**YILDIZ TECHNICAL UNIVERSITY**

**MECHANICAL FACULTY DEPARTMENT OF INDUSTRIAL ENGINEERING**

**ERGONOMICS – TERM PROJECT**

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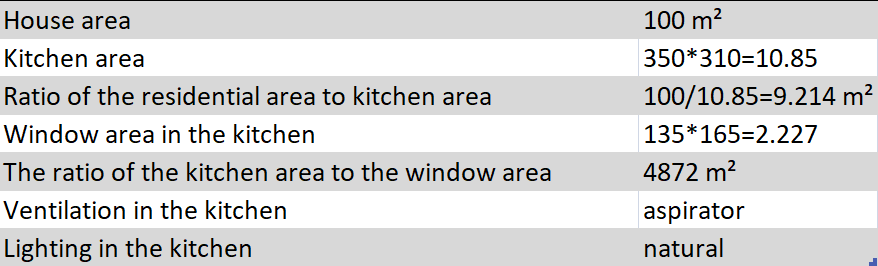
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**DEFINITION**

Our ergonomy homework environment is the kitchen. The house is located in Bursa and is on the 1st floor of the building. The kitchen is East facing and is used by 4 people. Our kitchen is L shaped and rather small. It has a balcony and a single wide window. There is a television, a dining table, 4 chairs, a microwave oven, an oven, a fridge, a dishwasher machine, a kettle, an extra cabinet which is used for storage. Our kitchen has an aspirator for air conditioning. The kitchen is the most commonly used part of the house.

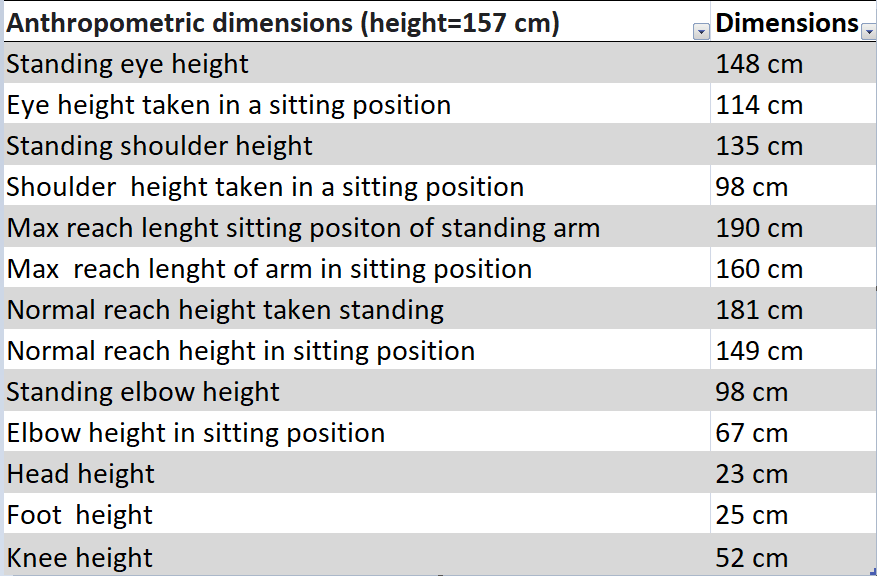
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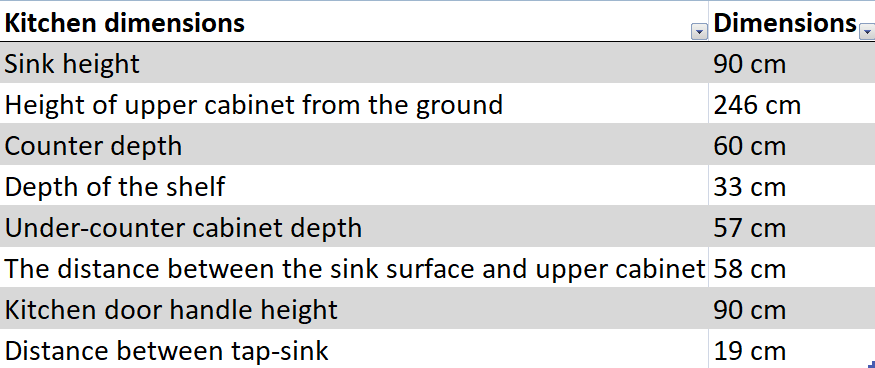




