

# **Statistical foundations for understanding workforce change**

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### **Other Research Papers produced in the course of the project:**

Toner, P. (2005) The Survival and Decline of the Apprenticeship System in the Australian and UK Construction Industries March , ACIRRT Working Paper 96,  
[http://www.acirrt.com/O01P002/A01/V01/\\_Assets/\\_Documents/WP96.pdf](http://www.acirrt.com/O01P002/A01/V01/_Assets/_Documents/WP96.pdf)

Toner, P. (2005) Long Run Shifts in the Industry and Workforce Structure of the Australian Construction Industry: Implications for a Sustainable Labour Supply, *Association of Industrial Relations Academics of Australia and New Zealand (AIRAANZ)*, Conference, Sydney, 9-11<sup>th</sup> February. Refereed conference paper  
<http://www.airaanz.econ.usyd.edu.au/papers/Toner.pdf>

Toner P. (2006 forthcoming) Restructuring the Australian Construction Industry and Workforce: Implications for a Sustainable Labour Supply, *Economic and Labour Relations Review*

Toner P. and Coates N. (2006 forthcoming) Competition and the Growth of Non-Standard Employment: The Case of the Australian Construction Industry, *Labour and Industry*

Rosewarne S, Shik Shin J, McGrath-Champ S, and Toner P, (2005) *The globalisation of the construction work force ~ the impact on the Australian building and construction industry*; Report given to 4th Asia Pacific Building Unions Seminar, Tokyo.  
<http://www.cfmeu-construction-nsw.com.au/pdf/06unisydrpt2.pdf>

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## SUMMARY

Population Census data has proved to be a unique and rich source of valuable information on the nature of the Construction Industry workforce.

Analysis of the latest Census data set at a high level of detail has enabled critical labour supply issues to be highlighted as a prelude to in-depth policy-oriented research to follow. The age composition of key construction occupations is skewed towards the older age groups and this poses a challenge for the capacity of the training system for the near future.

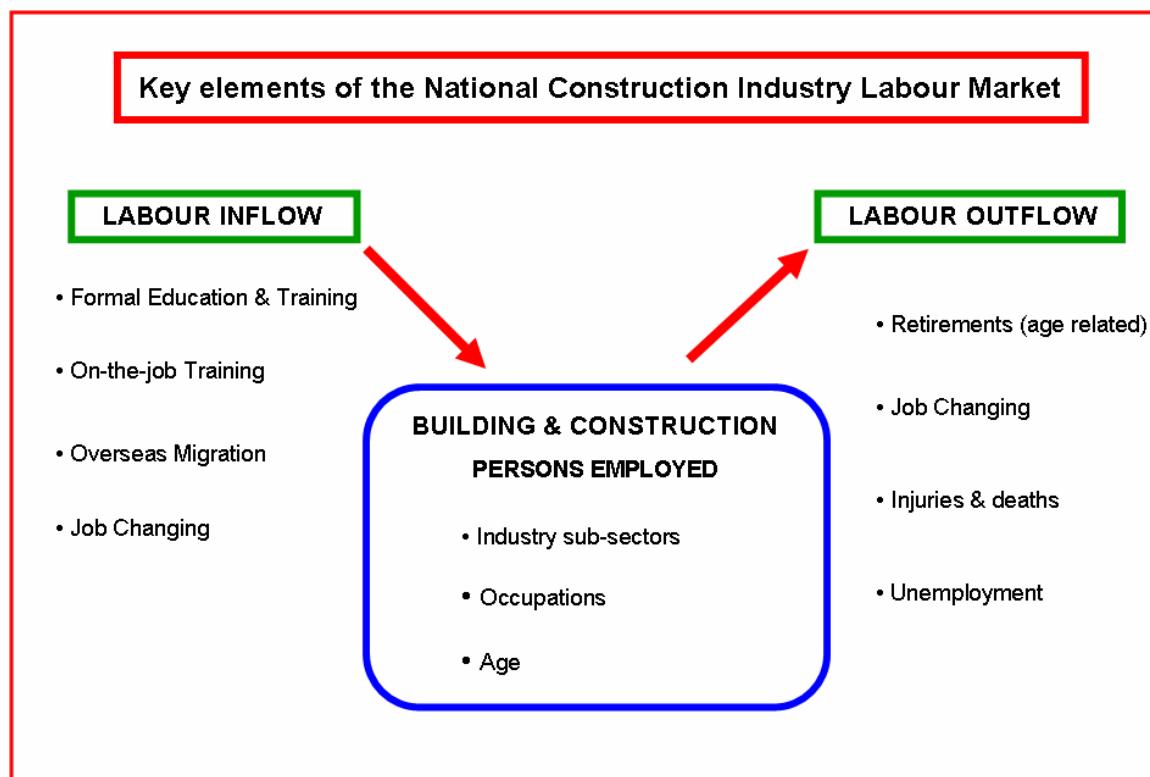
Trend analysis using data from successive Censuses proved to be considerably less straightforward because of changes in data classifications and other factors. The provision of concordances for alignment of successive Census data sets makes meaningful analysis possible. However the experience of this study shows that great care must be taken at the stage of data specification and the concordances must be applied at the highest level of detail possible. Nonetheless the study revealed changes of great magnitude in the Construction workforce composition, particularly in relation to the reliance of the industry on overseas migration for supply of key skills.

