ground that have been covered with a layer of cement, which is periodically filled with water from a well or pump. Examples of this type of ‘trough’ occur in the Kalahari and the remains of some have been retained by SANParks in the Kgalakgadi National Park, when animals had to drink water from the nearby well or pump that supplied water for reservoir. Due to the low gradient of the slope of this structure, animals can walk into the water and drink without any danger of drowning, slipping, getting stuck or causing damage to themselves.¹¹

Although dams or water reservoirs tend to be of any shape, the circular shape is the most common. The shape is a direct result of the logic underlying its use as dams, in terms of the

outwards pressure (pushing forces) of water inside the dam. Dams are containers and need to be designed with this in mind, especially as the quantity of the contents may change over time depending on the seasonal drought conditions and level of the water, resulting in the altered pressure on the walls. Dams can only be categorized as engineering structures.

Circular dams or reservoirs may occur in different sizes: from small drinking troughs to large reservoirs with a diameter of 15 m (figure 11).



Figure 11
Small drinking trough for sheep on the farm Berseba (Steynsburg district) northeastern Cape
(photograph: M. Naudé).¹²

Quite a unique structure not usually found or described in academic publications covering vernacular engineering works, is the water furrow distributor dam (figure. 12). Water is brought to the farmstead with a single wide furrow. Water then had to be distributed to other furrows serving several areas such as orchards and gardens. The distributor dam is circular in shape and consists of a central inlet furrow with several outlets depending where the water is needed for irrigation. These distributor dams may have a hardened clay floor or may be constructed with stone and lined with a cement floor.

Water is let through the appropriate sluice by lifting the small sliding sluice gate. They were made of sheets of galvanized iron (often a flattened sheet of corrugated iron).



Figure 12
Circular ‘distributor’ dam where water from the principal water furrow is distributed into several secondary furrows – Lydenburg district, Mpumalanga Province
(photograph: M. Naudé).

Kraals

The construction of circular ‘takkrals’ (a kraal constructed with branches) by the indigenous peoples of South Africa is quite common and they can still be seen in the rural areas where cattle farming are practiced (and ample wood is available). However, cattle or stock kraals have been replaced with more formal gum-pole constructed structures.

The kraal at Donkerhoek (east of Pretoria) was constructed with sandstone and a sand-and-lime mortar with a thin topping of the same material along the top of the entire wall. This prevented the top layer of stones to ‘open-up’ and break apart. It has an exceptionally wide entrance – not common for a stock kraal.



Figure 13

Circular stock kraal in the Donkerhoek area (east of Pretoria). The wall is approximately 1,2 m high and constructed with chunks of sandstone collected along the slopes of the surrounding ridge (photograph: M. Naudé).

Most of these kraals suffer from the same symptoms of structural decay as other open circular structures - they tend to widen at the top and cracks and structural problems occur along the higher portions of the wall.

Wolwehokke

‘Wolwehokke’ (‘hyena traps’) are not common structures north of the Vaal River but was quite common in the Karoo. The ‘wolwehok’ was designed to attract the ‘wolf’ or hyena into a stone constructed structure by setting a trap with chunks of meat inside. It is also referred to as a ‘wolwehuisie’ but this building has no association with ‘housing’ or with the ‘protection’ of animals or humans. It was normally constructed from stone¹³ and used as a device to catch nocturnal animals perceived to be predators such as jackal, aardwolf and other smaller species. The animal was lured into the building and the trapdoor would be triggered as soon the bait inside is moved or removed from its hook. The farmer would visit the site in the morning and shoot the trapped animal through a hole at the top of the structure.¹⁴

One of these structures was reconstructed by the former National Parks Board staff in the Karoo National Park near Beaufort West. Another example was proclaimed a Provincial Heritage Site in the Graaff-Reinet district.



Figure 14

A reconstructed ‘wolwehok’ with (vertical) sliding slate door and open at the top, in the Karoo National Park (Beaufort West) (photograph: Ditsong: National Museum of Cultural History, Pretoria).