**ANTHROPOMETRY AND HUMAN-MACHINE INTEGRATION**

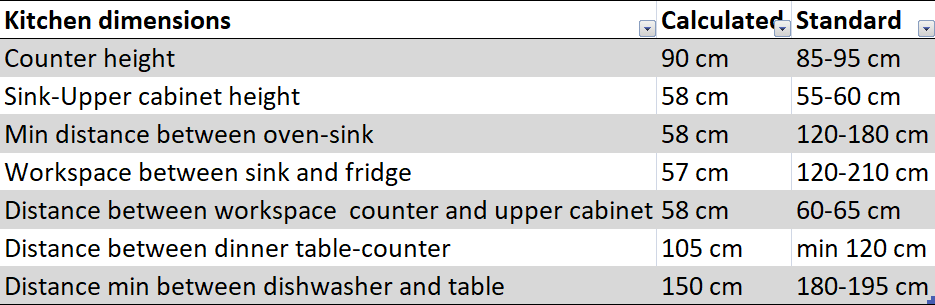
**Work Triangle**

* Work triangle is supposed to 360 – 660 cm. Also, between sink – oven be supposed to 120 – 180 cm ,between sink – fridge be supposed to 120 - 210 cm and between fridge – oven 120 – 270 cm, but our kitchen doesn’t have work triangle. Also , if we want to solve this problem, we have to redesign the kitchen so,this problem is difficult to solve.
* Height of elements of work triangle must be 90 cm and our heights are 90 that is optimal to the standards.

**Counter**

* Counter height and width are appropriate to the standards.
* The counter has 3 corners which all are occupied with different kitchen materials.
* The counter surface is made of marble, which is a durable material against scratching, is water resistant and heat resistant.

**Door**

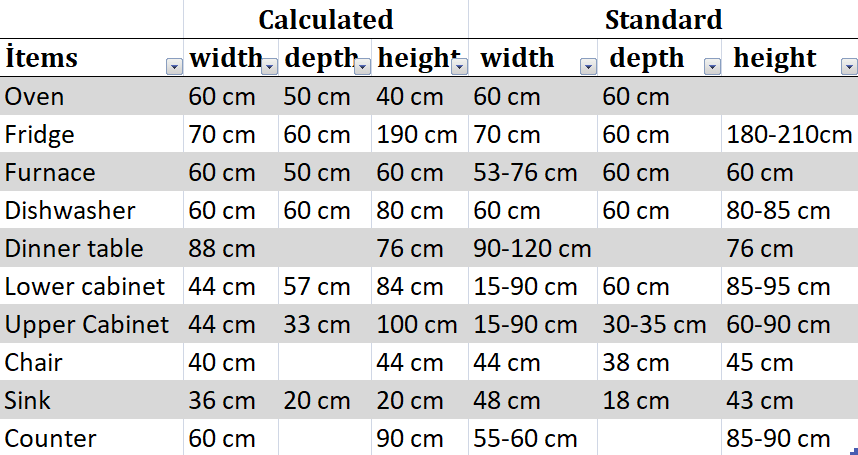
* Height of kitchen door handle is supposed to 100 cm according to aveage user but our handle is ( 90 cm ) lower than the standards so that we can change location of door handle with a basic tool but appearance of door may is seen damaged with hole.
* ****Height of kitchen door should be design for maximum so that our door is appropiate to the standards.

**Distance**

* The distance between sink and oven must be at least 60 cm which is for the kitchen without a work triangle but our distance is 58 cm that is lower than the standards so it is dangerous and it must be reorganized.
* The minimum distance between the counter and a dividing building element should be at least 120 cm and in our kitchen , dividing building element is table and the distance between the counter and table is 105 cm so ,it is appropriate to the standards.
* If two people are to work in the kitchen, the distance between the working plane should be min 120 cm and our distance is close to 120 cm so that it is appropiate to the standards.
* The distance between tap and sink must be 10 – 15 cm but our distance is 19 cm which is over the upper the limit. We can change the tap.
* The distance between sink (also counter) and upper cabinet must be 60 – 65 cm but our distance is 58 cm that is a bit lower than the standards but that does not cause a major problem.
* A tap that is 10 to 15 cm higher than the counter can spare your back, as it is easier for you to reach the bottom of the bowl when washing up, without having to bend over too much.Our distance is 19 cm that is not suitable to the standards.

