

hossam maghraby



بسم الله الرحمن الرحيم



hossam maghraby



شبكة المعلومات الجامعية التوثيق الالكتروني والميكرو فيلم



hossam maghraby



جامعة عين شمس

التوثيق الإلكتروني والميكروفيلم

قسم

نقسم بالله العظيم أن المادة التي تم توثيقها وتسجيلها
علي هذه الأقراص المدمجة قد أعدت دون أية تغيرات



يجب أن

تحفظ هذه الأقراص المدمجة بعيدا عن الغبار



hossam maghraby



شبكة المعلومات الجامعية



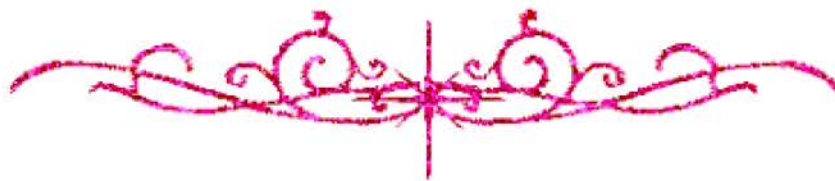
بعض الوثائق الأصلية تالفة



hossam maghraby



بالرسالة صفحات
لم ترد بالأصل



621.092

**FLOW REGIMES AND THERMAL PATTERNS IN
AIR-CONDITIONED OPERATING THEATERS**

By

BISA

Eng. Omar Ahmed Soliman Huzayyin

**A Thesis Submitted to the Faculty of
Engineering at Cairo University in Partial
Fulfillment of the Requirements for the
Degree of MASTER OF SCIENCE**

In

MECHANICAL POWER ENGINEERING

**FACULTY OF ENGINEERING, CAIRO UNIVERSITY
GIZA, EGYPT
June, 2005**

SA: 11

FLOW REGIMES AND THERMAL PATTERNS IN AIR-CONDITIONED OPERATING THEATERS

By

Eng. Omar Ahmed Soliman Huzayyin

**A Thesis Submitted to the Faculty of
Engineering at Cairo University in Partial
Fulfillment of the Requirements for the
Degree of MASTER OF SCIENCE**

In

MECHANICAL POWER ENGINEERING

Under Supervision of

**Prof. Dr. Essam E. Khalil
Mechanical Power Engineering
Department
Faculty of Engineering
Cairo University**

**FACULTY OF ENGINEERING, CAIRO UNIVERSITY
GIZA, EGYPT
June, 2005**

FLOW REGIMES AND THERMAL PATTERNS IN AIR-CONDITIONED OPERATING THEATERS

By

Eng. Omar Ahmed Soliman Huzayyin

**A Thesis Submitted to the Faculty of
Engineering at Cairo University in Partial
Fulfillment of the Requirements for the
Degree of MASTER OF SCIENCE**

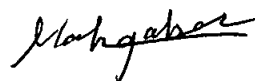
In

MECHANICAL POWER ENGINEERING

**Approved by the
Examining Committee**

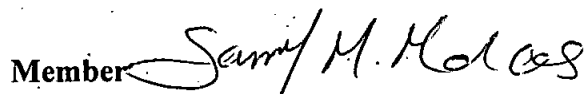
Prof. Dr. Mahmoud G. Morsy

Member



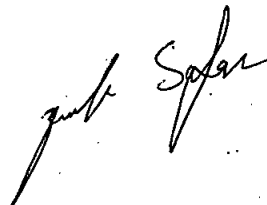
Prof. Dr. Samy M. Morcos

Member



Prof. Dr. Essam E. Khalil

**Thesis Advisors and
Member**



**FACULTY OF ENGINEERING, CAIRO UNIVERSITY
GIZA, EGYPT
June, 2005**

CONTENTS

SUBJECT	PAGE
LIST OF TABLES	vii
LIST OF FIGURES	viii
NOMENCLATURE	xiii
ACKNOWLEDGEMENT	xviii
ABSTRACT	xix
 CHAPTER 1 INTRODUCTION	 1
1.1 General	1
1.2 Comfort	2
1.3 Air Quality	3
1.4 Recommended Conditions for Operating Theaters	5
1.5 Present Work	5
 CHAPTER 2 LITERATURE REVIEW	 7
2.1 Introduction	7
2.2 Flow Regimes Investigations	7
2.3 Closure	22
 CHAPTER 3 NUMERICAL MODEL	 26
3.1 Introduction	26
3.2 Mass Conservation Equation (Continuity Equation)	26
3.3 Liner Momentum Conservation Equations	27
3.3.1 Newton's Second Law	27
3.3.2 Equations of Motion	27
3.3.3 Viscous Flow	27
3.3.4 Momentum Conservation Equations	28

3.4 Energy Equation	29
3.5 Turbulence Models	31
3.5.1 Reynolds Averaging	31
3.5.2 Boussinesq Approach vs. Reynolds Stress Transport Models	32
3.5.3 k- ϵ Model	33
3.5.4 Wall Function	35
3.5.5 Large Eddy Simulation (LES)	36
3.5.5.1 Boundary Conditions for LES Model	37
3.6 General Transport Equation	38
3.7 Solution Algorithm for FULENT.6	39
3.8 Solution Algorithm for 3DHVAC	40
3.9 Pressure Velocity Coupling	42
3.9.1 SIMPLE Algorithm	42
3.10 The Upwind Scheme	44
3.11 Under Relaxation	44
3.12 The Grid	44
3.13 Boundary Conditions	46
3.13.1 Walls	46
3.13.2 Air Supply (Inlets)	46
3.13.3 Operating Table	46
3.13.4 Light Pendent	46
3.13.5 Partial walls	47
3.13.6 Surgery staff	47
3.13.7 Autoclave	47
3.14 Closure	47
 CHAPTER 4 VALIDATION	 48
4.1 Introduction	48
4.2 Flow Patterns in Rooms	48

4.2.1 Gaspar et al. Work	49
4.2.2 Medhat Work	52
4.2.3 Zhang et al. Work	54
4.2.4 Said et al. Work	57
4.3 Effect of Changing Boundary Conditions on Solution (3DHVAC)	59
4.4 Closure	60
 CHAPTER 5 PARAMETRIC STUDY ON OPERATING THEATER	 61
5.1 General	61
5.2 Case Studies Description	61
5.2.2 Parametric Cases	63
5.3 Flow Patterns Study	64
5.4 Temperature and Relative Humidity	82
5.5 Comment	89
 CHAPTER 6 CONCLUSIONS AND SUGGESTED FUTURE WORK	 90
6.1 Introduction	90
6.2 Conclusions on Present Work	90
6.3 Recommendations for Future Work	91
 REFERENCES	 92
 APPENDICES	 97
APPENDIX A	97
APPENDIX B	100
APPENDIX C	103
APPENDIX D	104
 Arabic Cover and Arabic Abstract	

