

Alternative Barn Design Applicable in Different Environmental Condition for Goat Breeding[#]

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Abstract: In this study, the design of alternative open front barn with lot practicable for goat farm with different capacity was carried out. In the barn design, animal behaviour, barn area preference, and animal welfare were paid attention. To provide fresh air and sun to the animals was considered principal factors of the planning of barn. Portable walls were mounted to resting area having a frontage on courtyard to protect animals from adverse effects of the season in winter or cold regions. Goats were planned to be in group paddock. In this project based on calm paddock, using different areas were provided to goats in different seasons. The goat barn areas were designed as 2.1 m²/ goat, 3.2 m²/ goat and 0.4 m²/ goat in the resting, courtyard and feeding area respectively. It can be said that higher productivity rates will be achieved using developed barn design in goat breeding.

Key words: *Goat Barn Design, Barn Design, Goat Housing, Goat Breeding.*

Introduction

One of the main factors in the animal production is also buildings, in which the animals are sheltered. The main functions of building, besides meeting the need of a suitable resting, feeding, courtyard, and water for animals, can be put in order as protecting livings from the negative climatic conditions and to answer the behavioural desires of animals. While the first of these forms a living area for animal, the second one is the place, where the production is made. For the barns incorporating these two elements to be able to adequately actualize the life and productions, it is necessary for the level of planning and design to be sufficient enough (Uğurlu & Uzal 2007).

The three important factors are increasing the animal production, genetic, care-feeding, and environmental conditions. For increasing the productivity in the animal breeding, it is necessary to develop the races that genetically has high productivity and breed these races. For the continuity and high level of productivity, besides the genetic structure, it is necessary for animals to be accurately fed with a compatible ration. Environmental conditions have a considerably place in increasing the animal production. Since environmental conditions are of factors regulating the comfort of livings in the climatic, structural, and social issues regarding livestock building environments, in increasing the animal production, together with genetic and feeding, they constitute an inseparable triple structure (Uzal & Uğurlu, 2009).

In livings, there is an inverse relationship between stress and productivity. Living under remaining stress exerts an important section of its energy to eliminate the stress factor it is exposed to, and this situation results in decrease in the productivity. In the design of animal barns, for providing the animal welfare, it is necessary to eliminate the effect of the factors causing stress in animals. These sources of stress can be collected under four groups as the stresses, resulted from the climatic, structural, social, and the other factors (*e.g.* noise, dust; Uğurlu & Uzal 2004). Demir (1990) reports that in planning the animal barns, the aim, protecting the animals from the unsuitable environmental conditions, is to form the healthy living and production areas for them. Eliminating the effects of negative factors and forming healthy life and production areas for animals will materialize with barn designs in compatible with the animal behaviours (Uzal & Uğurlu, 2009).

According to records obtained in 2013, there is 2,178,436,192.33 sheep (1,172,833,189.79) and goat (1,005,603,002.54) all over the World. According to data taken in the same year, there are 35.782.519,00 head sheep (27.425.233,00) and goats (8.357.286,00) in Turkey (Anonymous 2014 a).

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According to records in 2013, the amount of sheep in Turkey constitutes 1.64 % of (2.34 % for sheep and 0.83 % for goat) that all over the World.

According to data taken in 2013, there are 29.284.247 sheep and 9.225.548 goats in Turkey (Anonymous 2014 b). According to the records in the same year, the number of sheep (1.928.807) and goat (213.732) in Konya is 2.142.539. This number equals to the 6.5 % of the number of sheep (29.284.247) and 2.3% of the number of goats in Turkey (Anonymous, 2014b).

In addition to that the most of sheep farms are small family farms in Turkey, there are some problems on innovations of production technology and marketing. There are 1-9 sheep or goats in 29,4% of farms in Turkey; and 10-19, 20-49, 50-149, 150-299, over 300 in 17,2%, 25,3%, 21,1%, 5,6%, 1,5%, respectively (Anonymous 2014c). In Turkey, that the capacity of 92.9 % of the business making sheep and goat breeding is under 150 heads reveals the necessity of commercial breeding and new barn designs.