## INTRODUCTION

The analysis of the Australian Construction Industry workforce that is incorporated in this paper was undertaken as part of a broader project entitled *Labour Force Challenges in the Australian Building and Construction Industry: Skills Infrastructure and Migrant Workers*. The project examines the sustainability of present labour supply arrangements in a building and construction industry. In the past decades the industry has had a history of boom and bust cycles and has undergone significant restructuring, particularly in relation to sub-contracting arrangements. In the more recent past, the rate of growth in construction activity and employment has outstripped that of many other industries.

This paper summarises the findings of detailed statistical analysis of the occupational composition of the Construction Industry workforce and key aspects of labour supply and demand. The analysis provided pointers for further research, using other methods and data sources, by the Project investigation team. The primary sources of data were the ABS 5-yearly Population Censuses conducted in 1986, 1991, 1996 and 2001. On the supply side, the main components selected for study were formal education and training for on-site occupations in Construction and inflow from overseas migration. Indications of likely trends in replacement demand due to retirements were obtained by studying the age structure of the workforce by age. The Paper also highlights some of the methodological difficulties in using Census "snapshots" for time series analysis at a high level of detail.

The diagram below outlines the key dynamics of an industry labour market. Several of these variables were selected for study using Population Census data and other information sources. This paper summarises some of the major findings and also some of the difficulties experienced in the course of the analysis.



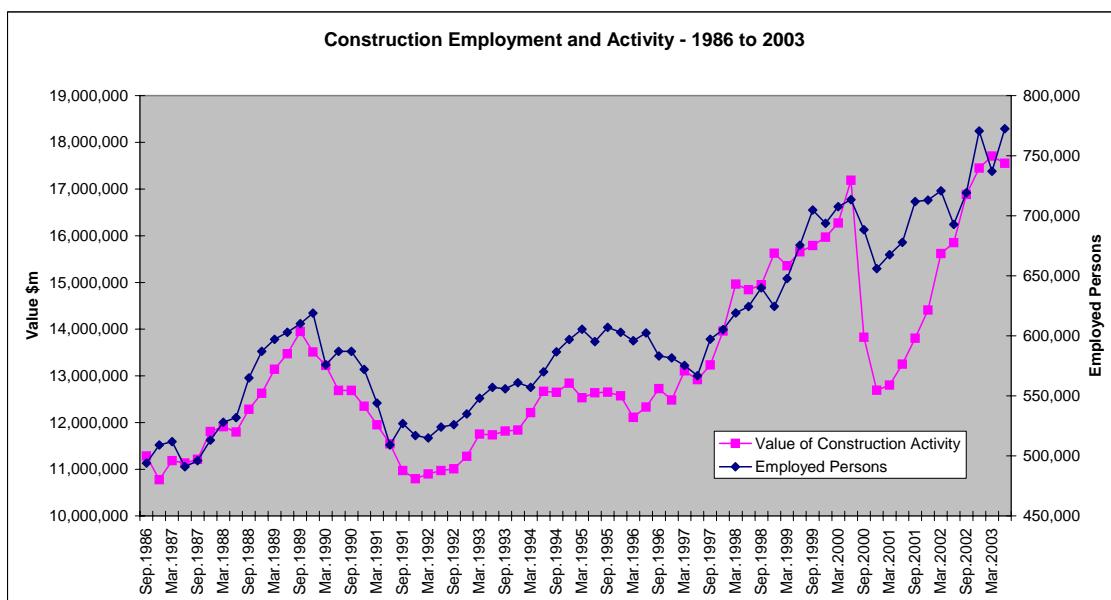
There have been challenges posed for reliable and flexible labour supply arrangements. New patterns of training and skill accreditation come into being, sourcing and recruitment arrangements have been modified and the industry has been seen to resort to short-term solutions through increased skilled migration and even clandestine migrant workers. The analysis of labour supply arrangements in the overall project aims to assist policy making for better assessment of the industry training requirements, and for improving the opportunities for sourcing labour locally through apprenticeships and traineeships, without undue reliance on skilled migrant labour.