Pen or small kraal

In terms of structures dating to the Iron Age, small circular structures (without roofs) are easy to identify and classify. Small circular structures with a diameter ranging from 2,5 to 4 m without any entrances or openings in the walls are not uncommon occurrences in Early and Later Iron Age sites. It has also been mentioned that some may have served as a foundation for a granary. Granaries are usually elevated above the ground in order to insulate the floor from the possibility of direct infestation by insects. The foundation would consist of a circular structure constructed with stone with or without mortar. A significant aspect of these structures would be that it forms a complete circle with no entrance or break in the circular walling. Timber beams would be laid on top to form the floor and the remaining wall structure would consist of a timber structure filled in with horizontal and vertical laths – sometimes also plastered with clay on the interior and exterior. However, the same structure could be constructed without the circular stone walling as the corner posts could have been planted directly into the ground and the floor mounted at an elevated position above the ground.¹⁵



Figure 15

Small pen on the farm Vaalekrans in the Steynsburg district, northeastern Cape (photograph: M. Naudé).

On historical sites these small circular structures are not that easy to contextualise. They are often too small to be classified as a kraal and seldom have any traces of a roof structure. The

walls of these structures may either be plumb or are tapered towards the inside. Fieldwork has not yet clearly secured a function for these structures other than keeping either small animals or for keeping a small number of animals for a special reason. Young lambs, calves or pigs (pigsties tend to be rectangular) were kept inside small circular structures. These structures may have had well defined entrances with gates or in some cases had no entrance.¹⁶

These are also not the remains of rondavels as rondavels tend to have larger diameters and have been constructed with walls that are designed to be load bearing. In cases where the rondavel roof has completely disappeared but the walls have remained intact, the top of the wall has been refined by finishing it off with a final set of level stone layers in order to accommodate the roof structure.

Still and fermentation tanks

Small fermentation tanks or subterranean pits serving various purposes were often constructed on farms. If the farmer was a keen stiller of mampoer or witblits (moonshine), these pits were either constructed with plastered brick walls or any other prefabricated containers. Otherwise, pits were constructed by excavating holes in the ground and plastering the interior surfaces with a layer or wash mixture of sand and lime. Subterranean pits were used for curing hides by filling the pit with water and wattle or blue-gum (eucalyptus) tree bark. They were also used to ferment fruit prior to the stilling process.

The still had to be heated from underneath as heat was an important element in the stilling process. Surrounding the copper still with a layer of sundried bricks and wet clay would ensure retaining of the heat inside. The makeshift clay brick solution was not a permanent structure and had to be rebuilt after the stilling season.



Figure 16

Still located inside a circular makeshift brick structure with circular fermentation pits at the back – in the Waterberg region, Limpopo Province (photograph: Ditsong: National Museum of Cultural History, Pretoria).

These structures have little load bearing capabilities. In the case of the still the clay and brick walling are removed when the still is cleaned and the fermentation pits only contain small quantities of fruit.

Water reservoirs

Water reservoirs are small water containers usually located near the dwelling and as in the case of the example on Hattingskraal (Winburg district in the Free State Province) (figure 17), placed underneath the spout of the downpipe draining water from the roof of the building. In this case the reservoir was constructed with bricks, plastered and whitewashed. Today it is more common to find prefabricated galvanized iron tanks serving the same purpose.



Figure 17

Water reservoir constructed at the corner of the building to collect water draining from the roof - farm Hattingskraal in the district of Winburg, Free State Province (photograph: M. Naudé).

Other water reservoirs were constructed in the same way as a dam wall of plastered brick but projecting higher into the air. In the case of the example in the Kruger National Park, the problems of mechanical or penetrating damp damage to the lower section of such a reservoir are countered by buttressing the lower part with another wall either of brick but usually with stone masonry. To prevent dust or any other material to end up in the water the top of the reservoir was covered with a conical roof of galvanized sheet iron.



