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Planning and Designing an Animal Shelter “Ideal” for Animals

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Abstract

The design of an animal shelter is often overlooked. The right plan and design can however decrease stress and increase adoption rates. In this Thesis multiple ways of enrichment, design and planning an animal shelter were researched and put together to form a basic layout and sketch of an animal shelter and its compartments. The focus was on reducing stress in animals by providing adequate structures and enrichment strategies that were proven to be effective in current research. The main basics of shelter design such as the temperature, the colors of the structures and the important parts of the shelter were researched to form a plan and design and visualize it with a planning software.

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2 Introduction

As a veterinary student with an interest in animal protection, I came across the fact that no one has yet planned an animal shelter based on scientific research. However, for the animal welfare and protection it would be important to have a solid starting point from where one can establish a shelter.

For the ideal animal welfare of pets kept in shelters it is important to establish a basic layout and design to ensure the animals safety and wellbeing. Certain values of housing are important to be formed, so that we can find a basis for the building of a shelter. The operational management has influence on the health of the housed animals and is thereby crucial to the understanding of ideal shelter care. It is dependent on the species of the animal; therefore, this Thesis will mainly focus on cats and dogs. The aim of a shelter is to house animals on short or long term, so the layout and design of this is very important.

There is only a small source of literature available that is based on evidence on how to design an animal shelter the best way. It is a relatively new field of study. There are a lot of sources on the management and building. In this Thesis it was carefully evaluated which sources provide a good base for the design of an animal shelter.

The objective is to find the layout and design of an animal shelter that is ideal for animals. This starts with the basic structure of the house. The aim is to find a basic layout on where all the facilities of the shelter are placed. This includes an entrance area, a veterinary facility for the sheltered animals, an isolation unit for new arrivals, the animals' enclosures, the outside areas, socializing areas for animals, a break room for the staff, a kitchen for the food and a storage facility.

For the adoption process, rooms are needed where the future owner and animal can meet and get to know each other. The search will show if there is enough evidence that can suggest the look of such room and how it helps facilitate the adoption process.

From a veterinarian's point of view, there is always a clinical establishment inside of a shelter as well. We need to consider carefully which is the best placement of this facility inside the building.

After we have achieved a general overlook of all structures, we need to establish how to build a basic enclosure for a cat and a dog. This includes first of all the size, it should be appropriate for the species. Research will show what is the ideal requirement of a dogs or

cats enclosure. The structures we need to have inside of an enclosure is crucial to find, we also need to find a basic layout of each compartment and an appropriate positioning of the compartment inside the enclosure. Concerning the enclosure, we need to keep in mind the hygienic aspects as well as the animal welfare aspects. The flooring is important as well as the correct choosing of materials used on the walls. They are required to be disinfected easily as well as still be appropriate enough for the animals. Research will show which type of flooring is preferred.

Another aspect that is rarely considered in building an animal shelter is the coloring of the walls. Walls are usually chosen by the basis of human eyes, however a dogs' eyes see a different variety of colors. The correct color has to be chosen according to the science behind the vision of dogs and cats. Regarding the vision, the lights used in the facility are also an important factor, as different lights can cause certain reactions. Research will show which type of light causes which effect.

Some structures inside of a shelter can cause stress. In an ideal animal shelter these stress factors should be eliminated. As part of stress reduction, there is enrichment. It is well known that in any type of enclosure enrichment is needed. The type of enrichment depends on the effectiveness of the given methods. There is auditory, visual and olfactory enrichment. It is important to choose the correct enrichment strategy and find scientific evidence, which of the enrichment is effective enough to be considered in an ideal animal shelter. It is assumed that a lot of the current animal shelters are based on the human needs. To find out what are the animals' needs, we need to look at how they perceive their environment, according to current studies. The goal is to find out whether enrichment strategies are effectively used in animal shelters and how we can use them further in the future to help enriching the animals' daily life. A big part of enrichment is also the human contact, that also plays an important role on how effective the adoption process will be. Research will show how important the human contact is and what can be done to improve the interaction between animals and caretakers.

After we have researched all of the important factors inside of an animal shelter, we will form a sketch and design that is ideal for the animal. Sketches and Drawings will be created that can visually emphasize the results of the research in hand.

3 Literature Review

3.1 Definition of an “Ideal” Animal Shelter

3.1.1 The 5 Freedoms

To form a basis on how animals need to be kept, the 5 freedoms will provide a foundation of general animal welfare. Following a report at the Brambell Commission, the five freedoms were established in 1965. [1] These include a ”Freedom from hunger and thirst; Freedom from physical and thermal discomfort; Freedom from pain, injury and disease; Freedom from fear and stress; Freedom to exhibit normal behavior “. [2] These freedoms lead us to certain criteria for animal welfare: “Absence of prolonged Hunger; Absence of prolonged thirst; Comfort around resting; Thermal comfort; Ease of movement; Absence of injuries; Absence of disease; Absence of pain induced by management procedures; Expression of social behaviors; Expression of other behaviors; Good animal-human relationship; Positive emotional state”. [2] These can provide the essential requirements for an animal shelter. It has to be stated that these are the minimum needs for every animal and should be the baseline for planning any animal shelter or housing for animals. Furthermore, it is not to be used as a manual of operation, thereby it is depending on the institution who applies the needs and requirements. [1]

3.1.2 Guideline for Standards of Care

The Association of Shelter Veterinarians in the USA formed a Guideline for Standards of Care in Shelter Animals on the Basis of the 5 Freedoms. They conducted literature research and came to the conclusion that many shelters were designed for short-term handling of animals and are therefore not appropriate to meet all demands of the animals. In addition, there have been a few occurrences where the inadequate housing led to inappropriate care and caused suffering and in some cases death of sheltered pets.

According to the guideline, the primary enclosure has to be built in a way that animals cannot escape, avoid injuries and prevent other animals from getting out and should facilitate the cleanliness of the animal and area. Cleaning and care are more beneficial to be done without taking the animal out of the enclosure in order to avert transmission of diseases. Newly arrived animals should arrive to a clean and disinfected enclosure and kept separate until diseases are ruled out. The animal should have enough space for normal movement like standing and turning around and it should be possible for the animal to hold the tail up while standing without restriction. [1]

3.2 Understanding the senses of a dog and cat to create a better shelter design

As stated in several sources, one must use the senses of the animals to ensure we can understand their perception of their surroundings.

3.2.1 Vision

3.2.1.1 Vision of the dog

In order to choose the right colors to use in an animal shelter, we have to consider their vision and to what colors they react in certain ways. The aim is to choose a color that is calming and familiar to animals and that doesn't provoke fear and anxiety or stress. It is crucial, that we remember there are several different dog breeds and there is a difference in vision between all of them. As an example, sight-hound dog breeds are hunting by sight but terriers hunt by using odors. [3] Dogs have two cone-photoreceptor cells: a spectral peak of 555 nm which attributes to blue and 429 nm which attributes to yellow. An older study suggests, that because of these spectral peaks the dog has dichromatic color vision. [4] In a newer study this was confirmed by using a human modified color vision test. This showed that the dogs' dichromatic vision is similar to that of the human red-green blindness. [5] A study of two Shiba dogs also showed that the dogs were able to differ between red, blue and green compared to grey. The study came to the conclusion that the color vision is well developed and they are able to discriminate between the colors. [6] However, humans can recognize details of an object more clearly than dogs. Dogs can see the differences in details on an object four to eight times worse than a human. They can also distinguish brightness details, but they are two times worse than in humans. [5] In conclusion this shows that color is an important factor in a dogs' vision and we should consider it in building the perfect animal shelter.

A group of dogs indicated a preference of using cues of color over cues of brightness whilst identifying optical matter. Color is an important feature for dogs. According to a newer study dogs can also perceive UV-light. This would mean that certain objects are visible to the dogs' eye. As an example, any material that has phosphorous in it will fluoresce under their vision. Furthermore, it was suggested that they might be able to recognize the earth's magnetic field [3].

3.2.1.2 Lighting intensity and duration

Lighting cycles are important, as their activity depends on it. One source suggests to split the day into 12-hour blocks of light and 12 hours of darkness used in a cycle. [7] Another

study however came to the conclusion that there is no difference in sleeping time whether dogs are exposed to light over night or not. With light on dogs slept 10.5h/night while with the lights off they slept 10.8h/night. [8] Further studies are needed to evaluate the importance of lighting.

Natural light should be traced and measured to ensure the duration of lighting is sufficient. There should not be too much sun to prevent overheating. Depending on the season this needs to be evaluated. Dogs subjected to light of natural sources match their activity levels better to their daily rhythm than dogs exposed to artificial light. It might be because of the higher brightness of the sunlight. [7]

3.2.1.3 Light flicker

Modern artificial light bulbs are connected to an alternating current, this leads to a fluctuation or flickering. The technology influences the light flicker frequency. As an example, incandescent light bulbs flicker at a frequency of about 50-60 Hz. In comparison fluorescent lighting has a certain cycle where it flickers at 100-120 Hz. LED lights also have a flickering frequency, their brightness is in a lot of cases adjusted by adjusting the flickering frequency. However, they flicker at a high frequency of up to 200Hz. Computer monitors flicker as well, with a frequency of 42.5 to 75 Hz. In humans, studies proved effects such as neurological effects or headaches with different frequencies. In Albino rats and laboratory mice flickering artificial light has led to physiological stress and visual effects. When a light flicker becomes not perceivable by an individual, this is called the moment of Critical Fusion Frequency (CFF). Different studies measured the CFF in different animals. In the domestic dog it comes to 75. This was measured through behavioral studies. In the domestic cat this frequency is at 47.5. [9]

In conclusion the Light Flicker of incandescent light bulbs can be perceived and may cause effects in dogs. These types of light bulbs should be avoided. If we want to provide enrichment with showing certain TV shows to dogs or cats we should choose an LED monitor with a high flicker frequency, so that the animals are less likely to be affected by the flicker. For lighting we should choose LED lights. However natural lighting should be always preferred.

Fear Free suggests using red lights if lighting is needed at night. To balance natural light during the day, cool color temperatures ranging between 3500-4000 Kelvin should be used.

