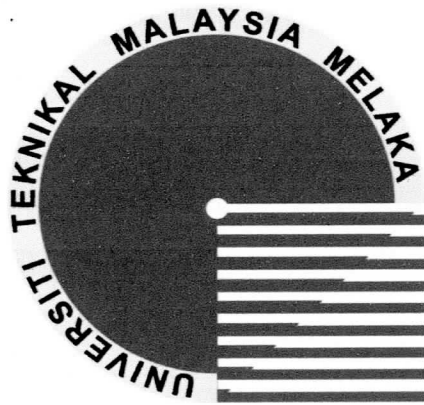


# DESIGN AND DEVELOPMENT OF SOFA BED

ABDUL RAHMAN B. ABDUL MALEK  
B050410097

UNIVERSITI TEKNIKAL MALAYSIA MELAKA



UNIVERSITI TEKNIKAL MALAYSIA (UTeM)

## Design and Development of Sofa Bed

Dissertation Submitted of the Faculty of Manufacturing Engineering in  
Partial Fulfillment of the requirement for The Awards of the Degree of  
Bachelor of Manufacturing Engineering (Manufacturing Design)

**Abdul Rahman Bin Abdul Malek**

APRIL 2008



# UNIVERSITI TEKNIKAL MALAYSIA MELAKA

## BORANG PENGESAHAN STATUS TESIS\*

JUDUL: DESIGN AND DEVELOPMENT OF SOFA BED

SESI PENGAJIAN :2007/2008

Saya ABDUL RAHMAN BIN ABDUL MALEK

mengaku membenarkan tesis (PSM/Sarjana/Doktor Falsafah) ini disimpan di Perpustakaan Universiti Teknikal Malaysia Melaka (UTeM) dengan syarat-syarat kegunaan seperti berikut:

1. Tesis adalah hak milik Universiti Teknikal Malaysia Melaka .
2. Perpustakaan Universiti Teknikal Malaysia Melaka dibenarkan membuat salinan untuk tujuan pengajian sahaja.
3. Perpustakaan dibenarkan membuat salinan tesis ini sebagai bahan pertukaran antara institusi pengajian tinggi.
4. \*\*Sila tandakan (√)

SULIT

(Mengandungi maklumat yang berdarjah keselamatan atau kepentingan Malaysia yang termaktub di dalam AKTA RAHSIA RASMI 1972)

TERHAD

(Mengandungi maklumat TERHAD yang telah ditentukan oleh organisasi/badan di mana penyelidikan dijalankan)

TIDAK TERHAD

Disahkan oleh:

\_\_\_\_\_  
(TANDATANGAN PENULIS)

\_\_\_\_\_  
(TANDATANGAN PENYELIA)

Alamat Tetap:

14,KG. TERSUSUN BATU 3,

35350 TEMOH

PERAK DARUL RIDZUAN

Cop Rasmi:

Tarikh: \_\_\_\_\_

Tarikh: \_\_\_\_\_

\* Tesis dimaksudkan sebagai tesis bagi Ijazah Doktor Falsafah dan Sarjana secara penyelidikan, atau disertasi bagi pengajian secara kerja kursus dan penyelidikan, atau Laporan Projek Sarjana Muda (PSM).  
\*\* Jika tesis ini SULIT atau TERHAD, sila lampirkan surat daripada pihak berkuasa/organisasi berkenaan dengan menyatakan sekali sebab dan tempoh tesis ini perlu dikelaskan sebagai SULIT atau TERHAD.

## DECLARATION

I hereby, declared this thesis entitled “PSM Title” is the results of my own research  
except as cited in references.

Signature : .....

Author's Name : Abdul Rahman Bin Abdul Malek

Date : .....

## **APPROVAL**

This PSM submitted to the senate of UTeM and has been as partial fulfillment of the requirements for the degree of Bachelor of Manufacturing Engineering (Designing). The members of the supervisory committee are as follow:

.....

Mr Zulkeflee Bin Abdullah

Main Supervisor

(Official Stamp & Date)

## **ABSTRACT**

A sofa bed is one of the products that improve people life style. It comes in different type and pattern to satisfy the users require. This product has been a great development and evaluation since couple of year ago. Starting development from it sizes until the simple mechanisms, this product has a great potential to increase the market chart.