**Sink**

* The sink is smaller than the standard sink sizes. This makes working at the sink (washing the dishes etc.) harder than usual. There is insufficient space in the sink to work in a comfortable manner. The sink is deep enough to prevent water splashing to the user.
* According to the standards, standart sink height must be at least 95 cm. If it is adjustable, it must be 5.0 – 7.5 cm lower than counter. If it is not , it must be at the same level with counter.Our sink is little lower than the standards but is same level with counter.If we want to enhance our kitchen, we can use little block to increase height of sink.



**Oven**

* The oven works with natural gas. It has 3 heating sections powered by natural gas and 1 heating section powered by electricity . Buttons to control gas flow works fine. However the oven size is a bit small so using a big cooking pot may prevent the usage of other heating sections.
* According to the standards, oven always must be at the same level with counter that is appropriate to the standards in our kitchen.
* Spices, oil, pans, pots and cooking spoons should be positioned near the oven.
* Oven and furnace must be located far from window and entering of door.Our kitchen the furnace is located next to the door so it’s location is not convenient to the standard also oven is placed far from window but it’s too close the sink.We can change furnace location but it might be difficult to solve because the kitchen should be totally change .

**Furnace**

* Furnace height , width and depth are appropriate to the standards.
* The furnace is a bit low and using it requires a small bending movement (approx. 20-30 degrees). Other than this, the furnace doesn’t have any technical problems and works fine.
* Ideally, the furnace door should be waist-high, not hugging the floor.In our furnace is not appropriate to ideal. We should rearrange furnace location but it can be hard figure out this situation because furnace’s place is steady. Maybe we can use another tool to make easy to open furnace door like stick or towel even though it can cause accumilation of stress on back. Maybe we can add a coil to furnace door so that it can be opened and closed by less body movement.

**Microwave**

* The microwave is placed in an easily reachable height and doesn’t have any technical problems, works fine

**Fridge**

* The fridge's cooling system works without any observed problems. Fridge's size measurements meet the standards.

**Cabinet (Design for minimum)**

* The cabinets have more than one layer of materials. Reaching the back sides of the cabinet is a tedious task. There isn’t a rail cabinet in the kitchen, which would ease the task of reaching storage materials. Therefore a rail cabinet is recommended for easier access to materials. The gripping parts of the cabinets does not tire hands or cause discomfort. Upper section of the cabinets are too high to reach and require the usage of a ladder.
* Although height of upper cabinet from the ground must be 200 - 220 cm , our height is 2 46 cm that is higher than to the standards.Also cabinets’ height is upper to the max reach level which is 190 cm.So people can not reach top shelf of upper cabinet directly, they should use these shelves with the help of chair or ladder.
* Height of lower cabinet must be between 85 and 95 cm and our counter is approximatly appropriate to the standards.
* Cabinet dimensions are appropriate to the standarts except height of upper cabinet.
* Height of upper cabinet that is 100 cm is higher than the standards that is 60 – 90 cm.This problem is related to height of upper cabinet problem.We gave advice for this problem.

**Aspirator**

* The distance between counter and aspirator must be 60 – 65 cm for air-conditioning and this distance in our kitchen is 60 cm so that is optimal.
* Aspirator lacks the necessary ventilation power. Instead of using aspirator ,we should use paddle box for better air-conditioning.
* The distance oven and paddle box should be 60 – 80 cm and it must be strong enough to soak up at least 200-350 m3 of air. In our kitchen the distance is 55 cm that is lower than the standards.It can be rearrange oven and paddle box location to have better performance.

**Window**

* Height of kitchen window must be between 125 – 145 cm , our height is 135 cm that is proper to the standartd.
* Window area is supposed to 1/6 of the floor area so ratio must be 0.16 but our ratio is 2.227 / 10.85 = 0.205 that is higher than the standards because of that kitchen has lots of light. We talked about this topic in lighting title.

**Table and Chairs**

* Both table and chair height measurements meet the standards. Table is big enough for all family members to use at the same time and the number of chairs match the number of family members.
* Chairs' back could be more ergonomically designed and somewhat more supportive to the users' back.
* The table should be placed at the most comfortable space in the room, and it is preferred to be exposed to natural light near a window.Our table can be more close to the window but its place is looks comfortable.