They also suggest adding brighter lights in adoption areas so that the activity of animals can be increased and therefore also the adoption rate. [10]

3.2.1.4 Visual Sense of Cats

One behavioral study evaluated whether cats have dichromatic or trichromatic vision and came to the conclusion that they have a dichromatic vision with a neutral point near 505nm. [11] They are exceptional regarding their vision as microspectrophotometric studies show they have a trichromatic cone system, however in behavioral studies it was revealed that cats have only a dichromatic capability of distinguishing between colors. The color vision is limited to nearby and large objects. Their vision might be described in a way that they are able to see apples as red, but cherries as gray. Compared to humans this results in differences in color vision compared to animals that are poorly understood. [12] Clark & Clark compared the cats' vision to that of human with deuteranopia, however Gelatt et al. did not make this assumption. Further Studies are needed in this field.

3.2.2 Choosing a color palette suitable for a shelter

After evaluation of the color vision of dogs and cats, one could predict which colors are the best to use in a shelter environment. Bright fluorescing colors are not suggested, as they can be visualized by the animals' eyes. It can be tested with a UV light lamp if a material fluoresces. Bright white can be irritating and glowing.

In a study in laboratory mice, it was shown that the color of the home cage had a significant effect on the body weight and food consumption and on behavior in a maze. Mice from a red home indicated greater anxiety levels. [13] Keeping in mind that dogs and cats see the color red as a dark grey tone, we should choose brighter colors and more blue walls, however studies need to be done on the effect of the coloring of the walls. We want to encourage the staff to move slow and feel calm, so we should also consider colors that are appealing and relaxing to the human eyes. [14, 15]



Figure 1 A color palette developed by Heather E. Lewis, an architect specialized in the Fear Free Design of Cat and Dog shelters [15]

3.2.3 Hearing

To understand the hearing of dogs and cats is important, because it is crucial for the positioning of the animal shelter itself, but also for the location of the dogs and cats within the shelter. The shelter should be placed in a calm environment, away from busy roads. Dogs and cats may hear sounds that are not apparent for humans and this can cause fear and anxiety. Additionally, it is essential to consider that the design and material of the shelter can contribute to loud noises. Sounds in a shelter can go higher than 100dB. It is known that after a 6 months exposure to the loud noise in an animal shelter it can cause a significant loss in the hearing ability of dogs. The problem of the shelter design is mostly that the structures that are meant to be hygienic can contribute to the reflection of sounds and leads to an increase of noise. [7]

Another Study showed that if in a shelter in the morning it starts quiet, but then increases the noise created by cleaning and feeding that this can induce fearful behavior in cats. [16] A solution can be to find Noise Control solutions.

3.3 Noise Control

There are a lot of factors to consider about the objects creating noises in a shelter environment. One of the main important factors is the kennel. If provided with enough enrichment, the noises created by barking can be reduced because dogs will spend more time with their enrichment than barking. Moreover, certain shelter designs can lead to overstimulation, in former guard dogs or reactive dogs. To decrease this, one can cover the front door of the kennel to reduce the vision a dog has on people walking by or dogs walking by. If the shelter or kennel has windows, we should keep in mind where it is pointing. Very reactive dogs might be placed in a calmer environment, facing for example the inner yard, while less reactive dogs can be placed at the busier environment. Dogs also should be provided with a hiding place, where they can hide from the visual stimulation if they want to rest. Additionally, the acoustic stimulation should be managed, music can decrease the audible noise from irritating sounds. [17] After lowering the stress, we can adjust the facility design to the needs of a noise-controlled environment.

Fear Free Pets is an organization dedicated to reducing fear and anxiety in shelter dogs and cats. They have published an article concerning the reduction of noise in a shelter environment. Reverberation needs to be reduced, the reflection of sounds from different building materials differs and thus, a suitable material for walls and the ceiling should be

used. The ceiling can be chosen based on a high Noise Reduction Coefficient, antimicrobial and cleanable. Fear Free suggests the use of the Rockfon Medical Plus ceiling panel, which has an NRC of 0.9. This equals to a reduction of 90% reverberant noise. In addition to the noise control ceiling sound absorbing panels should be placed on the walls, where we can choose the color to be used under the color palette suitable for dogs and cats. In addition, the separation of dogs and cats is crucial. In between needs to be a sound proof wall, as the barking of dogs can induce fear and anxiety in cats. [18]

3.4 Odor control

In a shelter environment odor control is a very important aspect, as the canine sense of olfaction is used for chemical communication and dogs can sense signals from the past, like presence of prey or enemies. [19]

Odor control can be managed by proper ventilation in animal shelters and a disinfection and hygiene plan. Similarly, by placing proper windows into the enclosures and providing enough time for dogs to go outside. Additionally providing appropriate cat toilettes can reduce littering next to the toilet and thus prevent odor. A source of odor can also be the drain. It should be disinfected regularly.

Frequent washing of bedding and blankets is crucial. The material should be durable and be able to withstand washing at higher temperatures.

3.5 Temperature and Ventilation

The air should be replaced 10-12 times per hour in animal housing areas. Nonetheless this depends on the number of housed animals. Air flow should be provided on a minimum of 1.5 walls. For this purpose, crate bars and plexiglass with holes for ventilation can be installed above the door or the front. For isolation areas the air flow should be separated from that of the main building. [20]

As recommended by the RSPCA the minimum temperature for dogs and cats is 10°C while the maximum temperature is 26°C. Sleeping quarters should be ventilated and have natural and supplementary light. [21]

3.6 Cleaning and Disinfection

Cages should be cleaned daily, while the opportunity must be provided that the animal can hide during the process. Cleaning should not cause distress in animals. Feeding gear should be cleaned thoroughly, stainless steel provides a good option. [21]

The problem of enrichment is, in most shelter environments, the more enriched an enclosure is, the harder it gets to disinfect. Cats are frequently carriers of feline herpesvirus and calicivirus. The expression of the disease is however dependent on stress levels. Consequently, if we can decrease the stress levels, we might be able to slow the spread of the pathogen. Disinfection is especially important for the case of parvovirus and dermatophytosis. Reduced shedding and reduced spread can be reached if we ensure a lower exposure to pathogens. In a shelter environment, we might refer to spot cleaning rather than complete cleaning and disinfection in order to decrease the stress during cleaning, but at the same time reduce the number of pathogens. This is of course if we don't expect new residents in the enclosure. In conclusion for the best shelter design, we need to keep in mind to ensure we reduce pathogen transmission to a minimum. [22]

3.7 Stress reducing structures and behaviors

3.7.1 Human Contact for reduction of stress in shelter dogs

Social Isolation can be a contributing factor to stress-related diseases. Human contact can help to decrease the stress levels of dogs upon their first arrival in the shelter. Dogs showed lower cortisol levels on Day 3 if they engaged with humans for a duration of about 45 minutes on Day 2. This shows that human contact can help reduce stress in shelter dogs. [23]

3.7.2 Human contact for reduction of stress in cats

In a study with 139 cats, cats were gently stroked four times a day daily for 10 minutes. Gentled cats had less anxiety than the control group. When anxious cats were gently stroked their production of IgA was increased and the occurrence of upper respiratory disease was decreased. [24]

Many cats also prefer human interaction over the interaction with toys. [25] Engagement with humans also provides for better reinforcement of positive social behavior and also lets the cat come more towards the "public" side of their housing enclosure. [22]

3.7.3 Visual Enrichment

3.7.3.1 For dogs

A recent study from 2021 evaluated whether a program called "DOGTV" is beneficial for dogs in a shelter environment. DOGTV is a TV-channel specifically made for dogs that are left home alone so they can watch TV. The researchers had limited findings, so more studies are needed in this area. The salivary cortisol stayed the same before and after the intervention. Dogs spent less time hiding in the kennel and increased the time spent in the

front. In conclusion, a low stress environment was already existent before they used the DOGTV. They suggested that a DOGTV is especially beneficial in quarantine areas where they have less human contact. The programs have a focus on the dichromatic vision of the dogs. [26]

3.7.3.2 In cats

Shelters have been using TVs as a form of enrichment for shelter cats. Especially combining prey elements and linear movement can be a potential for visual enrichment. [27]

As part of a cats' predatory instincts, they can detect fast movements. But cats also communicate through visual social communication. This includes body posture, facial expressions and tail positioning. Visual Enrichment is one of the most important factors in the shelter environment. Shelter cats also prefer toys that are moving, they prefer moving feathers toys over stationary mouse or feather toys. [28]

In a study with 577 indoor cats a total of 84,3% spent time looking out the window with a total of 5 hours or less during the day, which is less time than expected by the author of the study. [29] Nevertheless, windows are a necessity and can provide a great way of socialization, enrichment and a source of natural light.

3.7.4 Olfactory Enrichment

3.7.4.1 In Dogs

One study suggests, that there is no significance of olfactory enrichment used alone. They used lemon, rosemary and vetiver essential oil. [30] However another study suggests that using dog appeasing pheromones and lavender can get the dogs to lay down more and vocalize less compared to a control group that was not exposed to these stimuli. [31] In a publication about shelter dogs, it was found that dog appeasing pheromone can help increase resting periods and "response to a friendly stranger". [32] In contrast to this, a study was made to test out the effect of dog appeasing pheromone collars in long term housed shelter dogs. The result was there was no significant effect seen. [33] This shows that further research is needed to show if there is an effect of dog appeasing pheromone on shelter dogs. There is not enough evidence that suggests that we can use this in an ideal animal shelter.

