



# INSTITUT TEKNOLOGI MARA

MARA INSTITUTE OF TECHNOLOGY

Shah Alam, Selangor, Malaysia. Tel: 362311-3 362721-6

Tarikh:

Surat Tuan:

Surat Kami:

LAPURAN PROJEK TAHUN AKHIR  
KURSUS DIPLOMA LANJUTAN KEJURUTERAAN AWAM  
KAJIAN KEJURUTERAAN, I.T.M, SHAH ALAM

"BEHAVIOUR OF TIMBER BEAMS OF DIFFERENT SPECIES  
UNDER PURE BENDING AND PURE TORSION"

BY  
NORDIN HASSAN  
I/C ITM: 79004947  
SEMESTER XI  
ADCE, ITM, SHAH ALAM

## PREFACE

This experimental project which consists the testing of small timber specimens has its main purpose the provision of data for the comparison of the strength properties of different species. Actually, timbers should be tested both in the green condition and in the seasoned condition. But in this experimental project, only timbers in the seasoned (air-dry) were tested due to the inavailability of timbers in green condition.

The test results may be used to show the behaviour of timbers involving the pattern of cracks and the relations between load and deflection , and between torque and angle of twist. Furthermore, the results may also be used to determine the relation between strength and such properties as specific gravity and density to determine the effect on strength as to assist in the establishment of design functions for structural timber.

The results of tests made with the 2cm. standard, owing to dimensional effect, directly comparable in all properties with those for the 2 in. standard. A more extensive comparison with the results tests from laboratory, may be obtained if the results tested in accordance with the former standard are corrected to the equivalent values for the 2 in. standard. Unfortunately, the test with the 2 cm. standard is not done due to the difficulties the preparation of the specimen as well as the test itself.

However, with this experimental project, the writer hopes that it will provide some ideas and knowledge to everybody concerning timber beam which is one of the important construction materials.

## ACKNOWLEDGEMENTS

This experimental project was performed at the Structural Laboratory, Department of Civil Engineering, MARA Institute of Technology, Shah Alam, Selangor. It was under the supervision of the following supervisors:

- a) En. Wan Mahmood Bin Wan Abd. Majid  
(Course Tutor and lecturer at Dept. of Civil Engineering, ITM)  
Adv. Dip. Civil Engineering. (ITM)  
M. Sc. (Struct. Engineering) (University Surrey)
- b) En Mohd. Salleh Bin Mohd. Noh  
(Lecturer at Dept. of Civil Engineering (UTM)  
B. Sc. (Hons.) Civil Engineering (Glasgow University)

The writer wishes to express his gratitude to both the supervisors for their perusal and constant encouragement given in carrying out the experimental project.

The writer also wishes to thank the following technicians:

- a) En Mat Som Bin Hj. Marwi  
Senior Technician at Dept. of Civil Engineering, ITM.
- b) En Yusuf Bin Hj. Marwi  
Technician at Dept. of Civil Engineering, ITM

For their painstaking assistance in the preparation of specimens and tests.

Lastly, the writer would like to thank all those persons, who have in one way or the other, contributed to the success of this experimental project.

October '81  
Shah Alam.

## TABLE OF CONTENTS

	<u>Page</u>
Preface .....	i
Acknowledgement .....	ii
Table of Contents .....	iii
Nomenclature .....	vi
CHAPTER 1 - INTRODUCTION .....	1
1.1 Summary.....	1
1.2 Objective .....	2
1.3 Scope of study .....	2
CHAPTER 2 - THEORY .....	5
2.1 Physical properties .....	5
2.1.1 Moisture content .....	5
2.1.2 Specific gravity .....	5
2.2 Mechanical properties .....	6
2.2.1 Basic stresses .....	6
2.2.2 Stress grading .....	7
2.2.3 Grade stresses .....	8
2.3 Strength tests on timber .....	9
2.3.1 Pure or static bending .....	9
2.3.1.1 Data .....	9
2.3.1.2 Properties to be computed .....	10
2.3.2 Pure torsion .....	11
2.3.2.1 Data .....	11
2.3.2.2 Properties to be computed .....	13
CHAPTER 3 - MATERIALS AND EQUIPMENTS .....	14
3.1 Materials .....	14
3.1.1 Chengal .....	14
3.1.1.1 General characteristics .....	14
3.1.1.2 Uses .....	14
3.1.2 Keruing.....	14
3.1.2.1 General characteristics.....	14

	<u>Page</u>
3.1.2.2 Uses.....	15
3.1.3 Meranti (dark-red) .....	15
3.1.3.1 General characteristics .....	15
3.1.3.2 Uses .....	15
3.2 Duration of loading .....	15
3.3 Size and shape of members .....	16
3.4 Factor of safety .....	16
3.5 Equipments .....	16
3.5.1 Bending test .....	16
3.5.2 Torsion test .....	17
3.5.3 Rate of testing .....	17
3.5.4 Calibration of testing machine .....	17
CHAPTER 4 - FACTORS INFLUENCING STRENGTH OF TIMBER	18
4.1 Moisture content .....	18
4.2 Natural characteristics affecting the strength and appearance .....	18
4.2.1 Knot .....	18
4.2.2 Slope of grain .....	19
4.2.3 Rate of growth .....	19
4.2.4 Distortion .....	19
4.2.5 Fissures .....	19
4.2.6 Wane .....	19
4.2.7 Decay .....	19
CHAPTER 5 - EXPERIMENTAL PROCEDURE	21
5.1 Pure or static bending test(central loading method).	21
5.1.1 Procedure .....	21
5.2 Pure torsion test .....	23
5.2.1 Procedure .....	23
CHAPTER 6 - EXPERIMENTAL RESULTS	25
6.1 Static bending test (specimen A) .....	25
6.2 Static bending test (specimen B) .....	36
6.3 Static bending test (specimen C) .....	47