**Television**

* Television is located above the microwave and is slightly above head level and higher than the ideal height. Reaching television isn’t hard.
* The television doesn’t have any technical problems and works fine.

**Dishwasher**

* The placement of the dishwasher blocks some cabinets from opening which seems somewhat inevitable due to small kitchen size. The dishwasher doesn’t have any technical problems and works fine.
* Dishwasher must be placed below waist height like our dishwasher.
* Dishwasher should be located left side of sink for righthanded and should be located right side of sink for lefthanded. Our dishwasher is located right side and people who are living in house is righthanded so we have to chance location of dishwasher or sink but changing dishwasher place is more cheap and easy to make.
* Dishwasher height , width and depth are appropriate to the standards.

**Dish Basket For Clean Dishes**

* The dish basket is insufficient in terms of size and not all dishes fit into the basket. A bigger basket is required to fit all cleaned dishes.

**Kitchen Knives**

* Knives are kept in the drawers. Since they are frequently used in the kitchen, a knife holder is advised for a better user experience.

**Oil Bottles**

* Oil bottles are placed in an easily reachable distance at the corner of the counter. This placement is optimal since it doesn’t get in the way while using the counter for cooking processes (like chopping, slicing etc.).

**Kettle and Toaster**

* The kettle and toaster are placed next to each other at a corner of the counter. They are placed in an optimal position and do not get in the way of the cooking process.

**Floor**

* Suitable kitchen flooring must be ceramic tiles with epoxy grouting so our floor is appropiate to the standards.

**Water Bottle - Water Fountain**

* There isn’t an electrical water fountain in the kitchen. Drinking water is kept in a  5 gallon dispenser - sized water bottle.
* Filling jugs with water requires a 30 degree bending movement forwards. Staying in this position for a long time might cause back injuries. Also the heavier the jug becomes, the pressure on the user's back increases. An electrical water fountain is advised to avoid these ergonomic problems from occurring.

**CPL**

We analyzed energy consumption of make a cake which is 3 kcal/min acoording to our calculate by internet website (aktivite-kalori- hesaplama.hesabet.com). Also, we looked to the another work which is shown on the table like puting up a wall that is 4 kcal/min . Making a cake is not exhausting as putting up a wall. Because of that standards energy consumption is for male=5 kcal/min and for female=4 kcal/min ,make a cake is not over CPL , so rest periods is not needed.

Also we looked the basal metabolism by website which is 1255.5 cal. Making a cake is not only static but also dynamic muscle work but this work doesn’t cause fatigue. For example, mixing with a mixer causes vibration which is important we mentioned about this in vibration part. Moreover, heartbeat and oxygen consumption are not remarkable increasing while make a cake so that recovery time is low.

**LIGHTENING**

This kitchens measurments are:

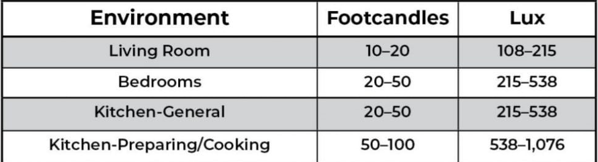
Length : 3.5

width : 3.1 m

height: 2.65 m

**Light Intensity:**

* We calculated from calculator the lumen we need and 3733 Lumens or 46 led watt.
* Current Led watt is 23 totally. And it is the proof that the poor lightening. Also the measurents for lux says there is not enough light intesity.
* Right under the light there is 100 lux intensity ( it is measured 76 cm over the floor) and in the farest corner there is 20 lux light intensity.

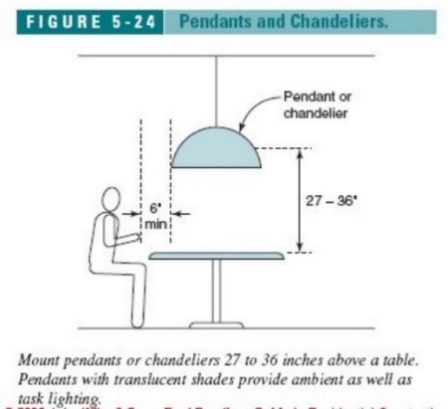


**Chandelier:**

There should 215 lux in general and 538 lux for the working triangle which is really far away from this kitchen.