3.7.4.2 In cats

A study showed that using catnip and prey-like smell impregnated on a cloth can help to increase the time spent sleeping, reduce the time standing and exploring and increase behavior suggested as catnip response. It might be beneficial to use them in a shelter

environment to use as an enrichment. [34] Catnip is in most cases preferred. However, there are individual differences between cats. Some cats prefer silver vine or valerian root. In a shelter, the keepers can provide toys or scented cloths with smells to provide a form of enrichment. Another form of olfactory enrichment is also by providing scratching and scenting posts. [28]

3.7.5 Auditory Enrichment

Several studies investigate the effect of auditory enrichment on laboratory animals and chicken. There needs to be a differentiation between noise and music. Korsós et al. tested the difference between noise and musical effects on young broiler chicken. The response to noise compared to music was similar seen in the behavior and endocrinology of the birds, the authors concluded however that the background music can be beneficial in terms of labor safety. [35]

As an addition, rats exposed to classical music during and before a task given to them, showed improved “hippocampus- dependent spatital learning capacity”. [36] According to a study by Fekete classical music decreased the activity of laboratory rats, in specific: a rodentized version of music. The rats reacted with being more calm and spent more time grooming and sitting. [37]

The use of Mozart and Bach was beneficial as a type of auditory enrichment for laboratory rats. In a trial, the use of rat-specific human music did not show significant benefits because of their differences. For mice, the human music did not have beneficial effects. Rats were more involved with human music compared to mice. This shows that the species difference is important to consider. Zoomusicology leaves a lot of room for additional research of the auditory enrichment.[38]

3.7.5.1 In dogs

Some sources recommend to use music as a way of enrichment for dogs. It can have a calming effect, decrease stress and increase sleeping time. It also enhances the time lying down and decreases the vocalization. [39] Especially classical music was used and showed it can be beneficial to use. It should be played at around 60dB or less, when the dogs are active. It should never be used when the animals are sleeping. White noise can also be beneficial to be used.[7]

Music in an animal shelter might have a positive impact on the mental health and physiological health of dogs. The use of music can also be beneficial for staff and

veterinarians. Nonetheless it is important to understand that only a certain type of music should be used. Studies showed that heavy metal and rock music increase barking, vocalization and standing. The pitch, tempo and volume have to be considered. [39]

Classical music is a broad term, one literature research came to the conclusion that if human voice is included in the classical music, it can be even more beneficial. Audiobooks showed an even better response than classical music. However further research is needed in this field. Some dogs preferred silence over music, so it is up to the individual whether a dog likes a certain type of stimulation or not. [39]

After a certain time of playing the same type of music dogs became habituated to the type of music played. [40] This shows that a variability of music should be chosen.

It is becoming crucial to underline that the importance of watching each individuals' behavior is important. This way we can decide which type of auditory enrichment is the best and easiest to use in a shelter environment. However, one must consider the practicality of such enrichment techniques. It might be hard for each worker to watch each individuals' reaction to music.

3.7.5.2 In cats

One study created a music that is species specific for cats. They evaluated the frequency range and tempo of the natural communication of cats. This way they developed a specific music style that is suitable for cats. Cats showed a higher interest in the species-specific music compared to the human music. [41]

Another possibility is the enrichment through human voice. In a one-minute time setting the cats spent on average 51.2% time with the person interacting with them. [25]

3.7.5.2.1 Book Reading as a form of auditory Enrichment

Recently a study was published that suggests reading books to dogs and cats can be very beneficial for the human-animal interaction, as well as to promote them with human contact. When a human was present and reading, dogs spent a significant amount of time in their beds and observed the source of the voice. Cats tried to scratch the door and tried to get to the human. They showed a better interest in a human that was sitting in front of their kennel compared to an audio that was played. If we keep in mind that these behaviors might be beneficial for adoption this would be an ideal form of enrichment. [42]

3.7.6 Feeding toys as an Enrichment technique

3.7.6.1 In dogs

The use of feeding toys, such as the Kong Extreme can be very beneficial to use for increasing the time spent on appetitive feeding behavior, it can provide a higher activity level and it decreased the time barking. These toys could increase the welfare of the dogs because they are more rewarding then just providing them with their food from a bowl. The food needs to be palatable enough according to the animals' needs, as it can decrease their time spend with the enrichment toy. It increases the activity of the animal in the shelter and can prevent obesity. The material and the form of the toy is also crucial. It should facilitate the activity standing up and walking around instead of calming. There was also a decrease in barking recorded. This can be used as a very good enrichment strategy for dogs. [43]

3.7.6.2 In cats

Food puzzles can provide an excellent form of enrichment for cats. Usually, cats can acquire the food by using their paws or their nose. Wet food can be used for stationary puzzles, while dry food is best used for mobile puzzles. The cats need to get introduced to the toys so they can learn how to interact with them without feeling frustrated. Feeding enrichment can provide a lesser shown negative behavior and benefits weight loss, decreases aggression towards their keeper and reduces fear and anxiety. [44]

Through the presence of enrichment toys in a group environment the aggression between the cats was not increased. Yet there was an individual preference between the cats concerning if they chose to interact with the feeders. Through using feeding enrichment, animal keepers can provide different types of food such as dry food or wet food and assess the individual preferences of the cats. [28]

3.7.7 Environmental Enrichment

3.7.7.1 Environmental Enrichment in cats

3.7.7.1.1 Handling

In most shelters the keepers are providing enrichment to the cats by interacting with them. In laboratory-housed cats the cats preferred direct contact over playing with toys, but this is influenced by the socialization of the cat. [45]

Petting towards the temporal region is especially beneficial. Petting in the caudal region is less desired. The belly should be avoided, as it is a sensitive area to the cats. Another role

plays the consistency of the handling. Significantly more cats were adopted when they were regularly handled by the keepers. It also lowered their stress level. [45]

The way of handling plays an important role as well. In a study with 100 cats the shelter educated the handlers to follow a “CAT” principle by paying close attention on how the cat reacts to certain movements and to watch over the body language. The results showed those cats handled with best practice handling guidelines were showing more positively associated behavior than the control group. [46]

Clicker training can also be used as a successful enrichment form. Spin, sit, target and high-five can be trained. This increases the exploratory behavior of cats. Moreover, training can provide a decrease in frustration and increase in content. It can also provide with more appealing behavior for future adopters. Problematic cats could be trained by the keeper to show less negative behavior. [28]

3.7.7.1.2 Group interaction

A variety of studies were produced to determine the effects on stress levels in single housed cats vs group housed cats. Conversely, they showed mixed results. There should not be housed more than 0.6 animals per m² to avoid high stress levels. [47] Compared to cats in single housing units, the cats housed in group environments showed elevated levels on a stress scoring test. [48]

If cats were moved from group housing to single housing, they didn't experience a significant increase in stress levels. But cats in groups were more active than cats in single housing. More active cats can be beneficial for adoption and are more likely to be adopted. [49]

A suggestion can be to try if a cat is comfortable in a group setting and monitor its fear and anxiety signs.

3.7.7.1.3 Floor space and vertical space

To increase the enrichment possibilities in a shelter environment, the vertical space can be used. Providing shelves, ropes, climbing poles and cat trees can be very positive to offer cats different points to retreat but also to observe. Providing additional structures for hiding and having the right number of beds in a group house for cats is an important problem to consider. The BC SPCA developed a special hiding box that provides a cat an opportunity for hiding, but also a look out point on top of the box. It is big enough to give the cat the option to hide

from exposure to the outside but also to enable it to lay in a way that it can observe its surrounding. [45]

3.7.7.2 Environmental Enrichment in dogs

3.7.7.2.1 Handling

Human specific contact might be more important to dogs than contact with other dogs. The behavior of dogs can be influenced by the presence of humans. Kenneled dogs become more active when a person suddenly appears. Daily grooming sessions can help improve the human contact to dogs in shelters. Grooming should be done by male and female caregivers. Behavior therapy can also be beneficial for shelter dogs, as it would decrease the return of dogs to the shelter. Play between the dogs and keepers can also be beneficial. [50]

3.7.7.2.2 Group interaction

When dogs are housed alone, they show more stress related signs. Such as repetitive behaviors, circling, feces eating and vocalization. Socially housed dogs show less signs of aggression and fear and show also more positive responses to humans. Furthermore, dogs housed in single shelters showed more signs of aggression after being adopted. Social contact is beneficial but also comes at the cost of more training and monitoring from the staff. There might also be disease and injury. In a study the visual barrier between crates were removed, so that the dogs in the shelter can see other dogs. This did not increase vocalization. Additionally, there was no decrease in stress related signs. The authors suggest that providing a choice to the dog to decide whether it can see its neighbor might be beneficial to the dog. [51]

3.7.7.2.3 Toys

Dogs prefer Nylabone chew toys over squeaky-balls, non-squeaky balls, tug rope and boomer ball. The dogs spent little time playing with the toys. Toys are suggested to be rotated to reduce habituation and encourage exploration. Their welfare can be enhanced by providing suitable toys. [50]

In another study dogs in a rescue center didn't appear to benefit from toys significantly, the authors suggested that the environment in a shelter might be already so stimulating that it does not improve. Potential Adopters might find it more positive if a dog has a toy in its crate, so it can be beneficial for the adoption of a dog. Habituation of a toy in older dogs is faster than in puppies, so care has to be taken with that. [52]

The color of toys also plays an influence, as stated before. In a study it was shown that dogs prefer blue and red toys, which confirms the study of the peak sensitivity as stated earlier in the color vision by Neitz et al. and Jacob et al. blue toys were selected more than any other toy. In the absence of a blue toy, the dogs preferred the red colored toy over green and yellow. Blue toys were also interacted with longer when they were chosen. [53]

3.7.8 Using Artificial Intelligence for a better Shelter Design

A very recent study was conducted on mice, where cameras were used to assess an animal's behavior. The system, called AVATAR is a chamber with multiple cameras – 1 on the bottom and 4 side views. The system can detect the body parts and how they move. The program called AVATARnet analyzed the data from over 1000 mice and used it to construct a model of a mouse on the computer. The program was able to calculate the 3D position of a body part. [54]

Now if we think this more through, in the future one might be able to use a camera connected to a computer with an artificial intelligence to evaluate the behavior of a dog inside its shelter. This can save a lot of time for the workers. It could adjust the type of music and enrichment strategy used to the dogs' preferences. We could bring this concept even further, an artificial intelligence might be able to analyze a dog's daily behavior, choose the best time to go for a walk for example. It can also help to conduct further research on behavior of shelter animals. The opportunities of this are important to be considered and are important for future studies.

