Patricia Isabela BRAILEANU

KITCHEN ISLAND FURNITURE DESIGN FOR RESIDENTIAL HOUSES

Abstract: *In terms of spatial configuration, kitchens design is related to the number of work fronts, shapes and their arrangement in the assembly, storage and distribution areas, as well as the location of the dining place. This paper focuses upon designing a prototype by taking into account the kitchen geometry, as well as different materials and their properties, thus providing an optimum combination of materials likely to ensure a long lifespan of the product at a minimum cost.*

Keywords: *design, island, simulation, furniture, kitchen, residential, house.*

1. INTRODUCTION

The kitchen with one island work space is a spectacular solution, specific to the very large spaces, opened to living room or hallway. Besides aesthetics, it offers the advantage of flexibility and low circulations space. The discontinuous work space can be a disadvantage in some situations (the two main features of the kitchen are located on separate fronts). However, for proper operation, it is recommended the optimal distance of 120cm between the two fronts, and leave at least 90cm of free space around the island.

Fig. 1 Kitchen forms.

The kitchen with one U-shape work space is similar to kitchen with one L-shaped work space, this type of arrangement displays a better working surface and optimizes the transit area. Nevertheless, there are some limits in the architectural structure.

2. CHARACTERISTICS AND COMPLEX TYPES OF KITCHENS

A large number of kitchen types have complex geometric configurations resulting from the dining integration spot in the work space, and annexing generous storage areas.

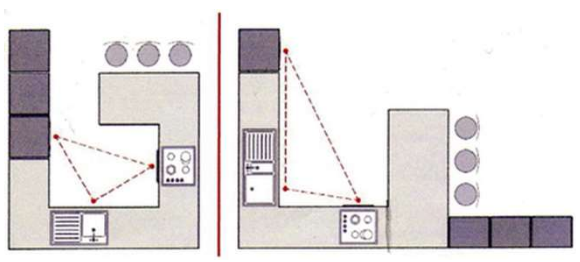


Fig. 2 Work triangle in different kitchen shapes.

Besides the advantages and disadvantages of a particular type of kitchen, the choice is primarily conditioned by the architectural context.

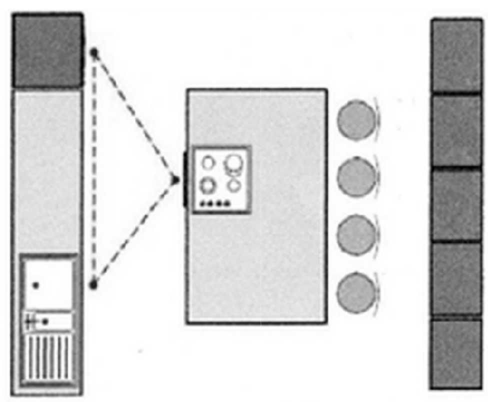


Fig. 3 Work triangle in kitchen with one island.

2.1 Dining places

Dining places can be implemented in different geometric shapes (straight or curved) and this type of dining space can be adapted easily to almost any design. Moreover, its flexibility is the big advantage. It is recommended to avoid positioning the dining place in a circular area, and provide a free space of 70÷90 cm on the open sides. For correct sizing of the table, a free space of 60÷70 cm for each person should be provided.

Fig. 4 Kitchen with classic dining place.

Another possibility can be the integrated dining place that offers an elegant solution for American kitchen style.

One consequence of this configurations the dining place atypical height, which results to be 86÷91 cm (depending on the working space) instead of 74÷76 cm standard high. For optimum comfort it is recommended the use of adjustable seats.

Fig. 5 Kitchen with integrated dining place.

This approach achieves volumetric compression of three distinct areas that otherwise would require larger perimeter.

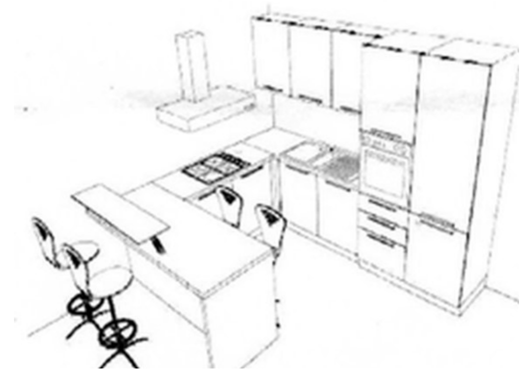


Fig. 6 Kitchen with integrated bar.

Moreover, the incorporation of a bar in this context, gives a touch of personality for the ensemble.