There are poor lightening in general and also the place of light is wrong. Because if it is a dinner table light it should be in the center of the table otherwise there will be shadows. Also the height is wrong it is 114 above the table it should between 68 to 90 cm.

And its diameter should ½ or 1/3 of the width of the dining table. If we evaluate as it is a square table with the same area then we get the result as 4 cm diameter for chandelier with 68 to 90 cm height from the table.



**![tablo içeren bir resim

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oluşturuldu](data:image/jpeg;base64,/9j/4AAQSkZJRgABAQEAYABgAAD/4SM+RXhpZgAATU0AKgAAAAgABgALAAIAAAAmAAAIYgESAAMAAAABAAEAAAExAAIAAAAmAAAIiAEyAAIAAAAUAAAIrodpAAQAAAABAAAIwuocAAcAAAgMAAAAVgAAEUYc6gAAAAgAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAFdpbmRvd3MgUGhvdG8gRWRpdG9yIDEwLjAuMTAwMTEuMTYzODQAV2luZG93cyBQaG90byBFZGl0b3IgMTAuMC4xMDAxMS4xNjM4NAAyMDIxOjA1OjI2IDEzOjQ1OjE3AAAGkAMAAgAAABQAABEckAQAAgAAABQAABEwkpEAAgAAAAMwMAAAkpIAAgAAAAMwMAAAoAEAAwAAAAEAAQAA6hwABwAACAwAAAkQAAAAABzqAAAACAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA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lightment:**

This ceiling height is 265 cm nearly 9 feet and light should distance from the Wall 107 cm.

**Distance to the walls:**

Left : 140

Right: 100

Up: 140

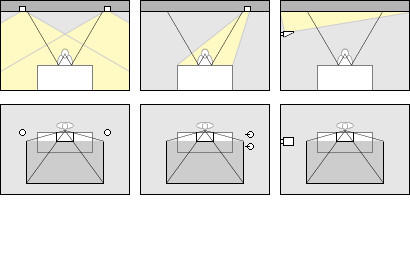
Down: 150

It is nearly optimum hence the light isn’t enough and also the luxs are different in the general and triangle.

**Windows:**

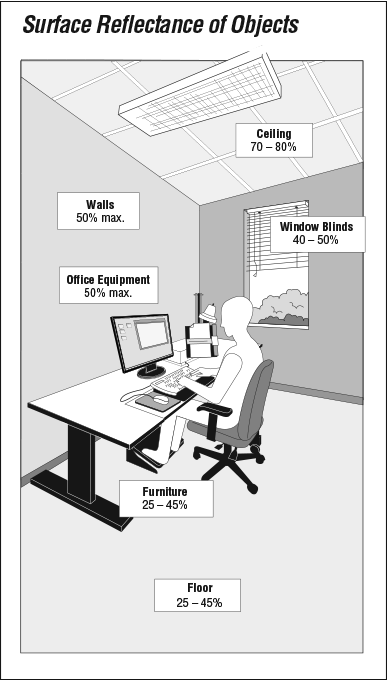
Windows area supposed to be 1/6 of the floor area . Our ratio is 2.227/10.85. It is higher than the standart. This kitchen has a lot of light. The kitchen in the east side and household spend a lot of time in the morning. Windows are enough in the morning.

**Suggestion:**

A lot of spot with angles can be suitable. Triangle should access more lumen and also the height to the Wall should remain in the safety region. We can say nearly 4 spot will be enough for this kitchen. Or 3 spot and one chandalier for the dining table may be suitable. Totally there should 46 LED watt. And light color should be 2700 Kelvin.

**Reflectance:**

Suggestions for the percent of light reflected off surfaces in a typical office include:

* Window blinds (40-50%).
* Walls (50% maximum).
* Business machines (50% maximum).
* Ceiling (70-80%).
* Floor (20-40%).
* Furniture (25-45%).

**Ceiling:**

* In our ceiling is White tile which LRV value is

|  |  |  |
| --- | --- | --- |
| Ceilings | 0.80 | White Paint on Plain Plasterboard |

* It is close to recommended LRV.

**Floor:**

|  |  |  |
| --- | --- | --- |
| Floors & Furniture | 0.80 | Paper, White |

* It is much higher than recommended LRV. It is not ergonomic.
* tablo içeren bir resim

  Açıklama otomatik olarak oluşturulduWALL is medium Brown with nearly %50 LRV and it is ergonomic.