3.7.9 Capacity for care

Capacity for care was researched and developed for the better shelter management, keeping in mind the five essential freedoms. It improves the flow through the shelter to achieve a reduction in the length of stay through its recommendations on the keeping of the cats. One of the key points is the "scheduled intake". Owners that surrender their cats, organizations that catch stray cats and other individuals surrendering their pet have to make scheduled appointments to surrender their pets. This provides the option that only the number of pets is brought in, that the shelter has enough capacity for. This way we prevent overcrowding and we provide sufficient space for all animals. It also includes providing an adoption floor, where the pets most suitable for adoption sit. This way we ensure fast adoption. Special events are held where people can come and adopt cats and dogs. It also provides a good online presence to present the most adoptable cats with their traits. The aim is to shorten the

adoption process as a whole, this includes changing from a long list of requirements in a form to a conversation with the potential owners. [55]

3.7.10 Housing Capacity

Based on a thoughtful analysis of the flow through the animal shelter we calculate the housing capacity of the ideal shelter. The optimal shelter population of cats is calculated by determining the number of cats the shelter aims to take in based on the available housing units, from which we will get the average daily population. This is multiplied with the length of stay (LOS). The length of stay describes how long each cat spends in the shelter on average. As an example, the Journal of Feline Medicine and Surgery states that a shelter admits 5 cats a day and keeps each cat for 30 days on average will require a capacity of 150 housing units once a steady state is reached. The length of stay can be lowered by increasing the adoption rate and optimizing the admittance of cats into the shelter. As a consequence, if it decreases the minimum housing number also decreases. [22]

However, the minimum number should be based on multiple factors including the flow through and the units compared to the available space.

According to the ASPCA the adoption rates were higher when the potential adopters got to see less cats housed in the shelter. This has to do with the psychology of people, a study from 2018 suggests if people have more choices, they have bigger fear of making the wrong choice and thus, less options provide for easier choosing. [56]

As a consequence, if we decrease the intake of cats of an animal shelter it will improve the adoption rate. If we implement these factors, we can achieve a lower stress environment by giving more space and a faster adoption process. A longer length of stay also increases the stress and anxiety.

On average in most shelters cats don't stay longer than 3-4 weeks, which is to be taken as the Length of Stay. After an expected monthly intake is determined, we should house not more than 75-100% of the calculated result. [22]

3.7.11 Animals first entering the shelter

Incoming animals should be quarantined on arrival for at least 7 to 10 days for dogs and 14 days for cats. It can be adjusted to the incubation period of common diseases in the area of the shelter. There should be a dedicated shelter area where the ventilation is restricted to that area. Disinfection should be done daily. The animals should be examined by a vet within 24

hours of their arrival, necessary treatments should be done and animals should be dewormed and vaccinated. While the animal is in quarantine, we can observe its behavior and decide whether it should be housed in single housing or group housing. Information gathered should be documented. [21]

3.7.12 Animals getting adopted

To ensure the animal matches with its future owner the shelter should provide questionnaires or talks with the future owners. Finding the right match is especially important to prevent early rehoming to another owner or to prevent the owner from bringing the cat back to the shelter. Animals should be assessed in their needs and behaviors. Animals showing behavioral abnormalities such as aggression towards humans should be provided sufficient training so that they can be adopted out. Only healthy animals should be made available for adoption. [21]

3.8 Stress Reduction for Workers

The stress of workers can transmit itself onto the animals, stressed workers might elicit a behavior that can negatively affect the animals. Stress also leads to making mistakes for example when cleaning. In a study about occupational stressors in workers in an animal welfare organization in Canada the most common sources of occupational stress were the feeling of not being able to provide enough care for the animals due to limited funding and resources which is related to understaffing and overwork. This can be changed by adapting the expectations of workers to the reality of the animal care that is possible to be provided. Emotional stress is a big factor, as well as communication problems between shelter units. Communication training might be useful for staff employed by the shelter. Team meetings should be done regularly. It is suggested to also provide the employees the choice of shift, personalized work areas, flexible working hours and rest breaks. Other stressors might stem from public work, social media threats or public protests. Sometimes euthanasia is necessary and negative public perceptions were associated with threatening the employees through social media. There should be regular organizational wellness programs such as team meetings and team building events, regular training on how to deal with occupational stress. Mental health and stress management workshops might also prove beneficial. [57]

3.9 Layout of the Building

The first priority should always be the prevention of disease spread. Isolation and Quarantine areas should never be accessible to the public. The reception area is the first place where

people enter the shelter. It should be clean and accessible. It should be clear where to go when entering. There should be a very small waiting area for people who come into the shelter. The administrative office is the important part of the shelter, as it overlooks and manages the shelter. The records are stored here. It should have access to both the shelter area and the reception. A veterinary office is placed next to the isolation and quarantine area. There will be a separate entrance to the veterinary room with a separate ventilation system. A cold storage should be provided for storage of carcasses, unless there is a crematorium on site. The local authorities should provide information on the appropriate disposal of carcasses. There should be an animal food preparation room with a sink, an access to hot and cold water and a refrigerator. Counter space to place the bowls and storage should be provided. The food should be stored off the floor in vermin safe containers. For staff there should be a wash area with toilets and a shower if possible. [21]

Guidelines for the building of Veterinary Clinics can be applied in certain aspects to the shelter design. The isolation room should have limited foot traffic, as well as an anteroom so that people can change their clothes and disinfect their hands. There should be a disinfection station. Deep sinks should be used to prevent scattering of organisms onto walls. Antiseptic lotion dispensers should be located around the building. [58]

The floor should be smooth and easy to clean. Floors for shelter should be resistant to punctures or impacts, resistant to scratches, stains, odor, urine and animal waste and should be easily disinfected. But at the same time slippery proof to prevent injuries. Another aspect is that humans usually focus their gaze on the wall or on the floor when walking through somewhere, so it has to be appealing and calming to the keepers in order to prevent further stress. The paint and material should be according to antimicrobial standards. It should be comfortable and suitable enough for long standing and walking. Ideally it should be monolithic, seamless. As an example, epoxy or methylacrylate flooring, sheet vinyl products might be used. The surface should not be completely smooth, as this can be a source of injury. Vinyl tiles are available with low-grade textures. The wall base should be covered with a rubber base. The better solution is also to continue the flooring material up the wall, which makes it easier to clean. Floor drains should be placed in suitable places, as they can harbor bacteria and should be frequently disinfected. [58] A drain should have at least a diameter of 20cm that is to be covered with a strainer grid. There should be main sewers or septic tanks. [21] Acoustic ceiling tiles should be used to minimize the auditory stress. [58] Windows that can be opened should be covered with insect screens. The outdoor area should

be carefully thought through. Gravel flooring is preferred over grass or earth but it must be thoroughly washed.

Shelters should be designed in a way that they maintain animal health. They should be species-appropriate, managed according to the number of animals and their duration of stay. This is to ensure physiological and psychological comfort. [1] In order to do so, the design should separate the animals by their age, gender, species, health status, temperament and predator-prey status. There should be enough space for all the shelter operations. The movement through the facility should be arranged in a way, that the animals most susceptible to disease or contagious disease should be managed last. Healthy animals are to be managed in the beginning. At least 10% of the housing should be available for isolation. [1]

3.10 General requirements

When designing any shelter area, there are some basic features such as cage doors. Doors should be made out of a material that is easily disinfected. There should be enough oxygenation coming in. A mix of glass and hinges on a door might be more beneficial than just hinges. Partial visual barriers, especially for cats are important. Bars might make loud noises when opening and closing and can lead to stress. Care should be taken when opening and closing. Metal-on-Metal might create a lot of noise, so special door latches can be used for the doors. The best is to check the latches before implying them in a shelter.[22]

As for the material of cages, for usage for example in the isolation unit, it should be non-porous and there shouldn't be any crevices or cracks where bacteria or viruses are harder to reach while disinfection is used. Stainless steel is recommended in areas where high disinfection is needed. It can be combined with plastic as well.

3.11 Design of Shelters for Cats

3.11.1 Sizing of the enclosures

The RSPCA recommends a minimum size of a cubicle to be around 2.2m². [21] The association of shelter veterinarians suggests the distance between the Litter, Resting Area and Food area to be at least 2 feet (0,6m). Cats housed in 5.3 square feet (0,49m²) area of space showed higher stress responses than cats housed in 11 square feet (1,02m²) of floor space. Thirty cubic feet (0,84m³) per cat are recommended in the guideline. For group housing the minimum space per cat is stated at 18 square feet (1,6m²) per cat. [1] There should not be housed more than 0.6 animals per m² to avoid high stress levels. [47]

3.11.2 Double Compartment Housing

Double Compartment Housing is a form of housing animals that provides a comfort for the cats, helps their well-being and can be beneficial for use. It is easier for staff to maintain. Connected by a portal or door, two units of housing provide a place to hide. The animal can access both compartments at all times. During cleaning the animal can escape to one side of the enclosure. Because an animal's natural behavior is to urinate and defecate in another area than where they sleep and eat, the double housing provides a good space for them. The University of Wisconsin Madison conducted research that shows that there has been a significant difference between cats housed in single and double compartment housing. The animals' needs were better met in a double housing area. Restricted Housing causes stress in animals and thus it can facilitate the development of diseases, like Herpes-Virus induced Upper Respiratory Infection. When animals don't know their caretaker yet this type of housing is beneficial because they can hide away from their caretaker if they wish and during the daily routine the risk of transmitting diseases from one animal to the next is reduced. [59]

3.11.3 Hiding Boxes for Stress Reduction

Cats with hiding boxes are able to recover faster when exposed to a new environment. It is an important enrichment for cats so that they can cope with stressors in a new environment [60]. Furthermore, it takes around 72 hours for cats to adjust to a new shelter environment. [61] Hiding boxes as a form of enrichment are very beneficial as they decrease stress levels and cats in a group provided with hiding enrichment showed a significant reduction in stress. [62]

3.11.3.1 Soft surfaces

Cats prefer to have a soft surface to lay down. In a study, pillows were given to laboratory cats and they laid down more. Treading behavior was only exhibited when the pillow was present. [63] Polyester fleece is the preferred material to lay on, while cardboard and woven rush-matting is not desired. [64]

3.11.4 Cat toilettes

At least one per two cats of litter boxes are recommended. [64] However newer recommendations aim at 1 litter per cat plus one extra. In a study cats preferred litterboxes of 86cm in length over the smaller commercially available litterboxes. [65] The litter box should be designed in a way that the cat can comfortably turn and dig in it. Cats preferred

clay or silicate substrates over wood pellets, with a preference of clay substrate over silica substrate. [66] There was no significance shown in the preference of covered or uncovered litter boxes. There were however individual differences. [67]

The right litterboxes are important to prevent stress related diseases such as feline lower urinary tract disease. To prevent excessive spread of litter, top entry litter boxes may be preferred. However, since cats have individual differences, it is best to provide different litter boxes with different entry systems and covered and uncovered. In a group housing this can be done easier than in a single housing.