The Australian Construction Industry is a key sector in the national economy, both in its own right as the largest component of capital expenditure and as a driver of associated activity in other sectors such as Manufacturing, Transport, Finance, etc. Construction constitutes approximately 6% of Industry Gross Value Added (Chain Volume Measures, Seasonally Adjusted, 2002-03). [ABS 2004 (c)] The Construction workforce, amounting to about 7% of the total, is a highly diverse mix of Occupations, incorporating job skills ranging from the most sophisticated engineering and management activities to the most elementary labouring tasks. The traditional skilled trades remain highly prominent in the Construction Industry. This wide breadth of skill requirements may be unique amongst industries by providing opportunities for participation in the workforce by members of the community with differing levels of aptitude and capacity. The Industry is also prominent in the scope it offers individuals for self-employment and work in an outdoor, non-office environment.

Industrial activity and employment is monitored regularly by the Australian Bureau of Statistics (ABS) through their National Accounts measurements and the Labour Force Survey. These are broad measurements which are published quarterly (monthly in some cases) providing valuable data for the most recent time periods. Graph 1 below shows aggregate activity and employment in the Australian Construction Industry. The statistics of Employed Persons and Value of Work Done (Chain Volume Measures, Seasonally Adjusted) cover the reference period under study in this report, as well as more recent data which is available from ABS at the aggregate level.

Less frequent but much more in-depth data gathering is carried out by ABS through focussed industry surveys and the 5 yearly Population Census. The Census provides invaluable insight into the structure and characteristics of the workforce at the most detailed level achievable. Up-to-date Labour Force Survey estimates are available for Industry and Occupation but these estimates are most reliable only at the aggregate level [ABS 2004(a)].

**Graph 1.**



The Census is the principal data source employed in the analysis following, although additional source data are referred to where necessary. The most recent Population Census data was gathered in August 2001 and will be referred to in this report as “current” data. To provide a useful comparison with the structure and characteristics of the Industry workforce in the medium-term past, the 1986 Census data is presented. Because of changes in data collection methodology and classification systems within the reference period 1986 to 2001, a significant degree of data matching, alignment and manipulation was necessary for reasonably accurate comparisons to be made. These issues are dealt with in some detail in the relevant sections of this Paper.

## METHODOLOGY

This stage of the project involved intensive descriptive analysis of cross-classified data on employed persons from the Population Censuses conducted by the Australian Bureau of Statistics (ABS) in 2001 and 1986. Additional data relating to 1991 and 1996 were also on hand but were not used in this part of the analysis.

Census data was chosen because it is the only source of Labour Market data available providing the degree of detail and level of precision desired for this project. The ABS Labour Force Survey provides a considerable amount of valuable data on a monthly and quarterly basis, but the precision is not high when cross-classified by detailed Industry and Occupation. The degree of precision in the Labour Force Estimates can be gauged using tables of standard errors of the estimates provided by ABS in their publications. For instance, Survey estimates approximating the 2001 Census figures for Drivers, Refrigeration & Air-conditioning Mechanics, Structural Steel Workers, Roof Tilers, Floor Finishers, Paving and Surfacing Labourers and Civil Engineers would be associated with relative standard error rates ranging from around 14% up to 30% at confidence levels of only 66%. [ABS 2002(a) p67].

The specifications for the ABS data are outlined fully in Appendix 1 of this report. The variables covered were Industry, Occupation, Age, Qualification, Year of Arrival (for persons born overseas) and Country of Birth. All except Qualifications are subject of analysis in this paper.