**Kitchen Cupboard:**

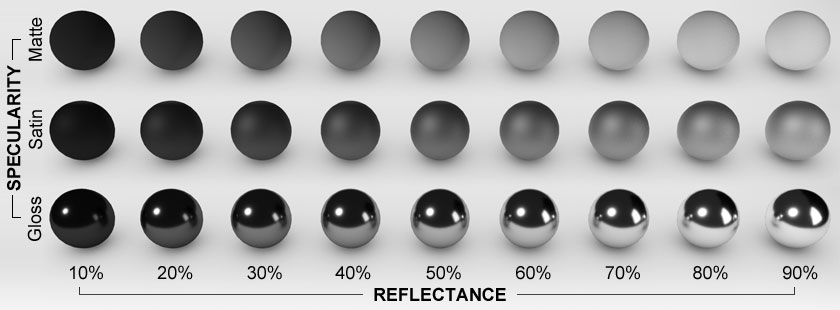
Furniture is not exact but something like American Cherry with Lrv nearly %20. But the ceramic is paper White with %80 lrv. Ceramic should be more safety color in terms of ergonomics.



**Chair:**

* Chair is starfish color. With LRV: 28.
* It is about ergonomic borders.

**Fridge, Kettle, Microwave Oven and Oven:**

Fridge is LRV levels are about 60% kettle is about 80%, microwave oven and oven is about 40%. Fridge and kettle is not ergonomic in terms of reflectance.

**Suggestion:**

Painting floor and fridge will be the most ergonomic and cheapist solution in terms of reflectance.

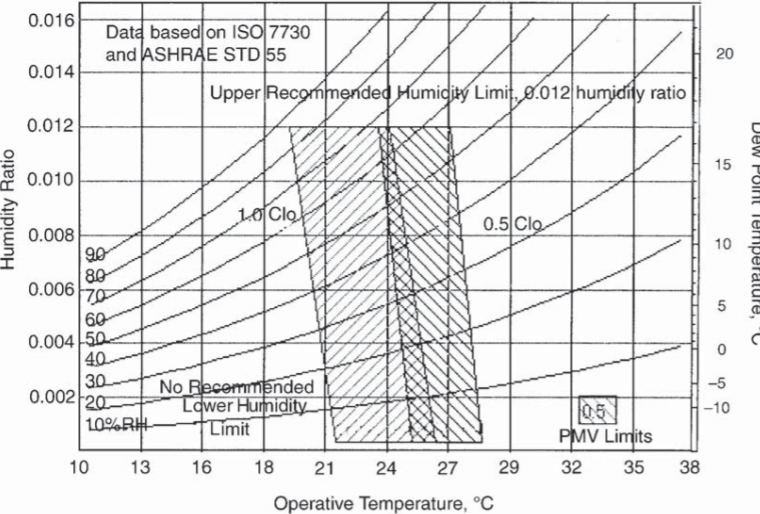
**CLIMATE**

**Air temperature:**

* In a workplace, air temperature should be between 19-26°C for working healthy and comfortable. Normally, human body temperature is between 36.5 and 37.5 degrees.It can change between 33.2 and 38.2 depending on gender, location and pyhsical activities that performed.
* Human body secretes sweat to decrease body temperature to normal values by evaporating under extreme heat conditions.
* Temperature is nearly 21°C in these days in this home.
* The heat exchange between the outside and inside reduced by exterior insulation.
* If the oven is running for long time when there is no air flow, temperature may increase in indoor and moderate heat stress can occur on person who is in there.

**Humidity:**

* Humidity levels should be between %30-50 ideally. The average humidity level is %50 in the house.
* When humidity decreases under %30, especially during the cold months, some irritations arise for human and environment. It causes dry skin, sinus problems and irritated eyes for people. Also wooden furnitures can constrict, plants can wither. A bowl of water can be placed near the radiator in order to avoid decreasing moisture in the air.



Humidity limits according to ASHRAE-55-2013

**Air movement:**

* Ventilation is provided by window, aspirator and balcony door.
* Best way to refresh air is keep interior and window or balcony door open at the same time. The draft pushes polluted air out.