A sofa bed can make our life become simpler, easy and relax. It can make 2 main product combine become 1 new product. The sofa bed can reduce living cost such as when we need to buy furniture and other equipments, we don't have to buy sofa and bed. Enough with sofa bed, it can be multi function equipment for every one.

The methods that use in this research are Design for Manufacturing Assembly (DFMA) and Quality Function Deployment (QFD). DFMA's method use to analyze and make comparison between existing product design and new concept product design. It determines which design should be develop and modify. QFD's method is use to determine the customer requirement and their need. So the new design is refer to their requirement.

Generally, sofa bed gives good effect and benefit for human life style. It can make our life become simple, relax and easy with this stuff. There is no waste to develop this product.

## **ABSTRAK**

Katil sofa adalah salah satu produk yang boleh meningkatkan gaya hidup masyarakat dan membuatkan cara hidup menjadi lebih mudah, Ia dikeluarkan dalam pelbagai bentuk dan model. Untuk memenuhi kehendak pengguna, produk ini telah mengalami peningkatan atau kemajuan yang mendadak sejak kebelakangan ini. Pembangunan ini termasuk dari segi saiz sehingga kepada mekanismenya yang mudah, dimana produk ini mempunyai potensi untuk berada di dalam pasaran.

Katil sofa dapat menjadikan hidup manusia lebih mudah, ringkas dan relaks. Ia menggabungkan fungsi 2 produk menjadi 1 produk yang hebat. Katil sofa dapat mengurangkan kos sara hidup terutamanya dalam pembelian perabot, dimana kita tidak perlu membeli katil dan sofa. Cukup hanya dengan membeli katil sofa sahaja.

Kaedah yang digunakan dalam mereka bentuk katil sofa ini ialah “Design for Manufacturing Assembly” (DFMA) dan “Quality Function Deployment” (QFD). Kaedah DFMA digunakan untuk menganalisis dan membandingkan antara rekabentuk produk yang lama dengan rekabentuk produk yang baru direka ini. Kaedah QFD pula menentukan kehendak dan permintaan pengguna atau orang ramai tentang sesuatu produk.

Keseluruhannya, katil sofa memberi kesan yang baik dan manfaat dalam kehidupan manusia. Ia menjadikan hidup lebih mudah, ringkas dan relaks. Tiada pembaziran dalam meningkatkan dan membangunkan produk ini di Malaysia.

## DEDICATION

With all praises and thankful to Allah S.W.T because of His love and wisdom, I get opportunity to prepare my thesis for this project.

I dedicate this thesis to my parent, Abdul Malek B. Haji Baaudin and Amnah Bt. Jalaluddin, to all my family members, to my entire FKP lecturer, *Mat Men Itam, Apit Burger, Mudd, Arin @ Pi'e, Wan Skoyos and Wak Din* and friends that always give a moral support and encourage during finish up this thesis.

I also dedicate this thesis to my project's supervisor, Mr Zulkeflee B. Abdullah and to entire Manufacturing's lecturer.



## **ACKNOWLEDGEMENTS**

Praise to Allah Almighty for giving me a chance to complete my final year project and successfully complete this final report. First at all, I would like to thank my beloved parents, En. Haji Abdul Malek B. Haji Baaudin and Pn. Hajah Amnah Bt. Jalaluddin for giving me their full support and my family members that always gives a moral support and encouragement during this project timeline.

With honour and sincerely, I would like to thank you to my supervisor, Mr. Zulkeflee B. Abdullah for giving me the opportunity to be under his guide. I appreciate him gave me a lot of guide and advices to complete this thesis. I also would like to thank you to all Manufacturing lecturers who help me give some advice and tips.

I also would like to thank you to Universiti Teknikal Malaysia Melaka (UTeM) because gave the opportunity to their final year students to come out with final year project that evaluate student learning outcome. All the learning and practical lesson that we get will be used and practise in future.

Last but not least, I would like to thank you again to the entire person that involved as live or not and gave support to me. Thank you.