ABS supplied SuperTable data cubes containing the requisite data separately for 1986 and 2001. Detailed cross-classified Australia-wide data on Industry and Occupation of employed persons in the Construction Industry were included, as well as aggregate data for employed persons in Industries other than Construction and the residual population.

It should be noted that although most employment directly associated with Construction activity is coded to the relevant Construction ANZSIC Class, some is not. Certain Professional Services activity may be coded within the Business Services ANZSIC Industry Division. This is usually the case for persons employed in businesses undertaking Architectural Services, Civil Engineering Services and Surveying Services. Therefore the Occupational totals in Engineering and some Associate Professional areas shown in Construction Sectors in this report will be understated to some extent. However the residual numbers will in all cases be found in the tables in the "Other Stated Industry" category.

The aim of the analysis was to document the current Occupational structure in the Australian Construction Industry in as much detail as possible, by individual Industry Sector and individual Occupation as far as practicable. A complete coverage of Industry Sectors was feasible in the analysis, as there are only around 20 detailed Industry Sector categories in the ASIC Classification in relation to 1986 data [ABS 1983] and the ANZSIC Classification [ABS 1993] in relation to 2001 data. The full range of Industry data was able to be used in the analysis of the current workforce, but because of several problems with comparing 2001 Industry data with that for past years, more aggregated data was used for looking at changes over time. Although there are differences between the ASIC and ANZSIC classifications, most of these are readily reconciled with the concordance supplied by ABS, so this was not found to be a problem (details are provided in the section on Industry Data Comparability later in this paper).

Because a further stage in this project involved relating current workforce and changes over time with the supply of skills through training, the maximum possible detail for Occupation was desired. The Australian Standard Classification of Occupations (ASCO) Second Edition [ABS 1997], includes 9 Major Groups, 35 Sub-Minor Groups, 81 Minor Groups, 340 Unit Groups and 986 Occupations. The degree of occupational differentiation at Unit Group (4 digit code) level was considered quite sufficient for the present study. At this level Construction workers can be

associated with Occupational Titles such as Civil Engineers, Carpenters, Plumbers, Crane Operators, Labourers, etc.

However, to keep the analysis data set more manageable, only selected Unit Group Occupations were included, with the remainder being at Minor Group (2 digit code) level. Many of the 340 Unit Group Occupations are poorly represented in the Construction Industry. With this in mind, a preliminary analysis of 2001 Census data identified approximately 70 Unit Groups which included all key Occupations occurring in the Industry. All Trade, Sub-Trade, Labouring, Engineering and Sub-Professional Unit Group Occupations that were thought to be of importance in Construction were included at this detailed level. In all, 105 Occupation categories were available for analysis.