The ideal kitchen is the one that adapts best the available space to your lifestyle, that responds to your personal needs and ensure the comfort and facilitate for specific activities.

3. DESIGN PROPOSAL FOR KITCHEN ISLAND FURNITURE

For the overall design of the kitchen, SolidWorks 2013 software has been used. The location of the sink is important since this has been decided to represent the "piece de resistance" of the kitchen design. The sink design is a combination of two sinks that are already on the market, made by new material.

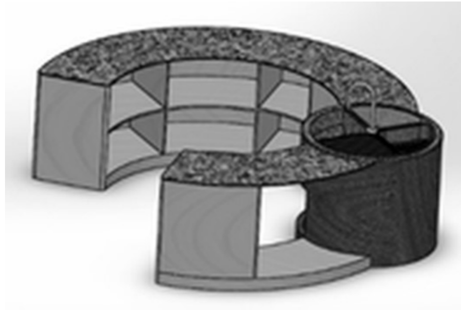


Fig. 7 Kitchen prototype.

By means of thermo-moulding, the new sink model will come in various shapes and colours using Corian DuPont.

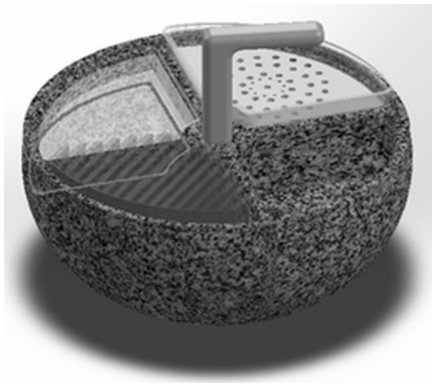


Fig. 8 Sink prototype with the modular furniture.

3.1 Main materials used for kitchen fabrication

M.D.F Medium-density fibreboard: an engineered wood product made by breaking down hardwood or softwood residuals into wood fibres, often in a defibrator, combining them with wax and a resin binder, and forming panels by applying high temperature and pressure. The waterproof one will be used since the kitchen is prone to humidity and, thus, preventing deterioration over time.

CORIAN – DuPont or Solid Surface is a non-porous low-maintenance countertop surface. It can mimic the appearance of stone, wood and other naturally occurring materials, and can be joined invisibly by a trained craftsman. This material will be used for the sink and/or for the top table of the kitchen island. This type of material is new on the market. It, nevertheless, proves beneficial for it helps moulding a sink by means of thermoforming.

3.2 Machines used in the manufacturing process of the kitchen furniture

The main machines used to manufacture the kitchen are the following ones:

a) 4-axis machining centre ROVER 33 – Biesse;
b) Line pressing panel (calibrating machine and electrically heated press platens);
c) SINGLE curved edging machine –Biesse;
d) Line finish (painting).

The sink can be fabricated by thermo-moulding processand the all holes by drill and reamer processes.

The remaining sink parts can be bonded with the special adhesive for corian.

3.3 Simulation analysis

The modular furniture with the sink attached has been analysed as reported follow:

- ***Input material properties:***

Alloy Steel is a linear elastic isotropic material with the main properties suggested in the following Table 1.

Table 1

Alloy Steel properties

Property Name	Value	Units	Value Type
Elastic modulus	2.1e+011	N/m²	Constant
Poisson's ratio	0.28	NA	Constant
Shear modulus	7.9e+010	N/m²	Constant
Mass density	7700	kg/m³	Constant
Tensile strength	7,24E+12	N/m²	Constant
Yield strength	6,20E+12	N/m²	Constant
Thermal expansion coefficient	1.3e-005	1/Kelvin	Constant
Thermal conductivity	50	W/(m.K)	Constant
Specific heat	460	J/(kg.K)	Constant

Corian DuPont is a linear elastic isotropic material with the main properties suggested in the following Table.

Table 2

Corian DuPont properties

Property Name	Value	Units	Value Type
Elastic modulus	8,46E+13	N/m²	Constant
Poisson's ratio	0.3	NA	Constant
Mass density	1700	kg/m³	Constant
Tensile strength	5,04E+11	N/m²	Constant
Yield strength	2.5e+007	N/m²	Constant
Thermal conductivity	0.2256	W/(m.K)	Constant
Specific heat	1386	J/(kg.K)	Constant

M.D.F. is a linear elastic isotropic material with the main properties suggested in the following Table 3.