# TABLE OF CONTENTS

Declaration.....	ii
Approval.....	iii
Abstract.....	iv
Abstrak.....	v
Dedication.....	vi
Acknowledgements.....	vii
Table of Contents.....	viii
List of Figures.....	x
List of Tables.....	xi
List of Abbreviations, Symbols, Specialized Nomenclature.....	xii
<b>1. INTRODUCTION</b>	<b>1</b>
1.1 Research Objective	2
1.2 Scope	2
1.3 Problem Statement	3
1.4 Gantt chart and flow chart	4
<b>2.0 LITERATURE REVIEW</b>	<b>8</b>
2.1 Definition of Sofa Bed	8
2.2 Bed Sizes	9
2.2.1 Standard sizes	11
2.2.2 Sofa also known as couch	12
2.3 Cushion	13
2.4 Sofa bed Mechanism	15
2.5 Field of the Invention	16
2.6 Background of the Invention	16
2.7 Generate Product Concept	19
3.4.i Design for Manufacturing and Assembly	19
3.4.ii Quality function Deployment	20

<b>3. METHODOLOGY</b>	
3.1 Introduction	24
3.2 Design Analysis	24
3.3 Design Concept	25
3.3.1 Design 1	25
3.3.2 Design 2	25
3.3.3 Design 3	25
3.4 Parts and Components Related	27
3.5.1 Suggestion size	28
<b>4.0 RESULT</b>	<b>29</b>
4.1 Basic Concept	29
4.2 Final Design	30
4.3 Result from QFD	32
4.3.1 Analysis Graph	35
4.4 Result from TeamSet Analysis	43
4.5 Summary	51
<b>5.0 TECHNICAL DRAWING</b>	
5.1 Layout Drawing	54
5.2 Detail Drawing	57
5.3 Orthographic View	59
5.4 Isometric Drawing	60
<b>6.0 DISCUSSION</b>	<b>61</b>
<b>7.0 CONCLUSION</b>	<b>62</b>
<b>8.0 RECOMMENDATION</b>	<b>64</b>
<b>9.0 REFERENCES</b>	<b>66</b>
<b>10.0 APPENDIX</b>	<b>67</b>

## LIST OF FIGURES

<b>Number</b>	<b>Title</b>	<b>Page</b>
Figure 2.1	Mattres	8
Figure 2.2	Box-Spring	8
Figure 2.3	Bed Frame	9
Figure 2.4	Sofa	12
Figure 2.5	Cushion	14
Figure 2.6	Sofa Bed	15
Figure 2.7	Mechanism of Sofa Bed	17
Figure 2.8	Sofa Bed in Market	18
Diagram 3.1	DFMA Flow chart	23
Diagram 3.2	QFD flow chart	26
Figure 3.3	Bed Shaft / Connector	27
Figure 3.4	Spring bed frame	27
Figure 3.5	Suitable size	28
Figure 5	Figure of Assembly	45
Figure 5.1	Wire frame drawing	54
Figure 5.2	Detail Wire frame drawing	55
Figure 5.3	Sofa Bed Wire frame drawing	56
Figure 5.4	Detail Drawing	57
Figure 5.6	Orthographic view	59
Figure 5.7	Isometric View	60

## LIST OF TABLES

<b>Number</b>	<b>Title</b>	<b>Page</b>
Table 1	Gantt Chart	4
Table 2	Standard size for commercial bed	10
Table 4.1	Summary of respondent	33
Table 4.2	Summary result for QFD method	43

# **LIST OF ABBREVIATIONS, SYMBOLS, SPECIALIZED NOMENCLATURE**

DFMA	- Design for Manufacturing and Assembly
QFD	- Quality Function Deployment
PSM 1	- Projek Sarjana Muda 1
FKM	- Fakulti Kejuruteraan Mekanikal
FKE	- Fakulti Kejuruteraan Elektrik

# **CHAPTER 1**

## **1.0 INTRODUCTION**

In our living hood today, there are lots of new equipments that can improve our life style and make it simple. For the example, the crowded space in room can exist several problem and uncomfortable. These problems such as hard to clean the room, too compact and give stressed to the owner. In addition, the room has to be share with other people like brother or sister or the family that have many siblings.

So, in this project, I will make research and redesign a new pattern of sofa bed (sofa + bed). The design should be cheaper, practical, save time and can fulfill the customer required. For this project, my scope is focusing on the condition and size of houses in Malaysia because the limited area or chamber to put the furniture and others accessories. If there is combination of a sofa and a bed, people can save space. When in regular setting or the user need to take a nap, as sofa is very suitable. When the user needs to have a long sleep at night the sofa can be converted into a bed with the bed taken out from the bottom of the sofa.