3.11.5 Cat scratching post

Cats prefer scratchers covered with rope and cardboard over scratchers covered with sofa fabric. Catnip increases the scratching duration. [68] Cat scratching posts are an important part of feline welfare as cats use scratching to communicate and to mark their territories. It is also used to sharpen claws and maintain their length to provide with withdrawal and extension of the claw. While scratching, cats leave a trace of pheromone which is called Feline interdigital semiochemical. In a study it was suggested that cats preferred the scratching posts with the FIS over the scratching post without FIS. [69] However further studies are needed to proof the usage of FIS in a shelter environment. Cat scratching posts are an important part of enrichment. Cats also prefer to have scratching posts that are inclined over a scratching post that is positioned on the ground. [28]

3.11.6 Scent Marking Spots

As a form of enrichment, scent marking posts can be used. Cats living in outdoor enclosures showed a scent marking behavior with urine spraying, depositing feces, object scratching and object rubbing. Within these the cats were moving and spreading out their scent. In a shelter environment this behavior might be inhibited by the frequent cleaning and disinfection. For this, shelters can use spot cleaning to avoid the removal of scent surfaces. Scent Marking Spots for scratching should be distributed around the shelter, to provide enough scented enrichment. [28]

3.11.7 Drinking Fountains

In a study with 13 cats a fountain didn't increase water intake significantly. A greater water intake could help dilute urine in cats. [70] In another study the method of water presentation did not significantly influence the water intake.[71]

3.11.8 Outside area for cats

In a study with indoor cats, it showed that an installation of a controlled outdoor area can be very beneficial for cats. The cats showed less aggressive behavior like scratching or biting. [72]

Europe's biggest animal shelter, the animal shelter in Berlin provides a big outdoor area for cats, as shown in the picture below.



Figure 2 Cat Outdoor Area in Berlins Animal Shelter [73]

3.12 Design of Shelters for Dogs

3.12.1 Sizing of the enclosure

Each dog should have at least 2m² of covered and draft-free accommodation with a raised bed surface. They require at least 2.5 – 3.5m² of open exercise run. The fences should be at least 2m high and made of mesh and slope inward to prevent animals from climbing over. They also must have a view outside of the kennel. [21]

Dogs in single housing usually were more inactive and showed more stereotypical behavior like circling. [74]

A study showed that 9m² head space is more beneficial for dogs than a head space of 4.5m². Dogs with more space showed an increase in activity. They also showed a higher amount of positive social interactions when housed in larger areas. This was shown to be beneficial for adoption. People prefer more active dogs for adoption than less active dogs. [75]

3.12.2 Double Compartment Housing

In a study with dogs housed in double compartments, dogs had two areas. One area with bed, food and toys and an empty area. The dogs showed elimination behavior mostly in the empty compartment. This can be beneficial for the cleaning and provides a lower stress environment, as the cleaning is limited to the other compartment while dogs can hide away if they wish to. [76]

3.12.3 Layout

The provision of a high platform where the dogs can look over the barriers and observe its surroundings proved as beneficial. In a study, dogs were on the platforms for over 50% of the time spent observing them. It might be beneficial to give the dogs a place to lay in the front of the kennel to increase their adoption rate. [77] One of the best and most comfortable form of dog housing is a rounded shape. In a paper about facility design the authors suggest a ring of linked but separated single story buildings. Visitors can circulate and see the inside and outside of buildings. In the middle there is a central service area, while the kennels are arranged around it. The beds are heated in this kennel. Dogs have 24h access to a covered outer exercise area. The buildings are surrounded by grass or paved exercise areas. During daytime, the areas are used for exercise and training under supervision. [78]

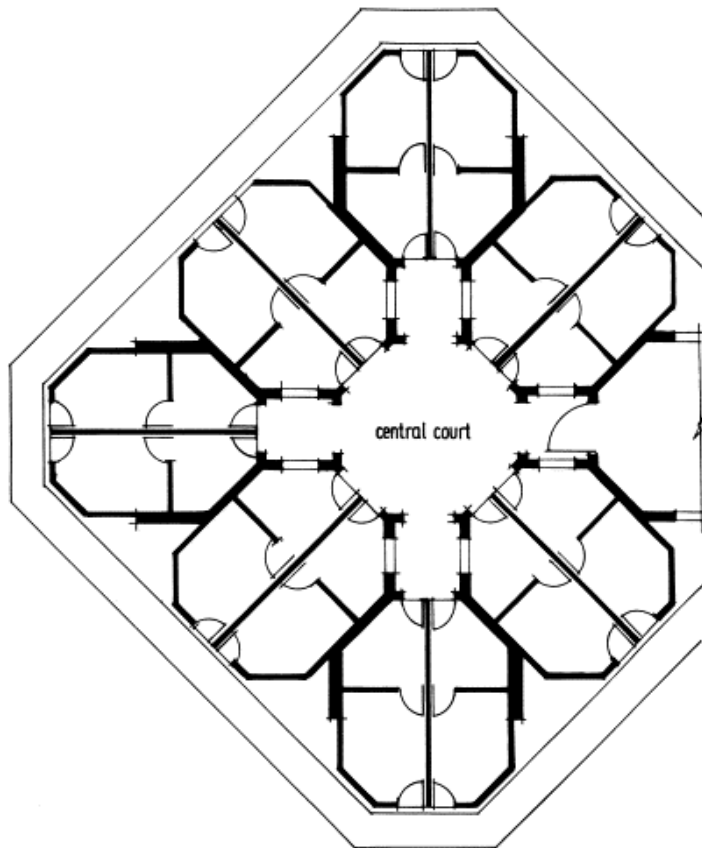


Figure 3 A kennel ring designed by G.G. Loveridge [78]

Octagonal shapes can provide an excellent option for shelter design. Each octagon faces the central courtyard for easy access. In the center there was a building with all the important facilities. In this design, a size of 7.5m² for small breeds, 9.5m² for medium breeds and 19m² for giant breeds was used. Natural light was used by providing large areas of glass in all compartments. For every octagon there was a separate air ventilation system. Dogs were housed in pairs and puppies in groups of three. The pens in this design were cleaned daily and feces were collected three times daily. The use of vinyl flooring was combined with epoxy on the walls, which provided the best concept for the authors. Dogs were lead walked daily. [78]

The round shape as a design future was also used in Berlin's animal shelter and provided a good structure. The size is about 16 hectares with four catteries, six dog shelter houses, a house for small animals, a house for birds and a big enclosure for outside cats. [79]



Figure 4 The Animal Shelter in Berlin, as seen from above [79]

3.12.4 Dog beds

In a study with elderly laboratory beagles, dogs preferred soft beds on a floor level over beds that were elevated. The author suggests that dog beds should be easily accessible. [80]

For the usage of beds, it is important to remember that dogs might chew the material and it can relate to foreign body issues. [81] Observation by staff is therefore important.

3.12.5 Daily Walks

Daily walks are associated with better behavior and adoption rates and less euthanasia rates. [82]

3.12.6 Contact to Keepers

A study showed that dogs form an attachment bond to people after only minimal contact. When a regular walking program was suddenly interrupted, an increase in fecal cortisol levels but also inactivity and barking was observed. Daily walking proves to be important and should be done by the same person if possible. [82] The daily walks might be limited depending on how many employees are available. For such, a volunteer program might be beneficial for the dog's welfare.

3.13 The Veterinarian

In every animal shelter there should be a veterinarian present. To make a veterinary visit free from anxiety can be crucial in minimizing stress in a shelter environment. In the veterinary clinic environmental stressing factors are auditory and olfactory stimulation, interactions between patients and separation from owners, and being in a new space. For animals that are still in development a stressful veterinary visit can lead to a series of neurochemical events that have negative effects on the learning behavior of dogs. Being afraid of the veterinarian means stress, and in some cases, owners might not bring their animals in just to avoid the stress of their animals. If dogs and cats have repeated fearful experiences at the vet, this can be avoided with counter conditioning them, for example with food. [83] In a shelter environment, before the animals are brought to the vet the keepers can train them to accept the veterinarian. Providing a favorite toy can help. In a shelter environment the veterinarian can also visit the dogs and cats in the shelter regularly to get them used to seeing the veterinarian. This is beneficial for the future of the animal and the future owner. Veterinary personnel in the shelter should be trained on how to approach fearful animals the right way. Proper restraint techniques should be learned. Never punish an animal that is fearful, as it can elicit aggression. Muzzles might be required for the safety of staff. The exam table should have a non-slippery surface and animals should have enough time to get to know the environment. [83]

3.14 Isolation Units

Isolation units should be designed in a similar way like the shelters, however they should be as isolated from the other units as possible, while at the same time being close to the veterinarian. Double compartment housing should be applied, so that animals can hide away if they wish to. Animals should have the possibility to hide away.

4 Materials and Methods

The aim of this Thesis was to find the basic layout and concept of an animal shelter ideal for animals based on researching topics and articles presented in different studies that are all available as smaller studies but never brought into relation with building an animal shelter as a whole. A thorough literature research was done to find as many aspects of an animal shelter as possible.

My aim was to provide an overview in a way that it could provide a possibility help a shelter to reach its full potential. It has to be kept in mind that the economical aspect is not included

in this research and leaves room for further research. For the proposal of a shelter design a software called Krita 5.0.6 was used and the rooms were drawn by hand and colored by hand with a pen on a Touchscreen Laptop. For the proposal of a Layout a software called Sweet Home 3D was used.