Figure 18

Small circular water reservoir with buttressed stone masonry wall around it in Skukuza, ca. 1932 (photograph: Pienaar, U. de V. 1990. *Neem uit die verlede*, p. 483).

Circular buildings

The circle as a spatial solution (and shape) for residential and storage needs is well-known in the vernacular architecture of the local indigenous peoples in South Africa and among traditional societies elsewhere in the world. It is a form type that occurs in all climatic and botanical regions. It is even used as an architectural form by people such as the Eskimos. For this reason the circular floor plan must be included into the typology of prototypes generally used in vernacular architecture all over the world. It is used as both a temporary and permanent solution for habitation, working and storage purposes.

Whether the circular prototype was identified and classified as a typical part of the South African architectural vocabulary is not very clear. In terms of the various typologies that exist among the local indigenous groups of South Africa it has been defined and accepted but it seems to have been excluded from the vernacular architectural vocabulary of European or white architectural history. In cases where South African or regional architecture was presented or displayed the rectangle remained the prime prototype for representing early white vernacular architecture and the circular floor plan typology was considered typical of indigenous black vernacular architecture.

Gazebos

Gazebos usually consist of a roof supported by timber columns but with the sides either left open or partially closed. Therefore it operates as a constructed ‘umbrella’ and shelter rather than a formal building with a proper foundation and closed walls.

This building type not only occurs in the gardens of farmsteads or suburban properties but also on farms and more official exclusive areas such as the Kruger National Park. Its function is to protect people from the sun while allowing free movement of humans and breezes through the created covered space underneath.

No research has been done on the occurrence of this building type in the vernacular architecture in the northern part of South Africa. This may be because the building type is of little architectural significance except when considered in some historical or cultural historical context. In structure and form the gazebo has the same characteristics as the rondavel with the exception that the sides were left open or were merely screened off with reeds or diagonal cross slats. This allows the building to serve its purpose as a place of leisure and enjoyment of a garden or as a private folk-type clubhouse next to a swimming pool, tennis court, or croquet lawn. Gazebos were either square, rectangular or had a rondavel shape.



Figure 19
Reconstructed garden gazebo on the farm Zwartkoppies outside Pretoria
(photograph: M. Naudé).

Another popular gazebo type occurs in the Kruger National Park and this type is still erected in other national parks as well. The thatched rondavel roof allows ample shelter to any number of people and can be maintained and replaced using the local grass available. The building type is also aesthetically sympathetic to the bush landscape and tends to disappear among the bushes of the Lowveld and Bushveld.



Figure 20
Large open sided gazebo at the Pafuri tourist picnic area in the Kruger National Park
(photograph: M. Naudé).

Mills

Jan van Riebeeck had to provide most of the basic services during the early years at the Cape including the grinding of wheat. For this reason, a so-called horse-mill was built. As they had no horses the mill was worked by oxen. However, when the Khoi people stole all the oxen in 1659, the miller, assisted by the Government, had to erect a wind driven mill. In the following century several wind driven mills were erected, some of these were privately owned and Mostert's Mill in Mowbray (Cape Town) is the last remaining example of these.¹⁷ This mill is of the type known in the Netherlands as a 'bovenkruier' or 'over-shot' wheat mill.¹⁸ Even though this building type and associated engineering have proved to be successful over decades in the Netherlands, it did not survive in South Africa and the tradition disappeared.

The entire tradition for wind powered mills was altered by the minimalist construction of galvanized iron water mill structures. However, these mills were never exploited for the generation of power to drive wheat mills.

It is constructed in the Dutch tradition of mill typologies and has a circular footprint. According to Doreen Greig, Mostert's Mill was built (ca. 1796) by Gysbert van Reenen, the same man who erected the original house on the farm Welgelegen in 1757. Mostert's Mill and the adjacent threshing floor were proclaimed a National Monument (now a Provincial Heritage Site) in 1940.¹⁹ This merely serves as evidence that some circular floor plans is not unique to Africa or South Africa but originates from a typology that has its roots in Europe. It was not the only mill with a wind driven milling machine in the Cape at the time but the only mill of its kind that remained in the Boland. This building tradition never continued into the interior of the country.