In the barn design, the compatibility with animal behaviours, optimum environ-mental conditions, herd management, and business economy are the important subjects that are necessary to be meticulously examined (Uzal, 2008). Although the phenomenon the concept design first evokes in the minds is aesthetics and beautiful appearance, its direct contribution to the performance and productivity remaining in the background from the sensorial aspect has been reorganized more at the present days. From now on, in the world of today, the power of the concept design has stood out in almost area (Uğurlu & Uzal, 2007).

As a result of the research, examinations, and observations, in order to meet the deficit of new design of barn, needed in goat breeding, the different samples of design of barn for goat breeding have been developed. To the breeders being in active in this area, a functional project, applicable to different, economic, and various capacities has been attempted to be presented.

Materials and Method

In the study, the dairy goat pen that can be used in capacity of 500 or 1000 heads was selected as design material. In herd projection, the number of animals, for goat pen in capacity of 500 heads was planned as 500 in dairy goats; 110, in billies, 113, in the female kids; 8, in male kids; and 7, in male goats. For a goat pen in capacity of 1000 heads, the number of animals was planned as 1000 in dairy goats; 220, in billies, 226, in the female kids; 16, in male kids; and 14, in male goats (Dağ, 2005). Total business capacity is 738 heads in a goat barn in capacity of 500 heads; and 1476, in a goat barn in capacity of 1000 head. In Turkey, sheep and goat farm capacity of 98.5 % of farm the sheep and goat breeding is under the capacity of 300 heads (Anonymous 2014c). In spite of this, in this study, alternative designs of barn were developed, which is readily applicable to the large farm targeting to make the commercial breeding, and adaptable to barns in different capacities (150-1000 heads and over).

In the study, as a result of the observations and examinations carried out on this issue, a design of barn was realized, which can be used as alternative in goat breeding, which is functional and economic, which can especially kept the animal welfare at the top level; and which allows for mechanization. In the study, in order to facilitate the herd management, group paddocks were formed. The design of barn was developed so that it can protect the building against the winds coming from North (prevailing winds), and also leave a frontage open the winds in the summer. Thus, it was planned to protect the goats from the undesirable winds in winter and mitigate the effect of wind together with summer months. In design of barn, optimum benefit was based in protecting from wind and sheltering In addition, forming the barn from the different structural units enables the developed plan to be readily used in sloping lands Unilateral feeding application, at the beginning, seems to cause to be need a little more area. However, that the developed design enables to build in sloping lands and its usability in the businesses having a large capacity of barn from 150 heads to 1000 heads will increase the applications of designs of barn. The developed project was designed in such a way that it will enable to form a new plan in flat lands, and in businesses having a trouble with areas, taking symmetry of each section. In the study, while the area requirements of animals and planning criteria are determined. Olgun (2011), Yüksel and Şişman (2003), Ekmekyapar (2001), Hirning *et al.* (1994), Okuroğlu and Yağanoğlu (1993), Balaban and Şen (1988) were utilized. In the design of open system structure, in forming the original planning principles, and in the other issues dealt with were utilized

from Uğurlu and Uzal (2007). Planning organization scheme, used for the study of design are presented in Figure 1.