5 Results and Discussion: Proposal of a Shelter Design

5.1.1 Layout of the shelter

The layout is rather traditional, however functional and compact. The Entry can be entered from the parking area for visitors. From there you can access the office, where a meeting room for the staff is placed but also 3 desks with 3 computers for the optimal management of the shelter. To the other side of the entry there is the veterinary clinic from which the isolation area for dogs and cats can be accessed. There is also a room for storage. Through the entry there is a door that leads to the back where there is a changing area with showers and toilets. From there one can go further to the feed kitchen and break room for staff. The break room can be accessed from the inside and outside. Two big corridors lead to the animal compartments. The dogs are placed on the left side of the building, while the cats are placed on the right side of the building. Each compartment room has access to the outside. The compartments outdoor areas can be reached from the outside. Each gate can be opened by remote control. There are larger spaces for bigger dogs and smaller spaces for smaller dogs, which are still really big and spacious. The size of the rooms should be adjusted in the further building and design process. The cat space is managed in a way that there are different rooms for different socialized cats. There are rooms with windows to the neighboring cat rooms, but also rooms without windows to the neighboring rooms and just pointing towards the outside. There are also rooms which provide access to a larger outdoor area for cats that can be housed in bigger groups. The shelter is designed to be functional, but at the same time as fear free as possible. Although not shown in this layout, there should be a basement where a cold storage room can be provided and food can be stored. The basement should be accessible from the outside as well, so that delivery of food and the disposal of carcasses is easier. The access can be behind the break room but also inside the floor space between feed kitchen and sanitary area.



Figure 5 Suggestion of a floorplan of an "ideal animal shelter"

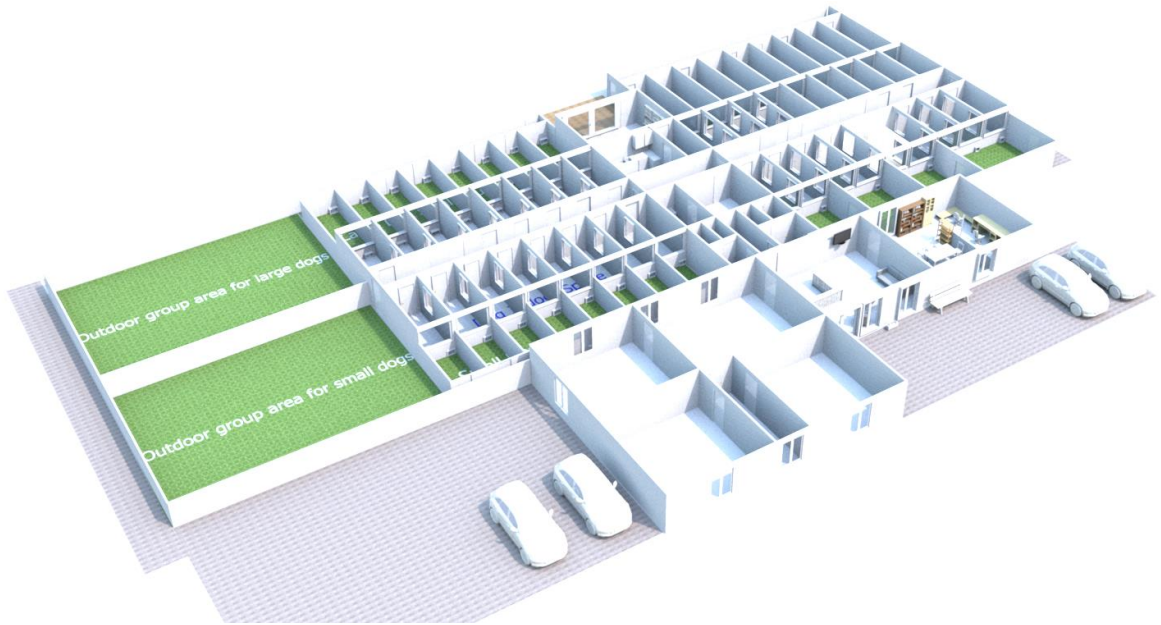


Figure 6 The 2D plan converted into a 3D image, left side aerial view



Figure 7 The 2D plan converted into a 3D image, right side aerial view

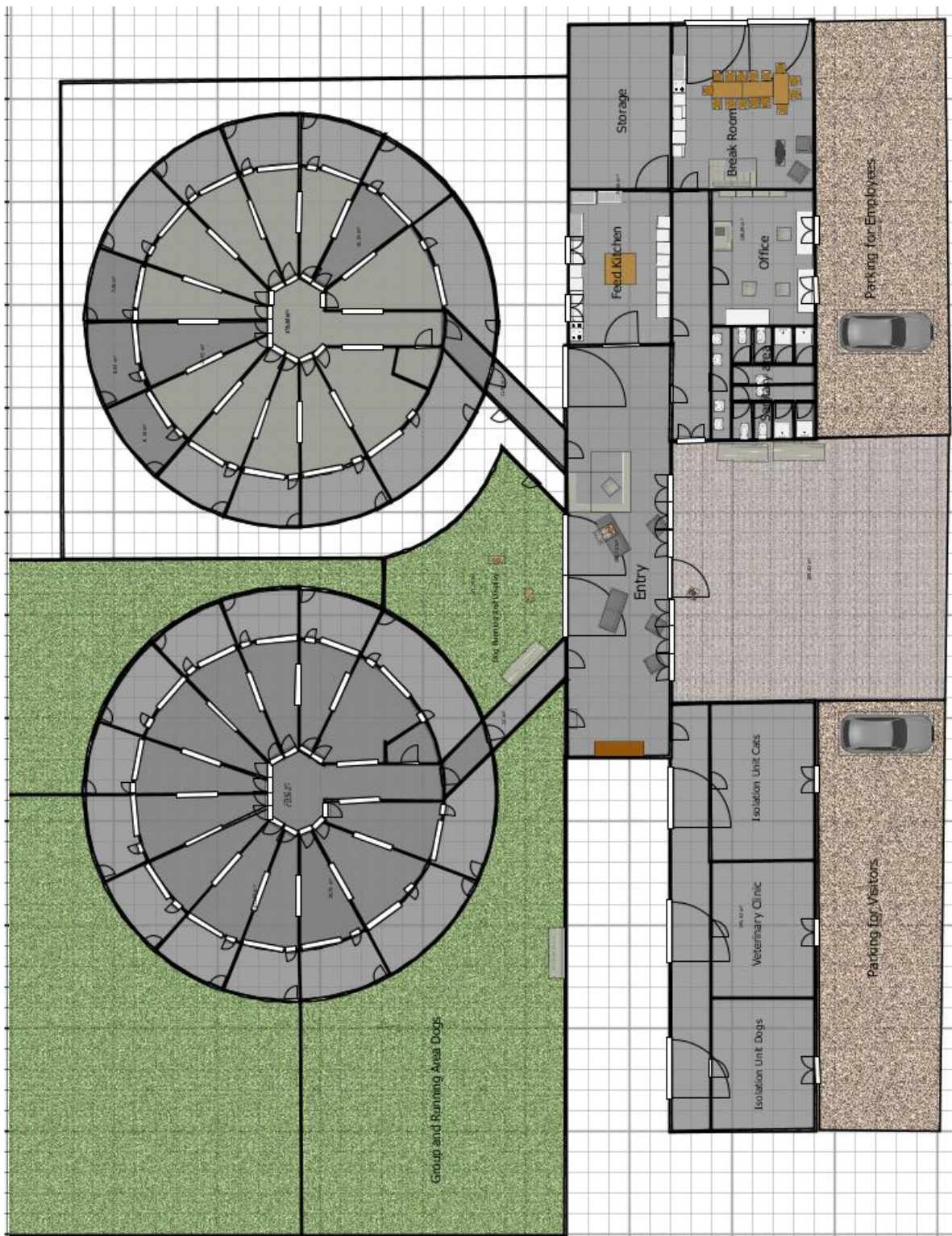


Figure 8 The circular floor plan of an ideal animal shelter

After proposing this idea for a shelter, a second one was created by the author to give different suggestions on how to reach the best animal shelter design. There is not one solution to the best shelter design, so a shelter “ideal” for animals might never be reached, as there are too many factors contributing to the ideal design. However, multiple good suggestions can be made that are the closest to “ideal” as possible.

As see in this plan, the actual compartment area is round, which provides a faster access to all compartments from the middle. This way we could imagine having a bigger center room from where visitors can watch all dogs and cats and one could even imagine a lounge in the center where people can come and visit the dogs and cats in the shelter. If we want to provide enrichment with the human voice, we can do so by placing the person reading in the middle. The access to a water system in the middle, by which all compartments can be reached easily. Below there is a closer view of the circular buildings. The left one is used for dogs, with an access to a single outdoor area but also group outdoor areas.