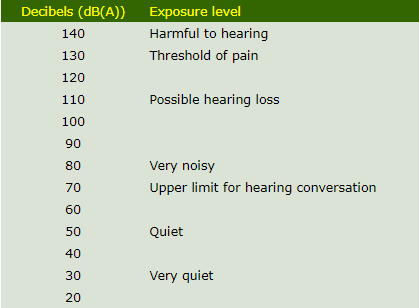
**Radiation:**

* Since dark surfaces absorb more heat than light colored surfaces, they generate more heat radiation.
* Microwave oven and television emit non-ionizing radiation.
* Direct exposure is harmful, so do not stand in front of the microwave and its cover should be closed properly and it should never be opened while working.

**NOISE**

* Nearby school causes average level of 80 dB
* The house is not in the traffic area which does not cause any high level of noise. When nearby school is inactive average dB is 59 dB
* When the dishwasher is working dB levels are between 70-75 dB.
* Refrigerator levels between 32 to 47 dB which is not a problem for ergonomics

Here is some dB levels for ergonomics:

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* The World Health Organisation (WHO) provides some guidance on acceptable levels of noise in the indoor living areas should be average of 35 dB’s
* Noise pollution can trigger the body’s stress response, one of its major health effects is chronic stress and the high levels of stress hormones that go with it. As a result, it can reduce productivity while working.

**Resolutions:**

* Sound waves bounce around in rooms with hard flooring, such as tile or laminate, adding a rug will absorb harsh noises and prevent a resounding effect to help reduce noise levels.
* Replacing the old window with a newer double- or triple-pane unit, and hang thick draperies or install interior window shutters to block even more sound coming from the nearby school.
* Using a white noise cancelling machine could emit a continuous soft stream of soothing sound, such as falling rain or the surf breaking on the beach, which can help you tune out unwanted school sounds in the environment.

**VIBRATION**

* Refrigerator and dishwasher do vibrate but their vibration levels are not high enough to cause risk assesments.
* Mixers tend to vibrate excessively especially for using extended periods of time and it can cause Hand Arm Vibration (HAV) risk assesments.

**Resolutions:**

* Altarnate hands if one hand begins to feel tired.
* If necessary, use two hands to reduce grip force.
* Use anti-vibration tape or gloves.

**FREQUENCY**

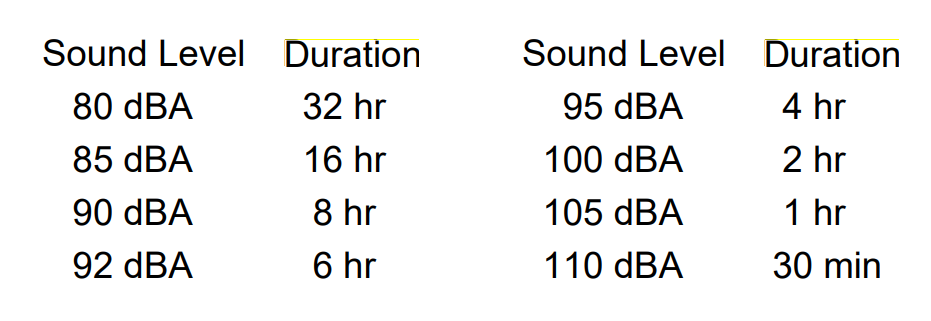
* When there is no sound coming from nearby school or dishwasher (59 dB) frequency is around 4000 Hz

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**DURATION**

* Exposure time of sound coming from nearby school is around 8 hours and it is an intermittent noise, so it does not occur any risks.
* Sound coming from dishwasher is continous and exposure time is between 1.5 to 4 hours. Due to low sound level it does not cause any risks.

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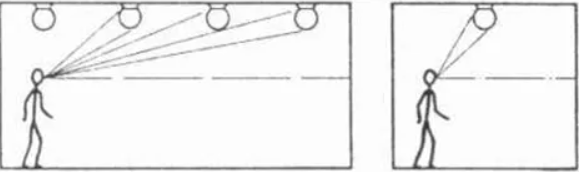
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**OCCUPATIONAL RISKS**

**LIGHTING RISKS**

The floor of our kitchen is white, it may cause eye diseases due to light reflection. Dark carpets can be used.