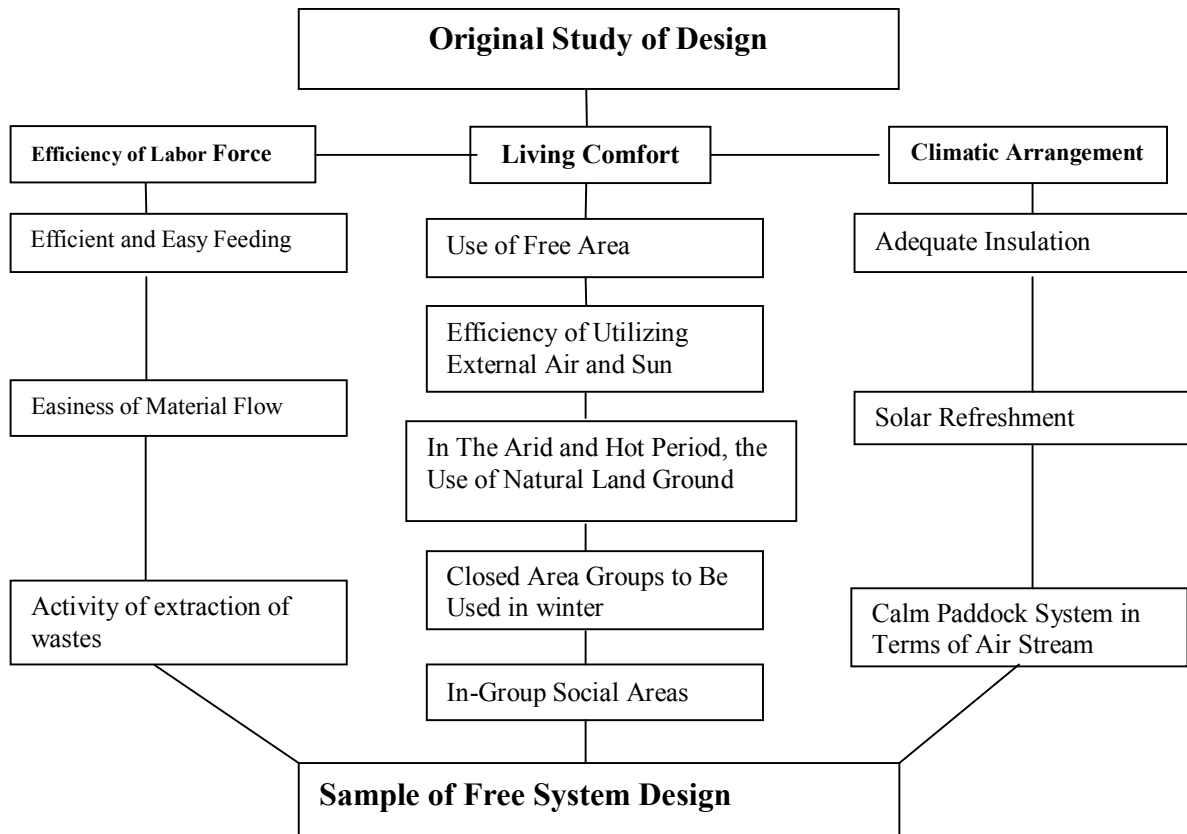


Figure 1. Planning and organization scheme used for design of barn (Uğurlu & Uzal, 2007)

Results and Discussion

Perspective view belonging to the alternative barn system, whose design is realized for goat breeding is presented in Figures 2 and 3; the plan view of barn, in Figures 4 and 5; and the drawings of view and cutaway in Figure 6. The barn systems, used in the sheep and goat breeding can be put in order as closed system, open system, open-front barn with lot, solid floor confinement, and slotted floor confinement (Olgun, 2011; Yüksel & Şişman, 2003, Ekmekyapar, 2001, Hirning et al., 1994, Okuroğlu & Yağanoğlu, 1993).