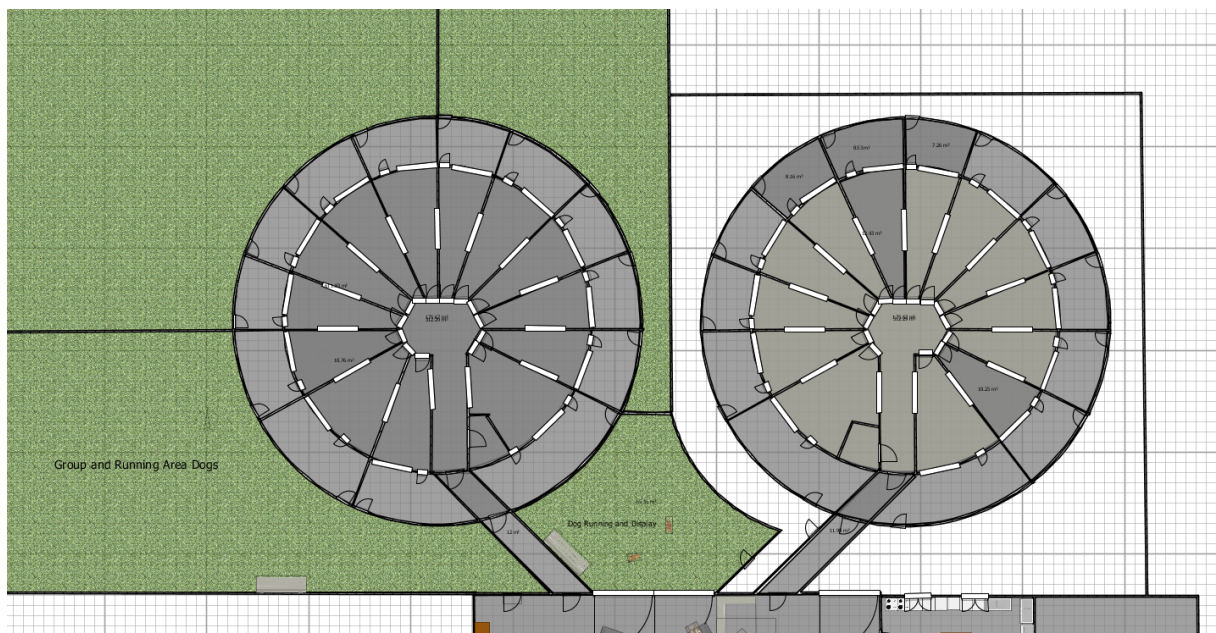


Figure 9 The circular compartment areas: on the left side the dog area; the right side the cat area

From the entrance area to the left there is an access to a corridor to the veterinary clinic and the isolation areas. This way the isolation units are isolated from the rest of the building, but at the same time directly accessible for the veterinarian. On the right side is the office area, a feed kitchen, storage and break room. There is also a sanitary area with showers and toilet compartments. Through the entry the dog and cat areas are accessible. This allows access to the public during visiting hours. There is a reception and a waiting area from where the dogs can be watched while playing.

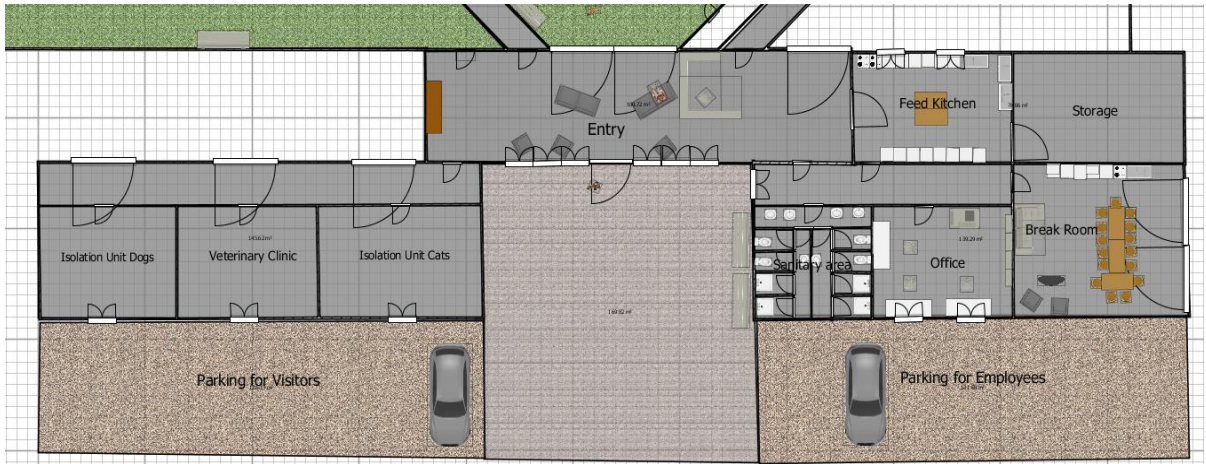


Figure 10 On the left side the veterinary area with isolation units. In the middle the entrance and central area. On the right side the organizational units, feed kitchen, storage, sanitary areas, office and break room with a meeting area

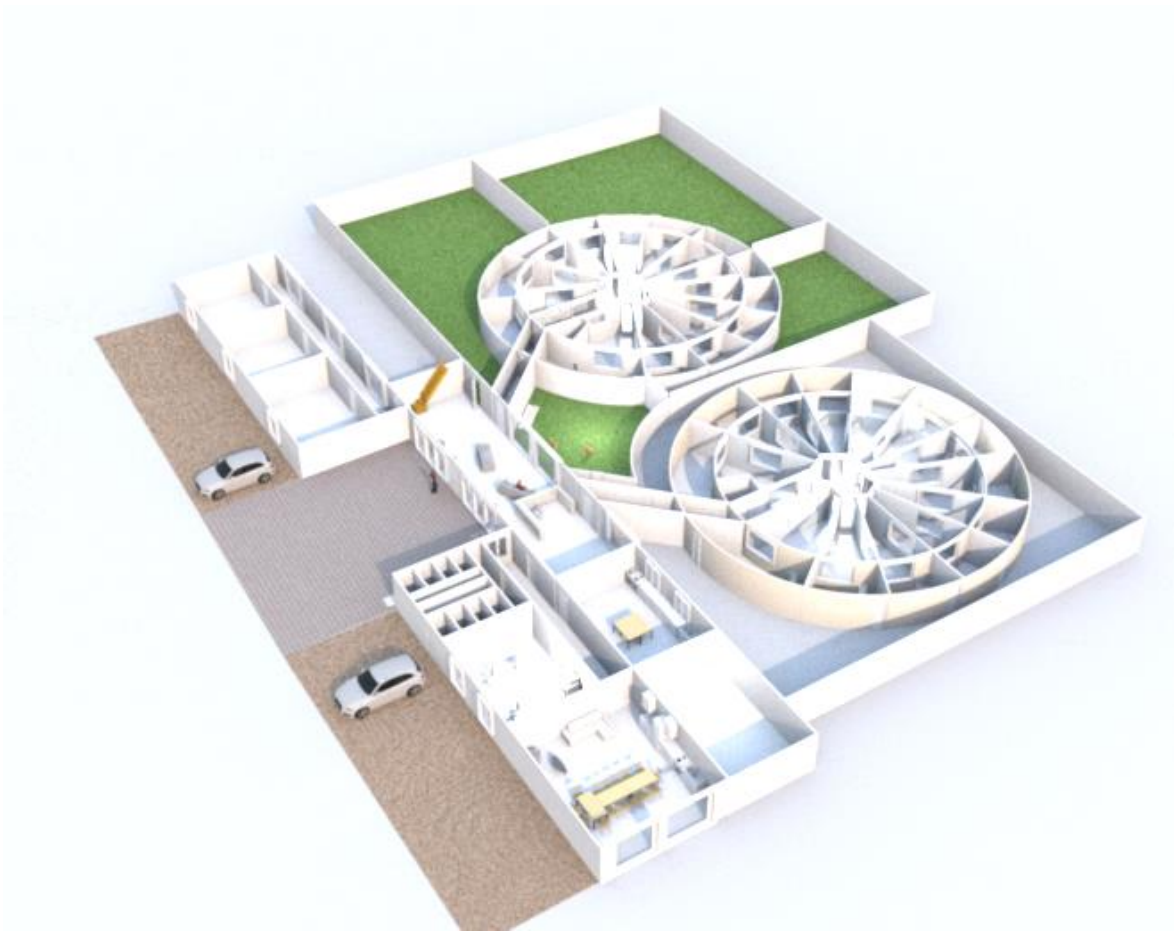


Figure 11 The 2D plan converted into a 3D image, right side aerial view.



Figure 12 The waiting area provides a view of the outdoor dog area to increase adoption rates

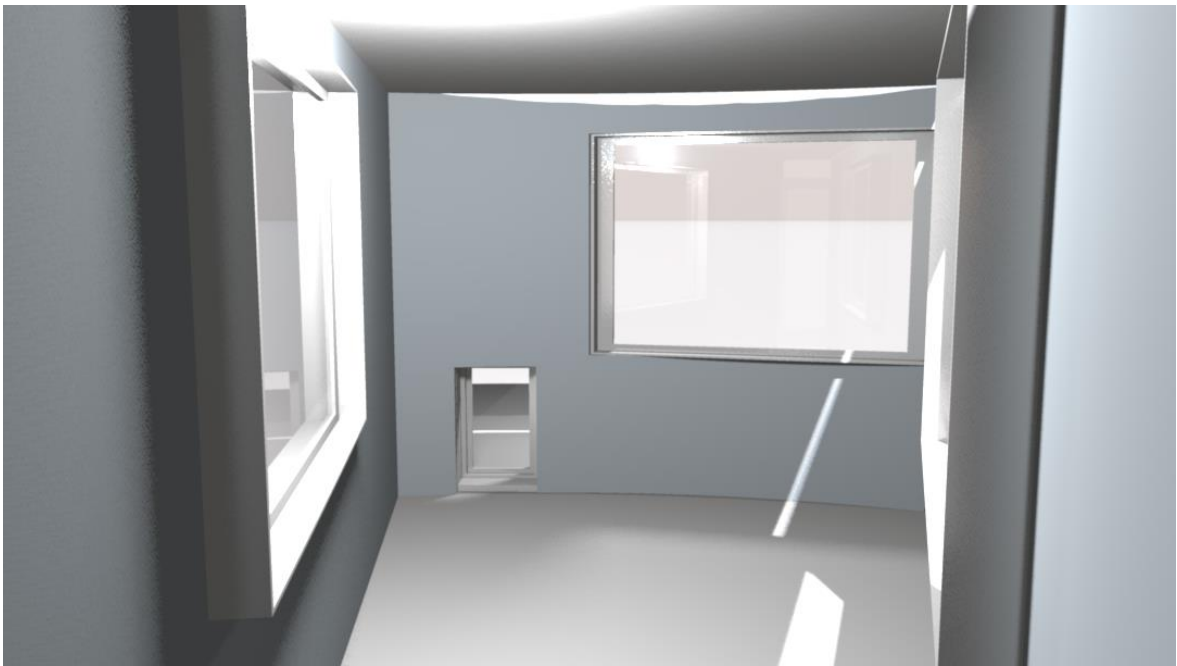


Figure 13 The inside of one compartment, three windows provide a light source and the side windows look into the neighboring enclosures. There is a pet door to access the outside



Figure 14 From the entry a second floor can be reached, from both floors the dog running area can be watched. The second floor provides a view of the whole shelter. The second floor has enough space to hold adoption events and to discuss adoption.