One of the smallest milling machines created for grinding purposes is the Norse Mill. It is a small machine with a horizontal flywheel driven by the movement of water flowing underneath the machine and the building. Flywheels may have diameter of between 1.5 m and 2.3 m. However, it is not the shape of the flywheel that determined the shape of the building

in which it was housed as the top part of the milling machine was usually square. These mills could therefore be accommodated in a rectangular or a circular building.



Figure 21

Mostert's Mill in Mowbray Cape Town. A circular threshing floor was reconstructed at the back, adjacent to the mill (source: Oberholster 1972: 42).



Figure 22

Exploded drawing of a Norse Mill (machine) and all its parts indicating the use of the horizontal flywheel (drawing: Ditsong: National Museum of Cultural History, Pretoria).



Figure 23

Lozenge-shaped building housing a Norse Mill on the farm Kaalfontein in the Cullinan district (photograph: M. Naudé).

Silos

Silos are storage facilities and their shape does not necessarily have to be circular or cylindrical. This is a relatively late development of the circular floor plan as it became a common phenomenon on farms in the 20th century when farmers learnt that they could collect fodder for winters and could use this building cum container for this purpose. Silos seldom had roofs but the walls had to be strong enough to contain the pressure of the fodder content inside. Silos are partly subterranean with only the top two-thirds projecting above the ground. As the farmer's needs expanded a second silo was erected or the walls of an existing silo was merely added on top



Figure 24

Two redundant grain silos on the farm Zwartkoppies east of Pretoria. One of them was enlarged by adding to the top. The second silo (right) was constructed using corrugated iron sheets as shuttering (photograph: M. Naudé).



Figure 25

Ruins of two silos on the farm Garstfontein - Pretoria (photograph: M. Naudé).

Corrugated iron or sheet iron silos have been used for a long time by riveting, bolting and welding flat sheets together to form a cylindrically-shaped container. The wall thickness depends as much on the requirements to resist vertical forces and the effect of wind on an empty silo as on the need to withstand the horizontal pressure of the fodder on the walls – from inside. The solution is the use of corrugated iron but with the fluting running horizontally which is stiff enough to resist wind forces. Such a silo also needs to be supported by vertical columns spaced around the silo wall to resist the vertical (outward) forces. The result of such a structure would be one of the most slender structures known to man with a slenderness ratio (ratio of the biggest dimension (diameter or height) to the smallest [thickness]) that can reach as much as 20 000).²⁰

After becoming redundant, they are often covered with a roof and used as accommodation as they normally have a diameter of about 5 m to 7 m, making them spacious enough to be used as a residential unit.

Worker's dwellings

One of the most common methods to identify and define a particular form type in a typology is to trace a contemporary example back to its origin, but often these lines supposedly leading towards the original archetype tend to become vague and eventually stop abruptly or disappear into another form type. It is not the focus of this paper to do such a tracing exercise but the links between the vernacular circular huts of indigenous peoples cannot be ignored as one of these avenues towards a local origin.

The occurrence of the circular floor plan among the indigenous peoples of South and southern Africa is well recorded as these people still use the circular floor plan today. They have used it in the period prior to Europeans entering into South Africa and the building typology can be traced back to the Iron Age and Late Stone Age.

However, tracing the origins of the rondavel on the farmsteads of European farmers has not been done in such detail and this form type has not been investigated either by archaeologists or architectural historians to the same extent as the occurrence of this form type among indigenous peoples.

The cone on cylinder hut or rondavel has a documented history and some of the earlier prototypes of the cone on cylinder still occur concurrently on farmsteads or in more traditional villages. The circular floor plan has been replaced by the square and rectangle on farms where black workers reside on a permanent basis. However, in some areas this change towards the rectangle has not been completed and the circular floor plan is still used.

