HIGHER TECHNICAL INSTITUTE

CIVIL ENGINEERING COURSE

DIPLOMA PROJECT

AGGREGATES IN MOAD BASES AND SURFACE COURSE

C/774

PAPALOIZOU DESPO MICHAELIDOU NICOLETTA

AGGREGATES IN ROAD BASES AND SURFACE COURSE

by

PAPALOIZOU DESPO

&

MICHAELIDOU NICOLETTA

Project report
submitted to

the Department of civil Engineering
of the Higher Technical Institute
Nicosia Cyprus
in partial fulfilment of
the reqirements
for the diploma of
TECHNICIAN ENGINEER
IN CIVIL ENGINEERING

June 1996



HIGHER TECHNICAL INSTITUTE

NICOSIA - CYPRUS

CIVIL ENGINEERING DEPARTMENT

Academic Year 1995/96

Diploma Project Number: C/774

Title: Aggregates in Road Bases and in Surface Course

Objectives:

- 1. To write an account of the desirable properties of aggregates as a road material.
- To give specifications for aggregates as a material for road bases and surface course
- 3. To discuss the tests used for assessing the aggregate properties.
- 4. To report on the occurence of suitable aggregates for road bases and surface courses in Cyprus.

Terms and Conditions

Specifications for aggregates should include the Cyprus
 British and American ones

Students : Papaloizcu Despo &

Michaelidou Nicoletta

Supervisor : Mr. I. Economides

External Assessor : Mr Jason Sophos



CONTENTS

ACKNOWLEDGEMENTS

SUMMARY

1.0	INTRODUCT	ION	٠	•	•	•	•	*	•	•	•	٠	•	٠	•	•	٠	٠	•	٠	٠	•	1
2.0	AGGREGATE	TYPES	5										•										3
2.1	INTRODUCT	ION .	•	•							•												3
2.2	GEOLOGIGAI	L CLAS	SSI	FI	CF	AT)	101	1 (ΟF	RO	OCE	S											3
2.2.1	IGNEOUS I	ROCKS		•																			4
2.2.2	SEDIMENTA	ARY RO	OCK	S		•			•														8
2.2.3	METAMORH:	IC RO	CKS	5									٠									·	11
2.2.4	GRAVEL			¥																			14
2.2.5	SAND .																						14
2.2.6	SLAG .		•				*									•							15
2.3	GROUPS OF	ROAD	AC	GGF	REC	GA:	re:	S				•											16
3.0	AGGREGATE	PROD	UC:	ric	NC			•	•				٠							•			21
3.1	INTRODUCT	ION	•			•																	21
3.2	QUARRYING	OPER	AT:	101	NS														٠				21
3.3	CRUSHING	OPERA	TIC	SNC	5										*			٠					26
3.4	SCREENING	OPER	AT:	101	NS.								٠		٠					•		•	31
4.0	AGGREGATE	S IN	UNI	вот	JNI	D	PA	VE	ME	NT	C	ON	ST	RU	СТ	IO	N			*			35
4.1	INTRODUCT	ION	•											•									35
4.2	DESIRABLE	PROP	ER	TI	ES	0	F	AG	GR	EG	ΑT	ES	F	OR	U	NB	OU	ND					
	LAYERS IN	PAVE	ME	NT	C	ON	ST	RU	СТ	IO	N									٠	,		35
4.3	RESISTANC	Е ТО	DE	GR.	AD.	ΑT	IO	N															36

4.3.1 INFLU	ENCE OF	PETRO	SRAI	PHY	•	•		*	*	٠	٠	•		•		•	•	36
4.3.2 INFLU	ENCE OF	PARTIC	CLE	SHA	PE	AN	D S	IZI	E	*							•	36
4.3.3 INFLU	ENCE OF	MOIST	JRE	CON	TEN	T		•							٠	•		36
4.3.4 INFLU	ENCE OF	GRADII	1G		•	•				٠	•					•	*	36
4.3.5 ENGIN	EERING	EFFECTS	oi oi	N DE	GR <i>I</i>	ATA'	TIC	N						•		•		37
4.3.6 WEATH	ERING					٠										•	•	37
4.4 MACADA	M BASES		×		•	٠									•		•	37
4.4.1 DRY-B	AM DNUC	CADAM				٠					٠		•					37
4.4.2 WET-M	IX MACA	DAM				٠		٠										37
4.4.3 CRUSH	ER-RUN	MACADAI	M			•		•									•	38
4.5 SPECIF	ICATION	S FOR T	UNB	OUNE) AC	GGR	EG <i>I</i>	ATE	S	•			•			•	•	39
4.6 REQUIR	EMENTS	FOR UNI	3001	ND A	AGGI	REG	ATE	ES :	IN	СУ	PF	US	5					39
																,		
5.0 AGGREG	ATES IN	BITUM	INO	US E	BOUI	ND	COI	IST:	RUC	CTI	01	1						
MATERI	ALS .																	43
5.1 INTROD	UCTION									٠	•				•			43
5.2 DESIRA	BLE PRO	PERTIE	S O	F AC	GRI	EGA	TES	5				•						43
5.3 INFLUE	CNE OF	AGGREG	ATE	PET	rRO	GRA	PH	<i>(</i> 0	N									
ENGINE	ERING P	ROPERT	IES						•	•						٠		44
5.3.1 CRUSH	ING STR	ENGHT		•														44
5.3.2 RESIS	TANCE T	O ABRA	SIO	N		•						•				•		44
5.3.3 RESIS	TANCE I	O POLI	SHI	NGS		•												45
5.3.4 RESIS	TANCE I	O STRI	PPI	NG									•					45
5.3.5 RESIS	TANCE C	F WEAT	HER	ING	EF	FEC	TS			•		•			•			45
5.3.6 ABILI	TY TO C	CONTRIB	UTE	то	ST	REN	IGH'	ГΑ	ND	S	ווי	FFI	NES	SS				
OF THE	TOTAL	MIX								•					•			45
5.4 HOW AC	GREGATE	S INFL	UEN	CE '	THE	PE	ERF	ORM	AN	CE	0	E						
A BIT	MINOUS	SURFAC	ING															46
5.5 TYPES	OF BITU	JMTNOUS	SU	RFA	CIN	G			_			_						4.8