5.1.2 Shelter area for dogs

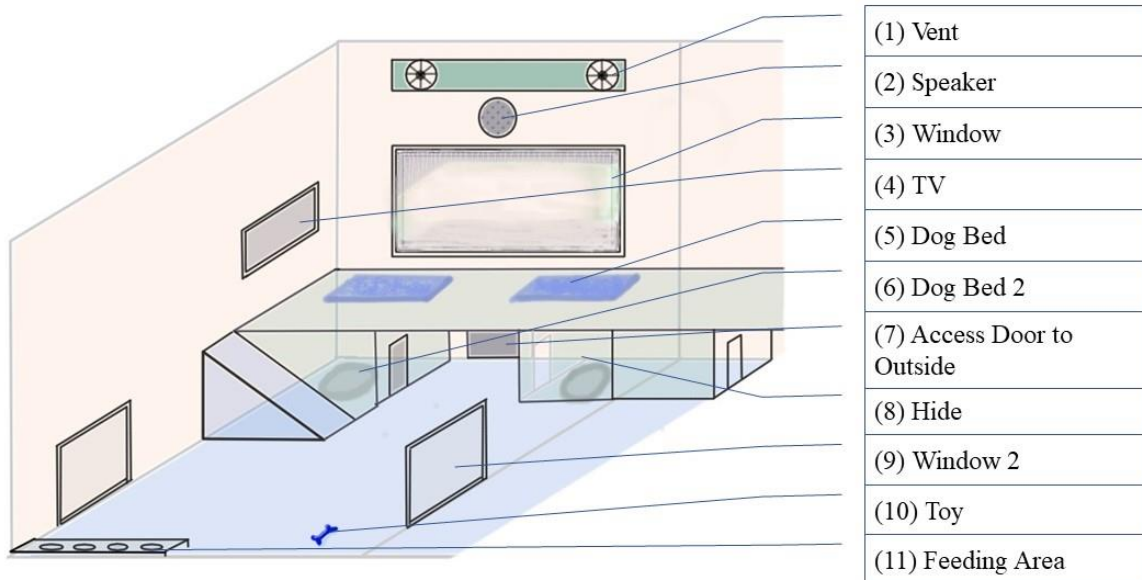


Figure 15 The suggestion of a dog enclosure.

This is one compartment of a shelter area for dogs. One compartment fits two dogs, if needed it can be reduced to one dog, depending on the current situation and circumstance of the dog. There are vents (1) to provide the air circulation needed. Speakers are used to play classical

music (2). There is a TV where a dog TV program can be played if wanted (4). Two dog beds on an elevated surface provide a good lookout through the big window (3). There is another area underneath the platform where the dogs can hide (8) if they would like to hide away. There are enough dog beds so that the dog can choose where to lay. (6). Side windows provide an area where the dogs can look at the neighbor compartment if they would like to. (9). A toy is placed in front of this area (10). A feeding area is placed in front of this area to provide easier access to the feeding bowls for the staff and that the cleanup can be done while the dogs are in the hideout or in the outside area. There is an access door to the outside, if dogs would like to go outside. (7)

The walls and elements are colored with the fear free palette as shown here. For the materials suggestions were made in section “3.9. Layout of the Building”.

5.1.3 Shelter Area for cats

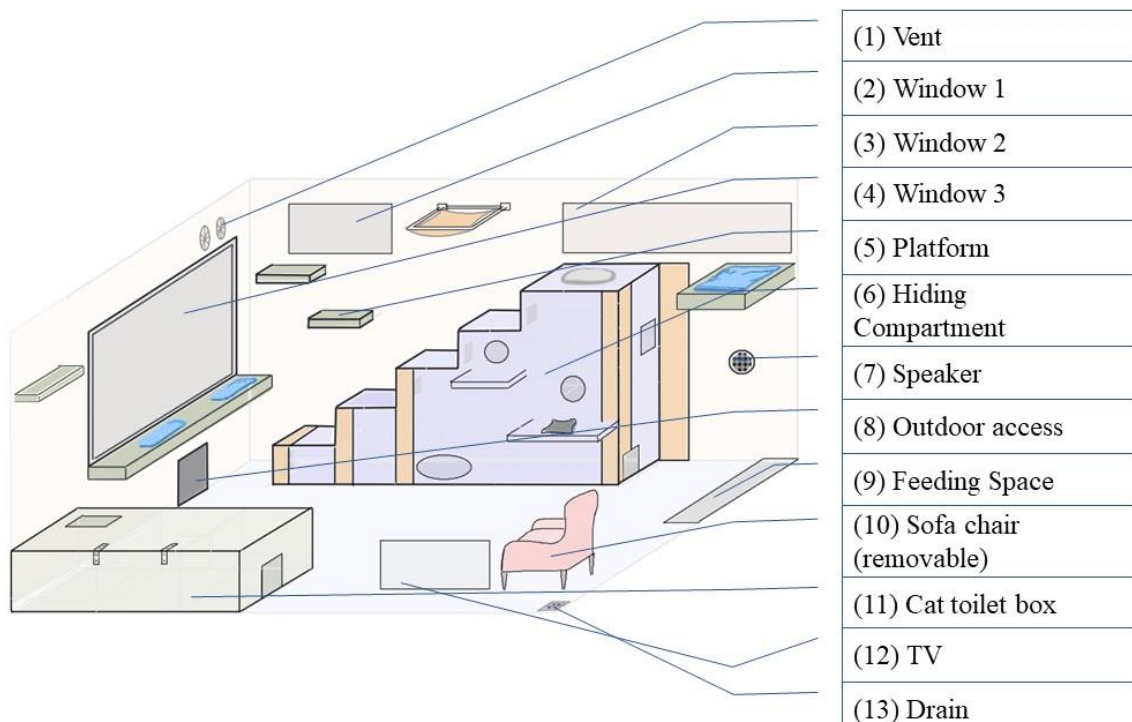


Figure 16 The suggestion of a cat enclosure

This is one compartment for a shelter area for cats. The Windows are placed to provide lots of lookout points for the cats to provide sufficient enrichment, they can look towards the neighboring compartment but also to the outside. Platforms are provided in front of the windows. There is a big hiding compartment (6) which is divided into smaller areas inside

where the cats can lay in. The material is coated with epoxy, for easier disinfection. There are replaceable scratching posts attached to the hide. Blankets and at beds may be removed for frequent washing and are attached with Velcro. This way the whole hiding platform can be disinfected. Speakers are provided to play music or appealing sounds. There is an access door to an outdoor area where cats can enjoy the outdoor space. The feeding space is made out of stainless steel and can be disinfected easily. There is a sofa chair (10) that is only inside if volunteers come by to look and play with the cats. The room should be inviting for both, cats and humans. The cat toilet box provides 3 boxes which are in the ideal size and there are 3 different entry points where cats can enter the box, the top, the front or the side depending on which entry the cats prefer. The box can be opened with hinges for easier access. It is coated with epoxy and can be easily disinfected. There is a drain in the bottom right corner, which is usually covered with a lid but it can be opened and accessed for drainage. There is also a TV which can be used for cat friendly TV. Important to add is, that toys and cat trees should additionally be provided. They were not drawn in this picture to keep the permanent structures more visible. Every compartment is equipped with cameras as well, which is connected to the website of the shelter. During different times of the day there may be live-streams of the cats and dogs for the public to watch. This can lead to better adoption rates.

6 Consequences

After several tries of finding the perfect shelter design, it turns out to be quite hard to find a shelter design that is suitable in all aspects and at the same time realistic. If one tries to find the design for a perfect shelter, the current research is a huge benefit for every veterinarian. Potential limitations for the perfect shelter design are the financial aspects of constructing and building a shelter. However, certain aspects and ideas can always be used to provide even a small form of enrichment to an already existing animal shelter. The ideal animal shelter can be created step by step. Enrichment is an important part of shelter design and should be included in every plan of a shelter. The most important point to remember is that, usually we are trying to find the perfect design from an animal's point of view. However, if we don't have enough research, people usually assume what animals might need or want. This means there is a lot of human influence on features in a shelter, where a person thinks it is the perfect design in an animal shelter, while it actually is neither beneficial nor bad for the animal. By researching before, we can avoid spending an unnecessary number of finances. This is why research should be the base of every shelter design. To find the "ideal"

layout of an animal shelter is a hard task for every planner or veterinarian that is consulted to provide the best shelter design for an animal. Even after finding several designs that can be implemented, the result will never be perfect. However, we can provide the best shelter design according to recent studies by including enough literature research and consulting the animal welfare organizations worldwide.

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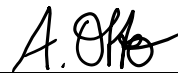


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Thesis progress report for veterinary students

Name of student: Adriana Otto

Neptun code of the student: SZT9J7

Name and title of the supervisor: Dr. Szilvia Vetter PhD. Head of Center for Animal Welfare

Department: Center for Animal Welfare

Thesis title: Planning and designing an animal shelter "ideal" for animals.

Consultation – 1st semester

Timing				Topic / Remarks of the supervisor	Signature of the supervisor
	year	month	day		
1.	2021.	03.	29.		
2.	2021.	04.	20.		
3.	2022.	03.	09.		
4.	2022.	04.	30.		
5.	2022.	05.	11.		

Grade achieved at the end of the first semester: 5 (excellent).....

Consultation – 2nd semester

Timing				Topic / Remarks of the supervisor	Signature of the supervisor
	year	month	day		
1.	2022.	08.	17.		
2.	2022.	10.	12.		
3.	2022.	10.	20.		
4.	2022.	11.	02.		
5.	2022.	11.	07.		

Grade achieved at the end of the second semester: 5 (excellent)...



The thesis meets the requirements of the Study and Examination Rules of the University and the Guide to Thesis Writing.

I accept the thesis and found suitable to defence,

di Silvie Ueller

signature of the supervisor

Signature of the student: *A. Otho*

Signature of the secretary of the department: *Elektra R.*

Date of handing the thesis in. *16.11.2022*