My design is different with other design that available in market today. It covered by mixture of leather and synthetic material. The body will fill with high quality of sponge and cushion, the structure or supporter made by chosen wood and alloy that can avoid corrosion, light in weight and high strength. It comes in suitable size that can be related to all types of houses in Malaysia. The transformation is simple and easy to use and come in fascinating and beautiful colours.

## **1.1 Research objective**

The main objective of this project is to design the new shape of sofa bed that can reduce space, simple, light and practical. The design can solve the crowded room or chamber in Malaysia.

## **1.2 Scope**

Scope of this project:

- i. To find the need of a flexible sofa + bed combination in crowded room.
- ii. To explore the mechanisms of a sofa and a bed.
- iii. To find out suitability of sofa size and bed size.
- iv. To generate the product concept
- v. To analyze and evaluate product concept.
- vi. To develop prototype, model / simulation of the product using CATIA solid Modeling.



### 1.3 Problem Statement

Nowadays, besides the house has limited room and crowded, too many siblings and people live together in one house is the problems which exist. Imagine that the house has small living room and kitchen, room and toilet. Imagine that there are 2 rooms in house and was share by 10 people, it look so crowded. Furthermore, the room is fulfilling with the others furniture and stuffs.

Others problem that occur:

- i. Uncomfortable life
- ii. Incommitted sin
- iii. Argue with family member
- iv. No privacy and prudential

Besides that, the sizes of bed and sofa also give bad reason. Both of these furniture needs a lot of space and make the house look crowded if not decorate properly. So the size is the main reason to design a new sofa bed that can be multiple function.

### 1.4 Gantt chart and Flow chart for PSM 1

Project Activities		Week													
		1 (9/7-15/7)	2 (16/7-22/7)	3 (23/7-29/7)	4 (30/7-5/8)	5 (6/8-12/8)	6 (13/8-19/8)	7 (20/8-26/8)	8 (27/8-2/9)	9 (3/9-9/9)	10 (10/9-16/9)	11 (17/9-23/9)	12 (24/9-30/9)	13 (1/10-7/10)	14(8/10-14/10)
Project briefing,& Introduction	T	Diagonal	Diagonal												
	A	Dark	Dark	Dark											
Study the objective & scope	T			Diagonal											
	A				Dark	Dark									
Study the mechanism and the suitable size for the sofa bed.	T				Diagonal	Diagonal									
	A					Dark	Dark								
Research to generate and evaluate concept.	T							Diagonal	Diagonal						
	A								Dark	Dark	Dark				
Literature review & data analysis	T									Diagonal	Diagonal				
	A										Dark	Dark			
Conceptual design	T											Diagonal	Diagonal		
	A											Dark	Dark		
Report Writing & Submit	T													Diagonal	
	A													Dark	