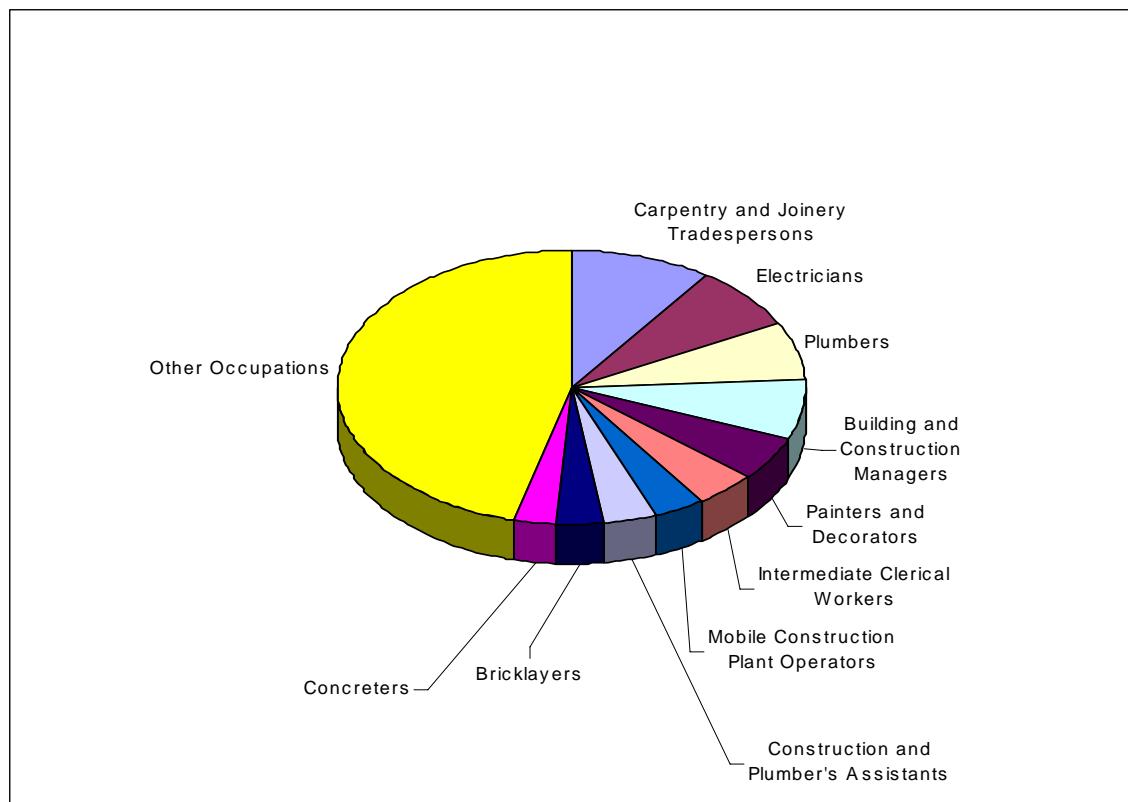
Changes made to the ASCO Occupational Classification are outlined later in the Occupation Data Comparability section of this paper. Because of the extent of these changes, alignment of the 1986 and 2001 Occupational data sets took some time. Using the ABS concordance as a guide [ABS 1998], exact matches were documented and as many reasonably close matches were also noted. A common code key was then used as the basis for building SuperTable field recodes for 1986 and 2001. Occupations were grouped where necessary and residual groups were created for those that could not be aligned with reasonable confidence as to accuracy. A problem which had not been anticipated was found in the Associate Professional group, in particular concerning ASCO2 Minor Group 32 Miscellaneous Business and Administration Associate Professionals. Because of changes to the Occupational Classification at Major Group level, involving Office Managers and Project Administrators, accurate matching was not possible using the 2 digit ASCO Associate Professional data on hand. Using additional cross-classified 2001 Census data at 4 digit level, adjustments were made to the 2001 data presented in the time series tables in this report, resulting in a reduction in numbers in Business and Administration Associate Professionals and boosting those in the Managers and Clerical ASCO Major Groups. These adjustments were only necessary where comparisons were made between 1986 and 2001.

## EMPLOYMENT IN OCCUPATIONS AND INDUSTRY SECTORS

### Current workforce occupational structure

In the 2001 Census a total of nearly 560,000 persons were counted as being employed in the Construction Industry Australia-wide. There were some persons employed in all of the 109 Occupations and Occupation Minor Groups included in the 2001 Census data set obtained for the purposes of this analysis. The following chart and table summarise the Occupational structure of the Industry.

**Pie Chart 1.**



Pie Chart 1 above indicates the diversity of Occupations represented in the Industry in 2001 and also shows the prominence of the traditional Skilled Trades. Six out of the top ten Occupations were Trades.

In Table 1 overleaf (listing Occupations with one percent or more of the total Construction workforce) it can be seen that there were 18 detailed Occupational categories with 10,000 or more persons employed. The largest was Carpentry and Joinery Tradespersons, with nearly 54,000 persons, followed by Electricians (41,000), Plumbers (40,000), Building and Construction Managers (38,000) and Painters and Decorators (30,000). Also included in this group were Intermediate Clerical Workers, Mobile Construction Plant Operators, Construction & Plumbers Assistants, Bricklayers, Concreters and Building Associate Professionals, etc.

Another 9 Occupations had 2001 employment levels over 5,000 and under 10,000 persons. The largest numbers were for Drivers (8,000), Specialist Managers (8,000), Refrigeration and Airconditioning Mechanics (7,000), Business & Information Professionals (6,000) and Structural Steel Workers (6,000), etc. There were a further 30 or so Occupational categories with 2001 employment levels of over 1,000 and under 5,000 persons. Amongst these were various Trades (eg Structural Steel Trades, Glass Trades and Communications Trades), Engineering Occupations, Cleaners, Labourers, Plant Operators and Crane Operators.