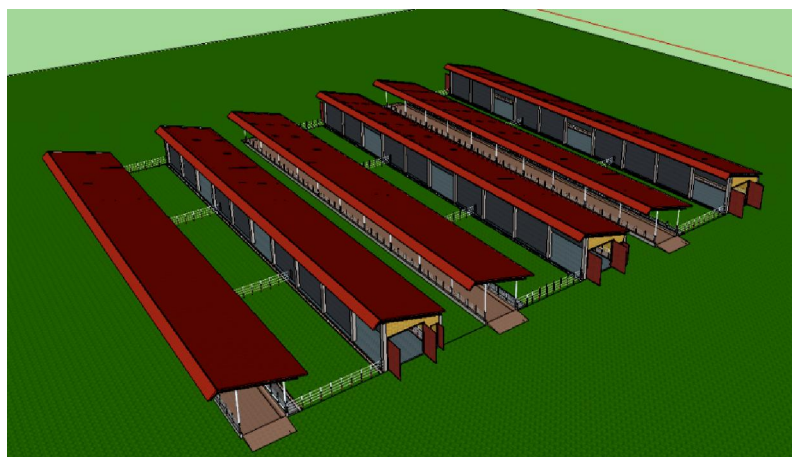


Figure 2. The perspective view of the designed goat barn



Figure 3. The different perspective view of the designed goat barn

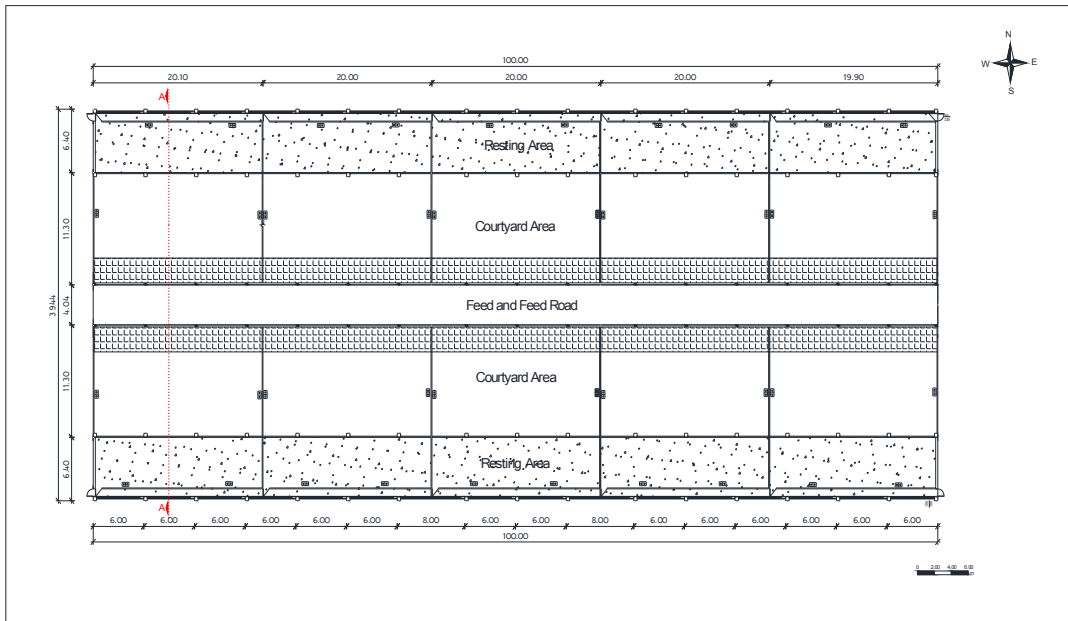


Figure 4. The plan view of the designed goat barn for 500 head capacity

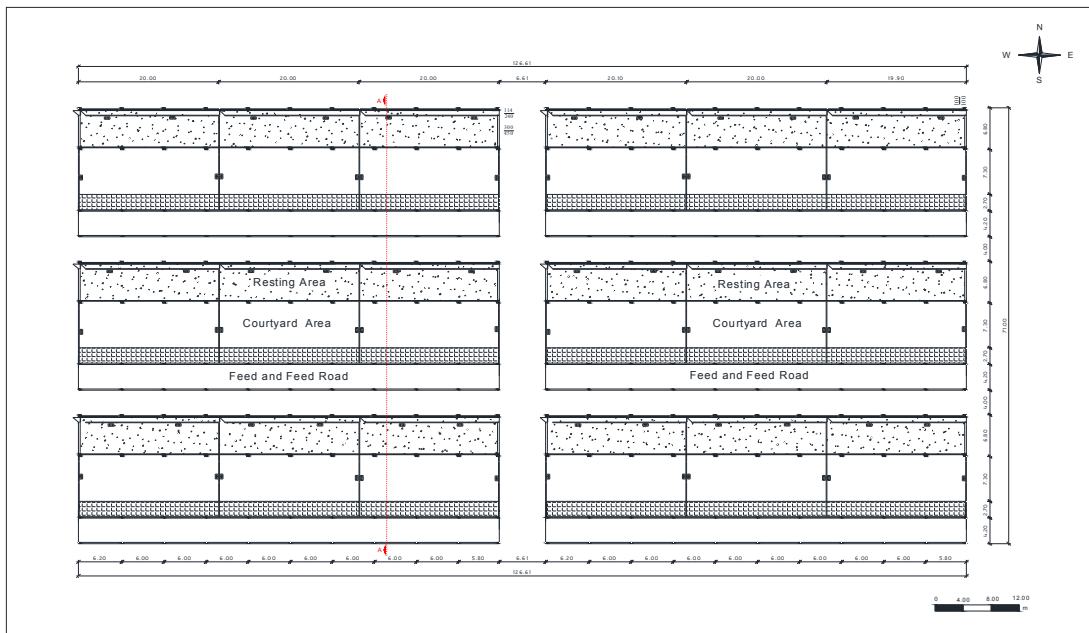


Figure 5. The plan view of the designed goat barn for 1000 head capacity

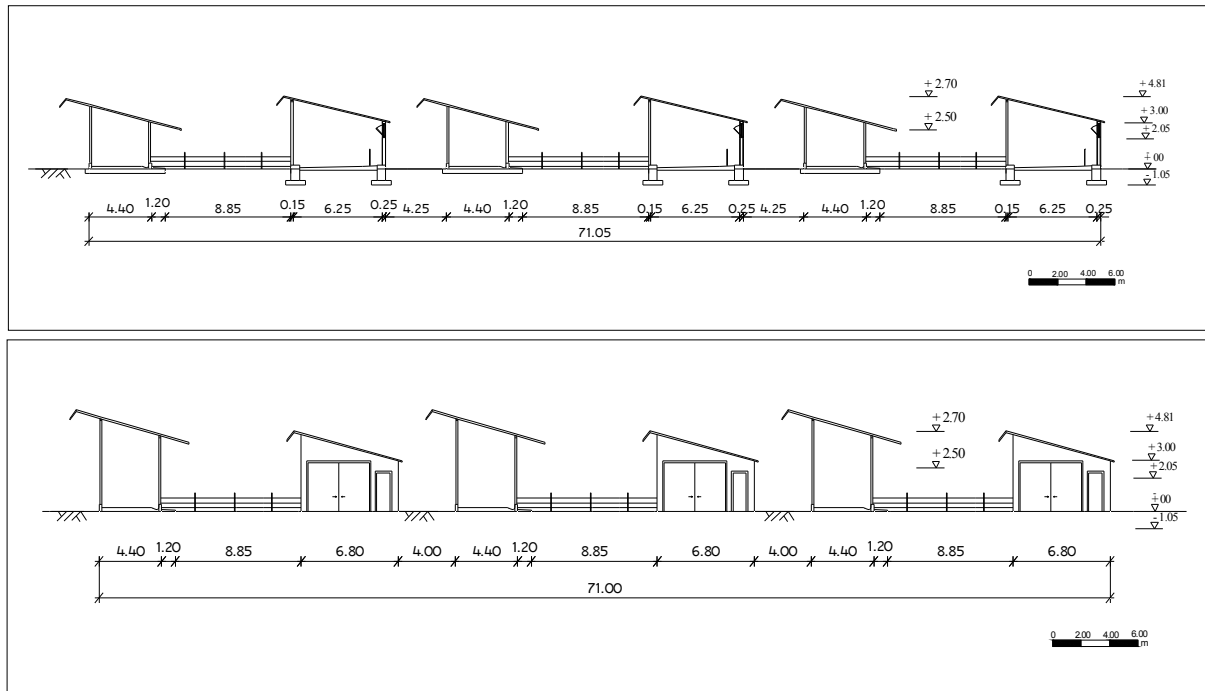


Figure 6. The view and cutaway of the designed goat barn

However, in the region Konya, just as in many places of Turkey, in closed systems of barns, breeding is made. Animals, in winter periods, are bred in the closed systems of pens; in the seasons of spring and summer, in pastureland. In the recent times, with standing out of commercial breeding in the sheep and goat breeding, the barns having courtyard instead of closed system, and resting area in the form of open-shed are used. Another one of this kind of applications is applying the barn system with the idled stop, commonly used in dairy farming, without stop. This system consists of a closed area, in which feeding and resting areas are in a closed structure, and which has big gates (except for cold periods, gates are kept open), and open courtyard. In spring and summer seasons, the animals are taken to the own lands of business or to pasturelands that are near business for them to graze in the certain hours of the day. This type of structure is an old system forming a rather high cost for dairy farming. For sheep breeding, this type of barn, since the width of building is more and is not planned toward sheep breeding, besides its increasing the cost of building, remains inadequate in providing the appropriate environmental conditions for animals. In sheep and goat breeding, the systems, begun to be applied in the recent years, besides they are advantageous compared to the previous pen systems, remain inadequate in terms of the climatic, structural, social