One of the first conclusions and perhaps most logical deductions, in terms of the origins of the rondavel as a spatial solution for accommodation among white settlers, may be to consider that the application of the circular floor plan was through acculturation as farm workers were responsible for the construction of these circular buildings for their European 'masters'.

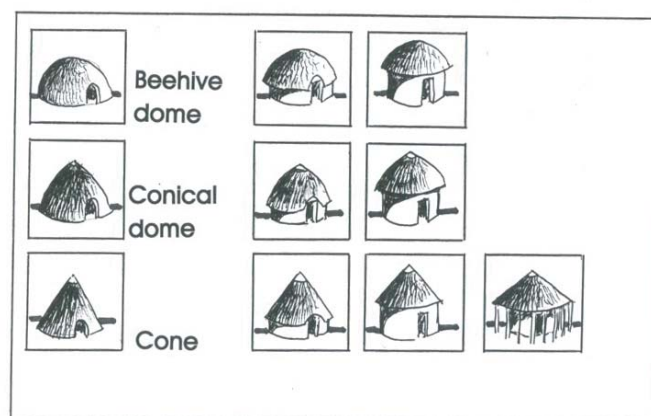


Figure 26

Diagram indicating various basic hut types associated with sheltering by indigenous peoples (drawing: M. Naudé - adapted from F. Frescura).

Grass mat dome structures of the Northwest and Namakwaland.

A well-known phenomenon in the region known as the Noordweste or Northwest and surrounding regions such as the Hantam, Gordonia, the Kalahari, and Namakwaland, is the occurrence of

the circular domed dwellings of both the indigenous residents and later also the white settlers. A dwelling type commonly referred to as the ‘grasmathuis’ or grass mat dwelling. In essence this is a temporary dwelling type with no architectural elements secured on a foundation or permanent structure linking the superstructure to the ground or to any subterranean base to indicate any hint of permanence. They also have a simple floor plan: circular in shape with only a single interior space – no subdivisions into several secondary or supporting rooms.

However, the key aspect is this building’s circular floor plan, its size and mobile structure. It cannot be defined as a residence, neither as a house in terms of permanence or its size but still served the purposes of its owners in most of their needs for shelter in terms of its transportability and easy construction. Due to the material it was constructed from, it also had the ability to counter the harsh climatic conditions of the regions where they were commonly used. The existing surface of the ground or a hardened clay surface served as floor and the super structure defined both the walls and roof. As the frame was covered with woven grass mats the material allowed air to flow through the matting. It was cool during the day and protected its inhabitants during the night. It had no need for windows and had only a single door (or merely an opening) used as an entrance (and exit) and covered by a grass mat that was rolled up or down during the day.

As a structure constructed with completely organic materials it would not have served its purpose in areas that were more humid but in these areas (mentioned above) with almost no rainfall during an average year, owners had no fear regarding building materials that would rot and had to be replaced often.

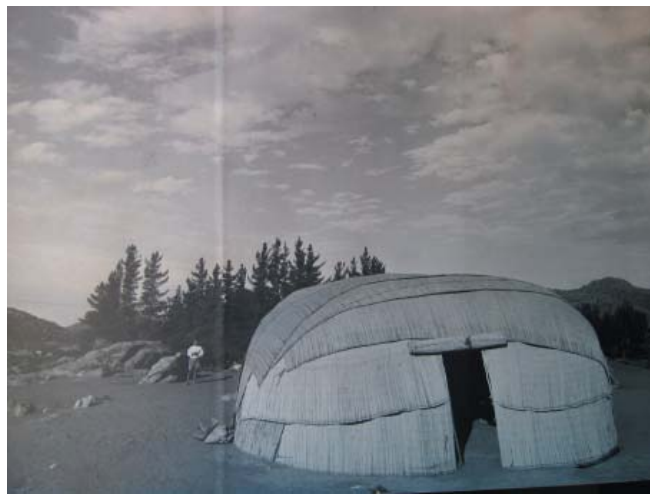


Figure 27
Large dome-shaped timber frame hut covered with grass matting in the Namakwaland region
(photograph: Ditsong: National Museum of Cultural History, Pretoria).