**Table 1.**

<b>Employed Persons in the Construction Industry by Occupation - 2001</b>		
Occupation	Number	Percent
Carpentry and Joinery Tradespersons	53,991	9.7%
Electricians	41,482	7.4%
Plumbers	39,790	7.1%
Building and Construction Managers	38,186	6.8%
Painters and Decorators	30,435	5.4%
Intermediate Clerical Workers	22,339	4.0%
Mobile Construction Plant Operators	20,900	3.7%
Construction and Plumber's Assistants	19,084	3.4%
Bricklayers	18,910	3.4%
Concreters	16,533	3.0%
Building, Architectural and Surveying Associate Professionals	16,472	2.9%
Fibrous Plasterers	16,292	2.9%
Secretaries and Personal Assistants	15,776	2.8%
Business and Administration Associate Professionals	15,090	2.7%
Other Labourers and Related Workers, nec	11,343	2.0%
Wall and Floor Tilers and Stonemasons	10,737	1.9%
Skilled Agricultural and Horticultural Workers	10,705	1.9%
Other Advanced Clerical and Service Workers	10,353	1.9%
Road and Rail Transport Drivers	7,836	1.4%
Specialist Managers	7,670	1.4%
Refrigeration and Airconditioning Mechanics	6,928	1.2%
Business and Information Professionals	6,196	1.1%
Structural Steel Construction Workers	5,786	1.0%
Roof Slaters and Tilers	5,466	1.0%
Generalist managers, nec	5,387	1.0%
Floor Finishers	5,337	1.0%
Other Occupations	99,527	17.8%
Total	558,551	100.0%

### Workforce Changes between 1986 and 2001 in Construction Sectors

The 5 yearly ABS Census provides Industry workforce statistics at a very detailed level. The table below shows the most detailed (4 digit ASIC/ANZSIC) 1986 and 2001 employed workforce figures. Between these Census years there were significant changes in the Industry Classification system. These changes and other issues of data comparability are discussed in detail later in this paper. Despite the changes, many sectors in the classifications still remained directly comparable. However other factors have conspired to cloud the issue of intercensal comparability.

Amongst the more clearly defined industry sectors in 1986, the top 5 sectors in terms of employment were House Construction (approximately 55,000), Non-Residential Building Construction (35,000), Electrical Work (35,000), Plumbing (34,000) and Road and Bridge Construction (34,000). In 2001 the Non-Residential Building and Road and Bridge Construction sectors were less prominent in terms of employment. House Construction was by far the largest employing sector in 2001 (with approximately 87,000), followed by Electrical Services (54,000), Plumbing Services (42,000), Painting Services ((34,000) and Carpentry Services (31,000). In addition to these large sectors there were large numbers of persons included in “undefined” Industry categories in both 1986 and 2001.