planning principles and animal wealth. Among these, the major ones are not being able to sufficiently protect the animals from the negative effects of wind and inadequate ventilation conditions at the expense of protecting them from wind. Inadequate ventilation leads in-barn air quality reaches the dangerous dimensions in terms of the animals and employees. In addition, in barns planned as wide, the cost of building increases. This situation also attracts attention of business owners and they refer to the searches for the alternative solutions. Therefore, not being able to provide a usable sheltering environment that is suitable for the animal welfare made unavoidable developing the design of new systems of barns as an alternative to the existing systems of barn planning. Today, the dominant thought in the design of barn is a style of planning that is appropriate for the animal behaviours and that will keep the production performance at the top level.

In this study, the animal wealth and sheltering them in the environments wider and near their natural conditions and utilizing the sun and fresh air were taken as a main principle in the design of barn. The alternative goat barn, whose design was made, consists of 3 separate structural units (Figure 4), placed next to each other for 500 heads in capacity; and 6 separate structural units (Figure 6), placed for 1,000 heads in capacity. Between each structural unit, a distance of 4 meters was left. Each structural unit consists of 3 sections of 58 heads and has a capacity of dairy goats of 174 heads. The

width of this structural unit is 6.80 m and its length is 60.00 m. Since the width of building is less, its cost will be lower compared to the other structural units. That investment cost is low will result in allocating more budget for buying animal and feed expenditures and will increase the success of business. In the study, feeding unit was built in such a way that it will parallel to the resting area