Table 3

M.D.F. properties

Property Name	Value	Units	Value Type
Elastic modulus	2,59E+13	N/m²	Constant
Poisson's ratio	0.25	NA	Constant
Mass density	1020	kg/m³	Constant
Tensile strength	2,51E+11	N/m²	Constant
Yield strength	2.5e+007	N/m²	Constant
Thermal conductivity	0.2256	W/(m.K)	Constant
Specific heat	1386	J/(kg.K)	Constant

3.4 Stress analysis. Study Results

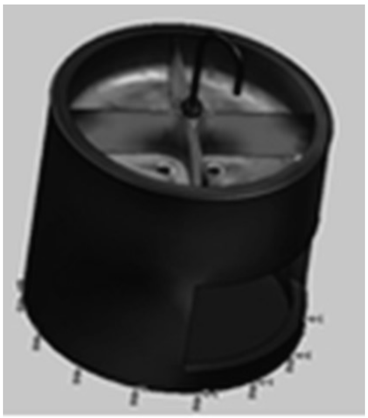
After having designed several models in Solidworks, each of them with its own finite element analysis, the one from figure 9 has been selected by taking into account the kitchen geometry, as well as different materials and their properties, thus providing an optimum combination of materials likely to ensure a long lifespan of the product at a minimum cost.

Fig. 9 Sink prototype with the modular furniture.

A normal force of 4000N (force 1) has been applied on 26 faces using uniform distribution with sequential loading type.

- Reaction forces for entire body:

Sum X: 0.0430832 N;
Sum Y: 1491.26 N;
Sum Z: -1.36784 N;
Resultant: 1491.26 N.



Free-body forces for entire body:

X: 3.45614e-005 N;
Y: -0.000109172 N;
Z: 0.000387509N;
R: 0.000404075 N.

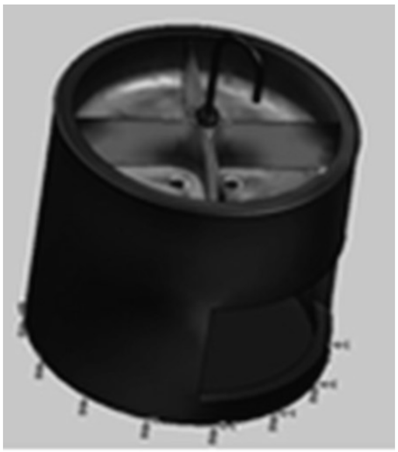
R (resultant)

Fig. 10 Static Displacement 1.

Table 4

Stress results – minimum values

Name	Type	Min	Location
Stress1	VON: von Mises Stress	0.00107106 N/m² Node: 2080	(715.174 mm, 941.05 mm, 739.104 mm)
Displacement1	URES: Resultant Displacement	0 mm Node: 4606	(659.607 mm, -248.414 mm, 1414.08 mm)
Strain1	ESTRN: Equivalent Strain	6,29E-10 Element: 780	(693.303 mm, 897.301 mm, 727.884 mm)



Free-body forces for entire body:

X: 0 Nm;
Y: 0 Nm;
Z: 0 Nm;
R: 1e-033 Nm.

R (resultant)

Fig. 11 Static Displacement 2 and 3.

Table 5

Stress results – maximum values

Name	Type	Max	Location
Stress1	VON: von Mises Stress	542291 N/m² Node: 18027	(991.582 mm, 451.568 mm, 845.168 mm)
Displacement1	URES: Resultant Displacement	0.0477248 mm Node: 14002	(720.494 mm, 331.886 mm, 702.095 mm)
Strain1	ESTRN: Equivalent Strain	3,00E+00 Element: 9221	(518.784 mm, 447.069 mm, 439.91 mm)

4. CONCLUSION

This scientific paper approach the technical innovative ideas in furniture design field so as to create a new kitchen design line.

This paper also aims to explain the implementation of the engineering techniques in developing the ideas and mechanisms, achieving the desired product line in order to provide utility and a modern design.

Having taken into account the different materials and their properties, this scientific paper provides the best combination of materials likely to ensure long lifespan of the product at a minimum cost.

REFERENCES

[1] Braileanu Patricia Isabela (2014). *Elemente de Design și proiectare mobilier rezidențial (Drafting and Design Elements for RezidentialFurnitur.*

[2] www.woodsolutions.com *accessed on April 3rd.*

[3] http://www.metric.ro/ *accessed on March 15th.*

Author:

Assist. PhD. student Eng. Patricia Isabela BRAILEANU, University POLITEHNICA of Bucharest, Faculty of Aerospace Engineering, Department of Engineering Graphics and Industrial Design, E-mail: braileanu.isabela@gmail.com, Phone: 0040731898333.