The location of the light source in our kitchen is lower than the standards. The light source enters the 45 degree area scanned by the eye. It causes glare. Glare makes vision difficult and reduces working capacity. The position of the light source should be adjusted according to the standards.



**FALL RISKS**

There is no carpet in our kitchen, so when something is spilled on the floor, we may slip and fall. Equipment and materials that are broken or spilled in the kitchen should be cleaned continuously.

The cabinets are long, there may be a danger of falling when trying to reach them. A ladder should be used.

**NOISE RISKS**

Sounds exceeding 85 decibels damage the auditory system. However, our kitchen decibel does not exceed 85 decibels. So there is no noise risks in our kitchen.

**BURNING RISKS**

The distance between the sink and the stove is short in our kitchen, so when working on the counter, contact with hot objects on the stove may occur and this may cause burns. İf possible, we can work on the dining table.

We should wear gloves when handling hot objects and we should not put cooker pots on the floor.

**ELECTRIC RISKS**

In our kitchen, there are many electrical devices such as electric kettle, microwave, toaster, oven. The devices cause fire and accidents. In order to avoid accidents, any wet equipment and skin should not be contacted with electricity.

All electrical equipment should be regularly maintained and repaired.

**CHEMICAL RISKS**

Our kitchen residents exposed to many chemicals in kitchens such as detergents, solvents and pesticides. These chemicals cause chronic respiratory symptoms such as cough, sputum, shortness of breath, severe shortness of breath, and nasal congestion. Using the least amount of chemicals possible will be effective in reducing respiratory diseases.

In our kitchen, ambient air should be circulated against chemical risk factors.

**CUTTING RISKS**

Knives are in the same drawer with spoons and forks in our kitchen, knives can cut the hand when we take a fork from the drawer. So, we have to place the knives in a separate drawer or stand.

In addition, person should have knowledge about not leaving knives on the counter, wearing glove when working with knife, not working fast with the knife and not trying to hold the falling knife.

**VENTILATION AND HUMIDITY RISKS**

If our kitchen window is closed for a long time, temperature and humidity increase, this situation causes an increase of microorganisms on the objects.

The humidity in our kitchen is optimum. In addition, when humidity decreases under %30, some irritations arise for human and environment. It causes dry skin, sinus problems and irritated eyes for people.

**ERGONOMIC RISKS**

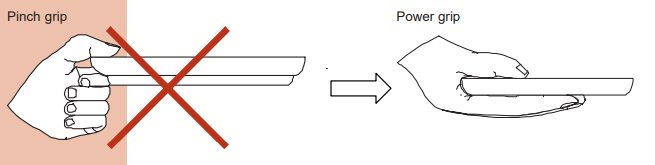
The extension references of our cabinets are longer than normal levels.In case of frequent use, it can cause some health problems in the shoulder and back. Therefore, a safe ladder that will assist in required access should be available during use.

Our kitchen has not work triangle. If we want to solve this problem, the working triangle should not be too long. It causes residents to spend more energy. If the perimeter of the triangle is shorter than standards, it will prevent comfortable movement during working in the kitchen.

While mixing food, we should not do the same mixing motion for a long time. Muscles and tendons do not have enough time to rest, which leads to fatigue and possibility muscle damage. We can use anti-vibration tape ogloves

In our kitchen placing dishes on high shelves stresses the shoulders more than working with the hands at waist level. A ladder should be used to eliminate this awkward posture.

Person working in our kitchen may stand for prolonged periods on hard surfaces. So muscles tire quickly in this static postures. Do not stay in the same position for more than 20 seconds.

When working with the mixer in our kitchen, we should not do the work at once, we should do it by taking breaks. Otherwise muscles and bones may be damaged by vibration. The person who is cooking should not be placed in corners or adjacent to a doorway. where the door could swing into the cook, and people may brush past pan handles and cause accidents.

**CONCLUSION**

If we look at previous steps you could see that the kitchen is anthropometrically correct to some degree but it has some problems. Some crucial problems are that the work triangle is missing, the upper cabinet dimension is too high and some distance problems which pose risks. Also, there are some dimension problems. Tools are mostly well placed but there is insufficient space on the counter. The ligthing in the kitchen is insufficient, dispersed and causes shadows.

Overall there are some major problems that can be solved only by a total redesign of the kitchen while there are some minor problems that can be solved without performing such tedious tasks.