and allow for unilateral feeding. One of the most important subjects of the study is to protect the animals from the negative winter conditions in the open pen system. For this aim, the direction, from which the prevailing winter winds (north, in the province), is closed with resting area, and side parts, with the curtain wall; and thus it is targeted on protecting the courtyard from the air streams. In the warm weathers of summer, opening these walls, while an airy and fresh resting environment is formed for animals, in winter months, closing these walls, it is prevented the animals from exposing to especially the cold stress. This form of design can be used both closed and open. Resting and feeding areas were planned in the form of open-shed from roof in the same direction. In the strong and cold winds, the winds coming from out of barn will form a calm area in the courtyard when, in this type of roofs, the width of courtyard is arranged in the sufficient distance. Uğurlu and Uzal (2009) report that in the width of 20 m of courtyard, in the wind velocity of 4.5 m/s. the wind velocity occurring in the courtyard at the level of animal will be 0.5 m/s. In the building designed, since the width of courtyard is 9 m, for the animals, natural courtyard, protected from the wind will have been provided. At the same time, it is allowed for the summer winds pass to the courtyard through feeding section that is open. Thus, in the summer months, more spacious environment is provided for animals. The other aim of making the design of barn in this form is to provide ability to the different structural applications according to the different conditions. Feeding area was planned so that it could make it possible the unilateral feeding. However, if desirable, the plan of barn can be symmetrically arranged so that feeding unit can be bilateral Adding a padlock to the south frontage of feeding area, a new design of barn (with a capacity of 300 -350 heads) can be made.