Corbelled huts

A unique dwelling type in the drier parts of the former Cape Province is the corbel hut (Afrikaans: ‘korbeelhuis’). On many farms in the Carnavon Williston area corbelled huts also referred to as ‘klip-rondawels’ (stone rondavels) are found.²¹ This is the closest relative to the rondavel hut type as it also has a circular floor plan, vertical walls to a certain height but the construction of the roof differs completely from the roof types associated with the rondavel. Walls often 760 mm thick were built to a height of approximately 2 m before the next layers were slightly tapered towards the top. Successive courses of flat stones were laid, overlapping inwards until it was closed at the top with a large single flat slab.²² The roof is merely an extension of the walls.

The roof structure is of a more complicated design as it was constructed exclusively from stone and tapered into a conical dome towards the top and the centre of the building.

A major difference when compared with the rondavel is the exclusive use of stone for the construction of the entire corbelled hut - the walls and roof form a single structure. According to Maguire who has been extensively involved in the identification and mapping of corbelled dwellings:

Stone for corbelled structures appears to have an optimum dimensional format, that is slabs that are approximately 3:1 in their length to width ration, but the size and shape of rock used in their construction is still being researched as is the precise manner of their packing. Packing technique is easy to see in corbelled huts which have collapsed due to structural failure. The reasons for such failure are also being studied. At this stage, it is possible to say that blocks which are too square create structures which are unstable^{7, 23}



Figure 28
Corbelled dwelling in Namakwaland (photograph: Ditsong: National Museum of Cultural History, Pretoria).

Rondavels

Rondavels form the core of the investigation and as mentioned in the introduction, this article merely highlights the occurrence of the circle as a spatial solution – one aspect of the investigation into the origins and history of the rondavel. For this reason, rondavels will not be analysed in detail in this article. Some general observations need to be highlighted though.

Rondavels remain significant vernacular building types in the entire classification and variety of form types of vernacular farm architecture. In terms of farmyard layout and spatial arrangement, rondavels can be clustered into two broad categories: (a) as separate buildings (or annexes) to the main residence and (b) as form type defining or included into the floor plan and spatial solution scheme of the main residence.

Where rondavels occur as annexes to the main farm residence they were used as a detached kitchen, a milk room (where milk is separated), a meat room (where meat is prepared after slaughtering of an animal), additional accommodation (sleeping facilities for visiting guests or as detached rooms for the teenage boys) or as additional work space (either for the farmer – as an office or for the housewife). Currently, rondavels are often used as space where farm workers are trained or where housewives assist in the administration of the farming activities.

The occurrence of rondavel houses or rectangular dwellings with a single or more than one rondavel (or circular room) attached to it is not the rule of thumb for early European vernacular architecture but many examples exist – to the point that it can be considered as a significant form type in the vernacular architecture of several regions.



Figure 29

Small rondavel constructed with blocks of dolerite and sandstone quoining around the window and as window sill (photograph: Ditsong: National Museum of Cultural History, Pretoria).

In some cases circular dwellings and structures were designed, manufactured and marketed as kits allowing farmers to order such a structure from a catalogue. Galvanised corrugated iron is a popular material for these structures. Water reservoirs, containers such as silos and even residential units such as rondavels were manufactured with this material and bought by farmers and especially building or other contractors, either as housing, site offices or as storage spaces.