6.0	TESTS AND SPECIFICATIONS	FO	R	AG	GR	EG	ľA	ES	I	N						
	BITUNINOUS MIXES						•			•						50
6.1	INTROUDUCTION			•					•			•				50
6.2	SAMPLING OF AGGREGATES	•		•		•	•	•	•	•	•	•				50
6.3	PARTICLE SIZE AND SHAPE			•				•				•	٠			52
6.3.1	PARTICLE SIZE DISTRIBUT	ION	I							•						52
6.3.2	PARTICLE SHAPE	•		•	•								•		•	54
6.3.3	B FLAKINESS INDEX										•					54
6.3.4	ELONGATION INDEX									÷						57
6.3.5	ANGULARITY NUMBER		•								•					58
6.3.6	SURFACE TEXTURE OF COAR	SE	AG	GF	REG	rA	ĽΕ		•							60
6.3.7	7 DISCUSSION															61
6.4	PHYSICAL PROPERTIES			•										.,		62
6.4.	RELATIVE DENSITY AND WA	TEF	R A	BS	OF	RPI	CIC	ON								62
6.4.2	2 BULK DENSITY OF AGGREGA	TE								•					¥	64
6.5	MECHANICAL PROPERTIES .											•				64
6.5.	1 AGGREGATE CRUSHING VALU	E								•						64
6.5.	2 TEN PER CENT FINES VALU	E													*	66
6.5.	3 AGGREGATE IMPACT VALUE									•						66
6.5.	4 LOS ANGELES ABRASION VA	LUI	Ξ				•									67
6.5.	5 AGGREGATE ABRASION VALU	E						•						į		69
6.5.	6 POLISHED-STONE VALUE .										,					71
6.6	SOUNDNESS														×	73
6.6.	1 SOUNDDNESS BY THE USE O	F S	SOI	ΟI	JM	01	F I	MA	GN:	ES:	IU	M				
	SULPHATE (SULPHATE SOUND	NE	SS	TI	ES!	Г)	•									74
6.6.	2 SOUNDNESS BY FREEZING A	ND	TI	IAF	WI	NG										74
6.7	ADHESION OF BITUNEN TO A	GG:	RE	GA	re	S										75
6.7.	1 STATIC WATER IMMERSION	TE	ST						•							75
6.7.	2 IMMERSION WHEEL-TRACKIN	IG '	TE	ST											,	75
6.8	SPECIFICATIONS FOR AGGRE	GA	TE	S	IN	С	ΥP	RU	s,							
	BRITAIN AND USA															7

AKNOWLEDGEMENTS

We would like to express our gratitude to all the people, who with their assistance made the execution of the project possible.

Acknowledgements are extended to Mr I. Economides for his valuable assistance and supervision throughout the work.

We would also like to thank Mr. Jason Sophos for kindly accepting to examine and assess our project.

Finally this project is dedicated to our parents for all their moral and economic support during our three years in H.T.I.

SUMMARY

The scope of this project is to give a general information for aggregates giving emphasis to those used in Road Bases and in Surface course. It verifies their origin desirable properties tests and specifications.

The project was divided into six chapters.

In the fist chapter a general information about aggregates is pointed out.

In the second chapter an account of the origin, types and classification of groups of aggregates is given.

In the third chapter a brief account on the aggregate production, operations and machines used are provided.

In the fourth chapter the desirable properties of aggregates used in unbound layers in pavement construction, are discussed. Also macadam bases and specifications are given.

In the fifth chapter the desirable properties and influences of aggregates used in Bituminous bound construction materials are given. Also the types of bituminous surfacing are pointed out.

In the sixth and last chapter an account of all the test carried out for the assessment of quality and suitability of aggregates are discussed. Also the specifications used in Cyprus, U.K. and U.S.A. for aggregates are tabulated.