In feeding area, for protecting the animals and tools of feed distribution from the excessive sunlight, the feeding unit was covered with a roof. Feeding areas were planned so that it could be in 10 cm high from the floor of court-yard and in the slope of 3%. Feeding length per animal was planned as 40 cm. For goat pen with a capacity of 500 heads, total feeding area is 180 m², while goat pen with a capacity of 1,000 heads, 360 m². For goats, an area of 2.1 m²/ animal was reserved as feeding area, and an area of 3.2 m² as courtyard. Resting area is 30 cm high from the floor of courtyard and using keystone on the floor was planned. In this area, a road of 70 cm next to the wall is left in the internal area for the animals to be able to go to the control and animal trafficking. In the barn, whose design was realized, making the open area as natural soil ground on condition that the drainage is provided, the cost was both reduced and the natural floors, compatible with the structure of leg of animal, were formed. It can be suggest that resting area, in order to provide the drainage more easily, is covered by keystone and stabilized keystone, feeding area, with keystone concrete lining

In the design of barn developed, forming control from a single point and viewpoint in the business, an advantage is provided for breeders to observe at which section of the bossiness and barn the animals are. In the barn, the area planned for animals are seen in Table 1. In the design of barn developed, the animal sections were planned according to the care easiness for animals, herd management, and social status of animals.

Table 1. In the goat pen designed, area sizes and unit areas per animal

	Closed Areas	Open Areas	Feeding Areas	The Areas Covered with Roads	Total (m ²)
Barn areas(for s pen with a capacity of 500 heads) ¹	1224	1620	180	756	3780
Barn areas(for s pen with a capacity of 1,000 heads) ¹	2448	3240	360	1512	7560
Areas per animal (m ² /animal)	2.4	3.2	3.6	1.5	10.7

¹. The active areas used by animals

Forming a different group of social structure in the business, being able to divide the animals into groups according to their age, gender, productivity, and social level provide a very important

easiness for breeders. Milking unit was placed in the position to be able to easily reach from the barn sections, where there are goats. In such a way that it will enable the animals to be taken for milking in groups, a planning was made. By planning the section of young animal (for billy, nanny, yearling and kid) and infirmary for a goat barn with a capacity of 500 heads, it is presented in Figure 7.

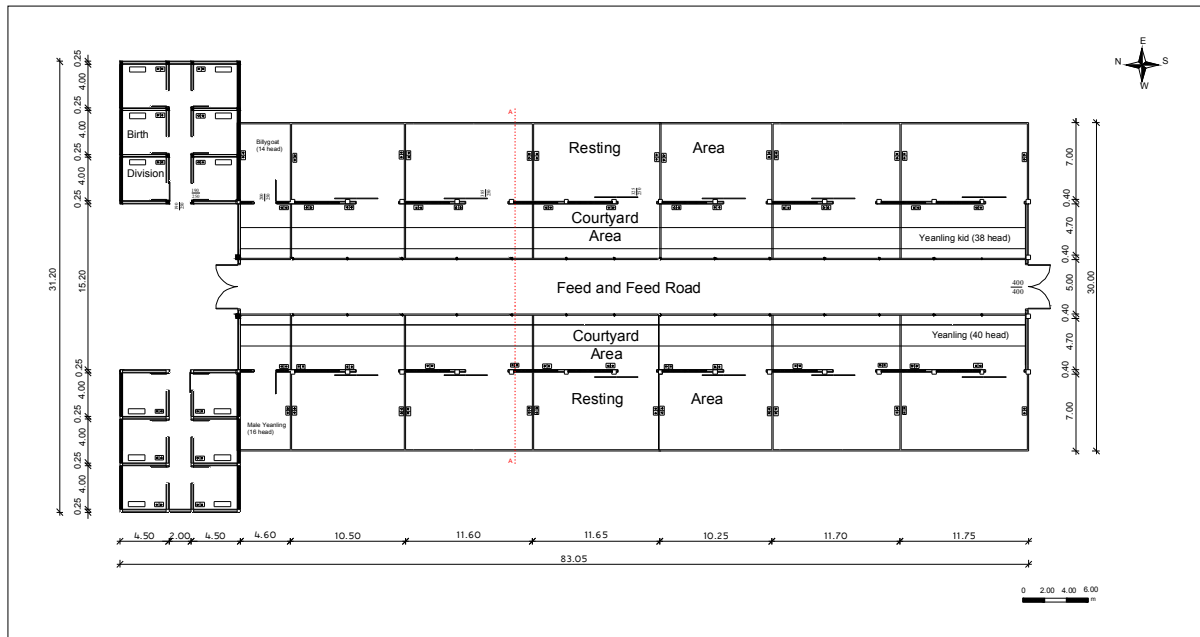


Figure 7. The plan view of the designed young animal (billy, nanny, yearling and kid) barn for 500 head capacity