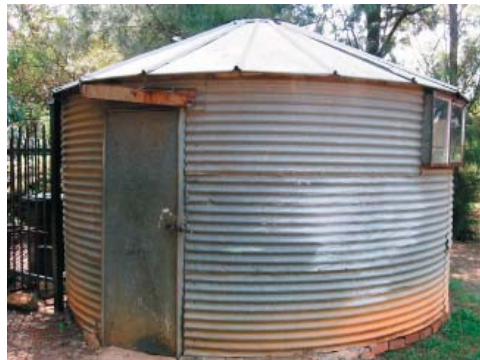


Figure 30

Prefabricated rondavel constructed from corrugated iron on the farm Zwartkoppies, Pretoria (photograph: M. Naudé).

Rondavel dwellings

There is general consensus that the single rondavel or the circular floor plan building is impractical as a residence. The rondavel is also an impractical building type as a kitchen and bathroom. One way to counter this impracticality is to either construct a ‘square-davel’ and to cluster numerous rondavels or rondavel type buildings together in order to create a rondavel house or to incorporate the circular building into another building with a rectangular floor plan. The well-known 1920-1930s South African architect Gerard Moerdijk noted this in the various articles he published in *Die Boerevrou*. Moerdijk promoted the design of an ‘Afrikaans’ dwelling but did not reminisce neither did he explore the current tendencies of the Boer dwelling as they existed in the landscape at the time.²⁴ Moerdijk never made any attempt to base his ideas of the rondavel house on existing traditions that may have existed in rural Transvaal.

In the case of the so-called ‘guesthouse’ of Gustav Preller on the farm Pelindaba (figure 31), the rondavel units were clustered into a single residence but instead of adding rectangular

spaces, the connected areas in between the rondavels were used to serve as more ‘practical’ interior spaces – with more or less rectangular shapes.



Figure 31
Preller guest house on the farm Pelindaba near Hartebeestpoortdam west of Pretoria (photograph: M. Naudé).

On the farm Koedoesrant,²⁵ two separate rondavels and a small rectangular cottage became a single dwelling unit when they were connected with a large verandah. This indicates the significance of the connecting passages, corridors, closed and open spaces in linking the various circular spaces together. In this way new spaces are added, often with odd shapes and always of varying sizes. These clusters do not have simple floor plans neither elementary roof structures as conical thatched roofs had to be linked and often only linked via flat roofed concrete slabs in between.



Figure 32
Rondavel dwelling with small gable building at the back, on the seasonal winter farm of the Bosman family (photograph: Ditsong: National Museum of Cultural History, Pretoria).

In the case of the dwelling on the farm Rietvlei (Rayton district, Gauteng) the façade of the original dwelling was flanked by two independent rondavels. When the dwelling had to be enlarged the original core dwelling expanded towards the rondavels and they were eventually linked to the main dwelling. Once again the space in between the rondavels and the rectangular dwelling was covered to form a covered verandah (similar to the example on Koedoesrant). The open façade of the verandah was later closed-off with a wall and windows to become a closed stoep and another ‘room’.

The phenomenon of rondavel houses has not been investigated in detail yet and it falls outside the scope of this paper to expand on the subject as these dwellings do not have a circular floor plan after they have been altered and extended. The circle merely becomes a feature and element of such a building.

Conclusion

The rondavel is a typical example of so-called ‘contact architecture’ – a term referring to the (in this case, the relatively slow) translocation of a foreign building form from one cultural group into the architectural vocabulary of another group. This paper does not focus on the use of this spatial form as a solution to spatial problems focused on ‘dwelling’ and ‘living’ but investigates this spatial form in a more general sense (as an exploratory investigation) – also from a vernacular point of view rather than a formal design angle. However, the occurrence of the circular floor plan or spatial mental framework seems to be universal. The occurrence of the circle as a form giving element in the construction of vernacular farm buildings and structures seems to be quite common (especially in the northern part of South Africa) and is not a unique engineering or architectural solution to serve the needs of early farmers and pioneer settlers in the interior of South Africa. The rectangular floor plan remains the dominating form used by early European settlers in the region for the construction for both residential units and other building types typical of frontier settlement.