**Table 1: Gantt chart**

T = Working target plan

A = Real plan

**Gantt chart for PSM 2:**

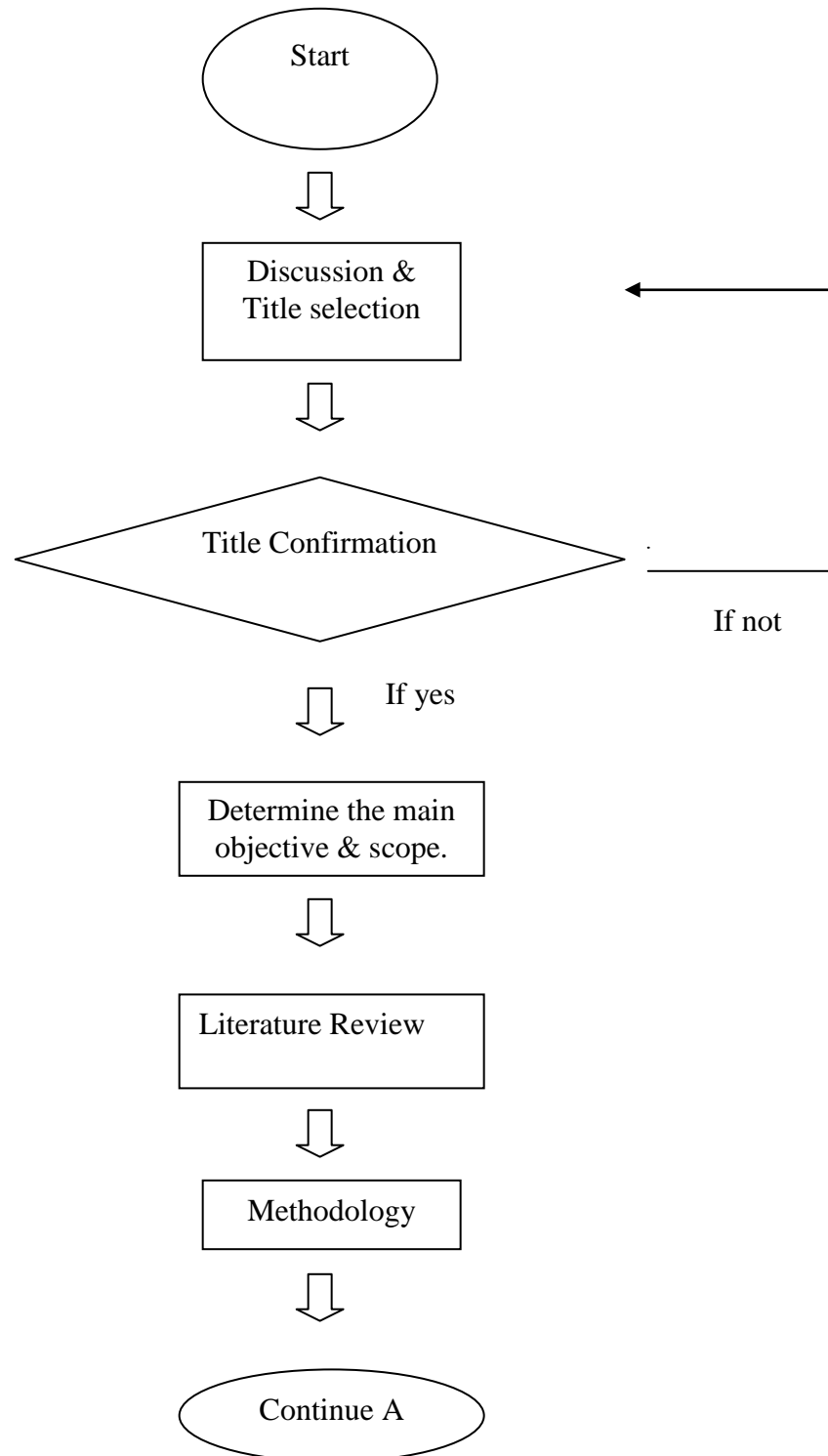
Project Activities	Week														
	Year: 2008	1 (1/1- 6/1)	2 (7/1- 13/1)	3 (14/1- 20/1)	4 (21/1- 27/1)	5 (28/1- 3/2)	6 (4/2- 10/2)	7 (11/2- 17/2)	8 (18/2- 24/2)	9 (25/2- 2/3)	10 (3/3- 9/3)	11(10/3- 16/3)	12(17/3- 23/3)	13(24/3- 30/3)	14(31/3- 6/4)
Identify the methodology.	T	Diagonal													
	A	Solid													
Search about the DFMA and QFD method.	T		Diagonal	Diagonal											
	A		Solid	Solid											
Prepare the questionnaire and survey.	T				Diagonal	Diagonal									
	A				Solid	Solid	Solid								
Run the survey at the selected location.	T						Diagonal	Diagonal	Diagonal						
	A						Solid	Solid	Solid						
Data analysis and results.	T									Diagonal	Diagonal				
	A									Solid	Solid	Solid			
Combined all chapter and report writing.	T											Diagonal	Diagonal		
	A											Solid	Solid		
Report Writing & Submit	T														Diagonal
	A														Solid

Table 2: Gantt Chart for PSM 2

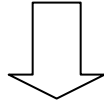
T = Working target plan

A = Real plan

Flow Chart to be guide for this project research:



Continue A



Data Analysis  
& Results



Produce the draft  
of the PSM's  
report.



Write the real  
report and  
rechecked by the  
supervisor.