Conclusion

In sheep and goat breeding, application of alternative designs of barns is considerably important in terms of animal welfare, increasing the quantity and quality of production. In addition, new designs will make a contribution to the well-being of working conditions employed in the barn.

References

- Anonymous (2014a) faostat.fao.org, date of access: 07.01.2015.
- Anonymous (2014b) www.tuik.com, date of access: 07.01.2015.
- Anonymous (2014c) www.tuik.com, date of access: 07.01.2015.
- Balaban A, Şen E, (1988) Tarımsal Yapılar, Agricultural Faculty Lecturer Publication No: 845, Ankara University, Ankara, Türkiye.
- Dağ B,(2015) Animal Behaviour, Selcuk University Agricultural Faculty, Lecture Notes (Unpublished), Konya.
- Demir Y, (1990) Orta Karadeniz Bölgesi Besi Sığırcılığı İşletmelerinin Yapısal Durumu, ÖzellikleriveBölgeİklimKoşullarınaUygunBarnakPlanlarınınGeliştirilmesiÜzerineBirAraştırma , PhD Thesis. Institute of Natural and Applied Sciences, Department of Farm Structure and Irrigation, Çukurova University, Adana, Türkiye.
- Ekmekyapar T, (1991)Hayvan Barınaklarında Çevre Koşullarının Düzenlenmesi, Agricultural Faculty Lecturer Publication No: 698, Atatürk University, Erzurum, Türkiye.
- Ekmekyapar T, (2001) Tarımsal Yapılar, Agricultural Faculty Lecturer Publication No: 204, Atatürk University, Erzurum, Türkiye.
- Hirning HJ, Faller TC, Hoppe KJ, Nudell DJ, Ricketts GE, (1994) Sheep Housing and Equipment Handbook, Midwest Plan Service, Iowa State University, Ames Iowa.
- Okuroğlu M, Yağanoğlu AV, (1993) Kültür teknik, Agricultural Faculty Lecturer Publication No: 157, Atatürk University, Erzurum, Türkiye.
- Olgun M, (2011)Tarımsal Yapılar, Agricultural Faculty Lecturer Publication No: 1577, Ankara University, Ankara, Türkiye.

- Uğurlu N, Uzal S, (2004)Süt sığırı barınaklarının tasarımında mevsimsel etkiler. *Selçuk J. Agric. Food Sci.*, 18 (33), 72-79.
- Uğurlu N,Uzal S, (2009) The model research on constitution of draught free area for suitable environmental condition in dairy cattle housing. *J. Int. Environmental Application & Science*, 4 (2): 136-145.
- Uğurlu N, Uzal S, (2007) Besi Sığırcılığında Açık Sistem Mikro Yapı Tasarımı, *Selçuk J. Agric. Food Sci.*,(21) 43,61-67.
- Uzal S,(2008)Serbest ve Serbest Duraklı Süt Sığırı Barınaklarında Hayvanların Alan Kullanımı ve Zaman Bütçesine Mevsimlerin Etkisi. PhD Thesis. Institute of Natural and Applied Sciences, Department of Farm Structure and Irrigation, Selçuk University, Konya,Türkiye.
- Uzal S, Uğurlu N, (2009) Serbest ve serbest duraklı süt sığırı barınaklarında sığırların zaman bütçesi ve barınak alan kullanımları. *Selçuk J. Agric. Food Sci.*, (23) 47, 27-37.
- Yüksel A, Şişman C, (2003)Tarımsal İnşaat, Tekirdağ Agricultural Faculty Lecturer Publication No: 278, Trakya University, Türkiye.