The vernacular use of the circle as a spatial and structural solution to create living, working and storage space or as a method to create a building or structure with exceptional structural capabilities have not been studied and recorded for academic or historical purposes yet, but this phenomenon forms a well-defined niche in the study of vernacular architecture and engineering. The decision to use the circle instead of the rectangle as spatial solution for a particular function or use will always be based on functionality, but is often the result of finding a blend between the needs of the landowner and the knowledge of the black workers responsible for construction a circular building. It can be assumed that the occurrence of the circular phenomenon is not necessarily a clinical decision in order to solve a spatial problem but based on the availability of local knowledge of this building type (and the way it can be constructed) by the local indigenous people. However, it is clear that not all circular buildings and structures were result of an activity that is of a circular nature. Some structures such as rondavels are not circular because it makes civil engineering sense, but were erected because the construction of this type of building was an extension of a building typology known to the builders and acceptable to both landowners and local builders.

The rondavel as dwelling type has a more extensive and perhaps more complex history and was merely touched-on without a proper discourse as this topic cannot be thoroughly expanded upon within the limits of this paper.

Notes

1. Oberholster, 1972: 42.
2. Interview with Dr U Küsel (19 October 2009).
3. Interview with Dr U Küsel: The structure is located among the trees on the way to the cemetery and defined by a circular floor surrounded by a single row of stones embedded in the ground (6 March 2008).
4. Vd Waal-Braaksma *Die Noordweste*.
5. Internet: http://www.yzerfontein.info.history/lime_kilns.html.
6. Vd Waal-Braaksma, 1986:104.
7. Vd Waal-Braaksma, 1986:104.
8. Vd Waal-Braaksma, 1986: 104.
9. Vd Waal-Braaksma, 1986: 104.
10. Vd Waal-Braaksma, 1986: 106.
11. The author visited several examples during an investigation (for SANParks) of the remains of farm the dwellings and structures of early white farmers in the area along the Aoub River that eventually became part of the Kalahari National Park (currently known as the Kgalakgadi Transfrontier Park).

12. Farms in the Steynsburg district were visited on several field trips between 2007 and 2009 as part of a research project by the Department of Archaeology of the National Museum in Bloemfontein (in collaboration with the Department of Anthropology and Archaeology, University of South Africa).
13. Maguire, 2008: 22.
14. Neethling, 1917: page unknown.
15. Personal comment: Dr J.A. van Schalkwyk (Anthropologist, Ditsong: National Museum of Cultural History) notes that he has never seen the use of circular stone foundations mentioned in the text but the use of timber columns at the corner of a square granary seems to be the rule of thumb for the construction of granaries (4 January 2010).
16. Personal comment: Dr J.A. van Schalkwyk has observed several instances where pigs were kept inside small circular stone structures in indigenous African villages in the northern and western parts of the Limpopo Province. Pigs are considered dangerous animals and were kept inside these structures. The structures had no entrances or any openings that needed to be secured or allowed the pigs to exist accidentally. These pigs were fed on daily tit-bits and prevented them from browsing in the neighbourhood eating human and animal faeces (interview: 4 January 2010).
17. Oberholster, 1972: 42.
18. Oberholster, 1972: 43
19. Greig, 1970: 77.
20. De Clercq, 2002: no page numbers.
21. Oberholster, 1972:179.
22. Oberholster, 1972:180. In order to preserve these unique buildings in South Africa's vernacular architecture, the former National Monuments Council proclaimed five individual buildings at different locations in the Karoo.
23. Maguire, 2008: 24.
24. Moerdijk 1920 and 1921: *Die Boerevrou*.
25. The author did not visit the farm. The photograph was part of the collection of the Bosman family (of the farm Roodepoort - district of Middelburg) that was donated to the National Cultural History Museum. The history of the farm and this farmhouse has not been recorded but a series of photographs taken during the alterations gives some indication of the sequence of changes leading up to the dwelling's character on the photograph.

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<http://www.flickr.com/photos/south-african-tourism/3918664733>

Internet: http://www.yzerfontein.info/history/lime_kilns.html

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