Submit the report  
and prepare the  
slide presentation



Presentation



Finish

## **CHAPTER 2**

### **LITERATURE REVIEW**

#### **2.0 Introduction**

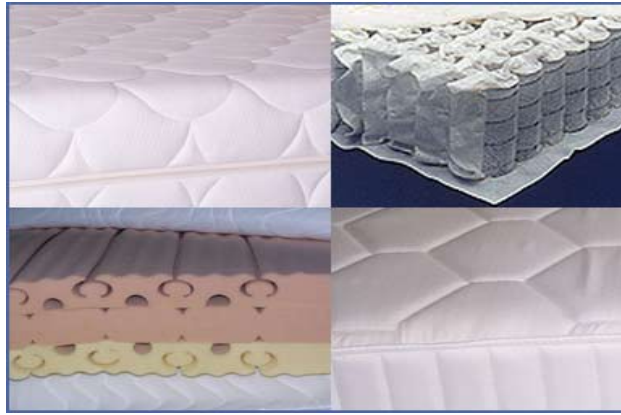
A sofa bed is furniture that combines 2 different usages; a bed and a sofa. This product can increase people life style because it so practical and give more benefit. It uses a sofa mechanism as main structure and adds a bed when it transform. This new product can reduce space and save cost to buy furniture.

#### **2.1 Definition of sofa and a bed**

Bed (listen) is a piece of furniture or location primarily used as a place to sleep, but can serve other functions, such as providing a place to lay down or for relaxation.

Beds come in a wide array of shapes and sizes. Early beds were little more than piles of straw or some other natural materials. An important change was raising them off the ground, to avoid drafts, dirt, and pests.

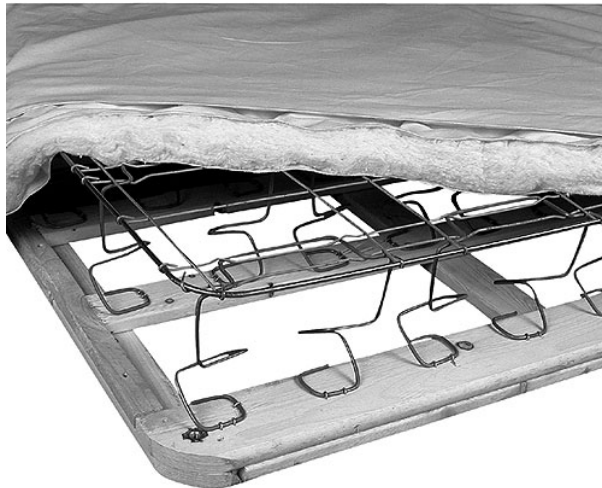
To make beds more comfortable, the top layer is frequently a mattress. Originally these were bags of straw for most people and filled with feathers for the wealthy. Eventually new fillings such as cotton and artificial fillers became common. In modern times most mattresses use springs, solid foam, latex, water, or air.



**Figure 2.1: Mattres**

(Reference: <http://www.quality-fabrics.com/images/mattres.jpg>)

The second layer is the box spring. The box spring or "divan" is a large mattress-sized box containing wood and springs that provide additional support and suspension for the mattress.



**Figure 2.2: box-spring**

(Reference: [http://thenaturalsleepstore.com/images/box\\_spring.jpg](http://thenaturalsleepstore.com/images/box_spring.jpg))

The third layer is the bed frame. The bed frame lifts the mattress/mattress-box spring off the ground. A dust ruffle, bed skirt, or valance sheet may be used to make the bed frame match the rest of the bedding.



**Figure 2.3: Bed Frame**

(Reference: [http://www.dragonballjee.com/blogpics/2006/05May/DSC\\_3712.jpg](http://www.dragonballjee.com/blogpics/2006/05May/DSC_3712.jpg))

At the top of the mattress, to provide greater support for the head, most people use a pillow. Also used is some form of covering blanket to provide warmth to the sleeper, often bed sheets, a quilt, or a duvet.

## **2.2 Bed sizes**

Most countries have a standard set of four sizes of mattresses. While the Double size appears to be standard among English speaking countries, based on the imperial measurement of 4 ft 6 in by 6 ft 3 in, the sizes for other bed types tend to vary. The European sizes differ; they are based on the metric system.

A king-sized bed differs from the other sizes in implementation, as it is not common to have a king-sized box spring; rather, two smaller box-springs are used under a king-sized mattress. On a U.S. Standard or "Eastern" King, the box springs are identical in size to a Twin Extra-Long.