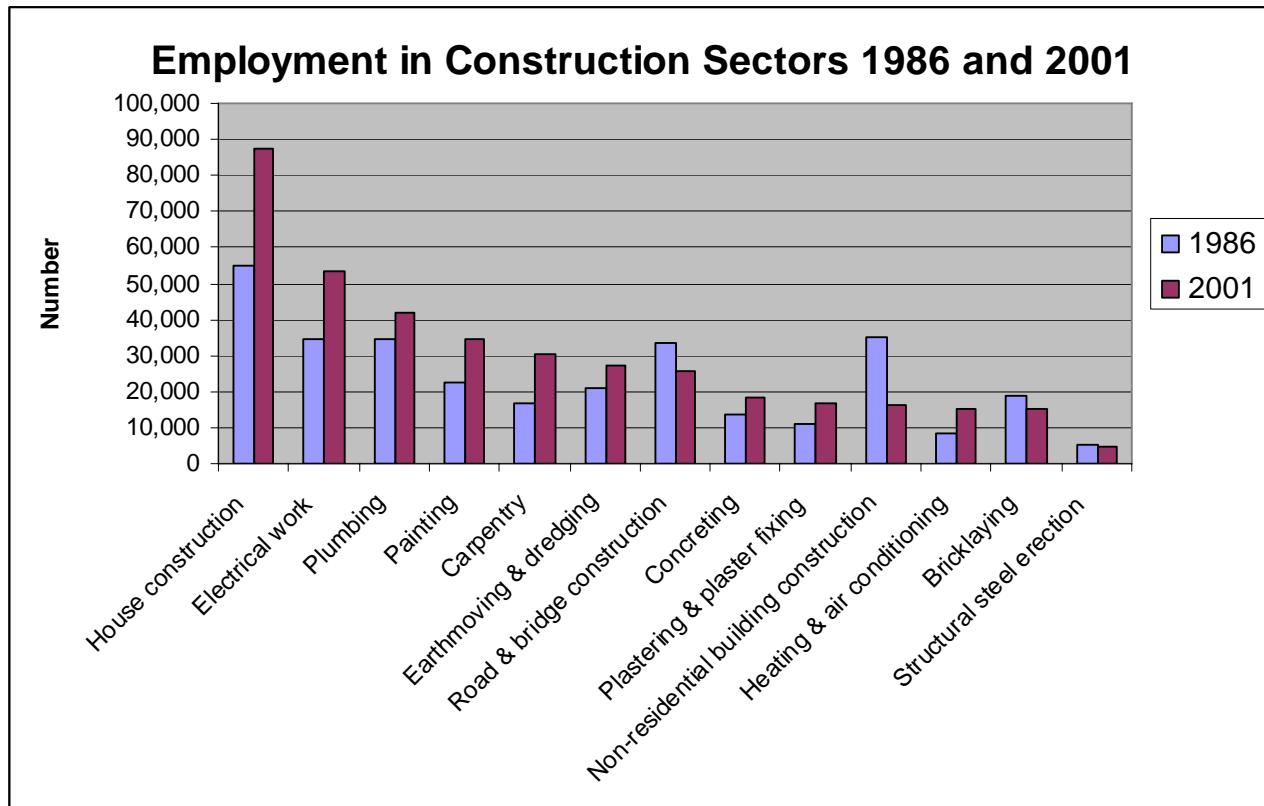
Table 2 below shows employment levels, changes and percentage changes between 1986 and 2001 for the key detailed Industry sectors. The sectors have been aligned using the ASIC to ANZSIC

Concordance. The Industry categories have been sorted in descending order of importance, based on 2001 employment levels. Note that the Other Construction Sectors group includes several large undefined categories and a number of smaller clearly defined sectors. Graph 2 shows comparative employment levels in key Construction sectors in 1986 and 2001.

**Table 2.**

Industry Sector	1986	2001	Change No.	Change %
House construction	54,938	87,184	32,246	58.7%
Electrical work	34,517	53,562	19,045	55.2%
Plumbing	34,377	41,896	7,519	21.9%
Painting	22,397	34,304	11,907	53.2%
Carpentry	16,685	30,589	13,904	83.3%
Earthmoving & dredging	20,958	27,251	6,293	30.0%
Road & bridge construction	33,717	25,903	-7,814	-23.2%
Concreting	13,515	18,571	5,056	37.4%
Plastering & plaster fixing	11,223	16,697	5,474	48.8%
Non-residential building construction	35,170	16,355	-18,815	-53.5%
Heating & air conditioning	8,450	15,354	6,904	81.7%
Bricklaying	18,749	15,293	-3,456	-18.4%
Structural steel erection	5,403	4,512	-891	-16.5%
Other Construction Sectors	116,041	171,080	55,039	47.4%
Total Construction	426,140	558,551	132,411	31.1%

**Graph 2.**



## The Age Structure of the Australian Construction Industry Workforce

Over the 15 year period 1986 to 2001 a little over half of the Construction workforce was aged between 25 and 44 years. The Construction industry percentage of 55.2% in 1986 was slightly higher than in Other Industries (51.9%). By the year 2001 these proportions fell to 52.4% and 48.9% respectively.

As can be seen in Tables 3 and 4 (as well as Graphs 3 and 4) below, there was a general ageing of the workforce overall between the Census years 1986 and 2001. Over that time period, the proportion of workers aged 45 or older increased by about 8 percentage points (from a quarter of the total to about a third) and the proportion aged between 15 and 24 fell significantly. By 2001 less than 15% of Construction workers were in this younger age group.

Looking at the extreme ends of the age range for Construction, the number of employed 15 to 19 year olds actually fell over the period (by 7%) and the number aged 65 and over more than doubled (up 172%). The equivalent changes in Other Industries were not nearly so marked (up 3% and 76% respectively).

**Table 3.**

**Age Structure of the Workforce for Construction and Other Industries, 1986 and 2001**  
**Number**

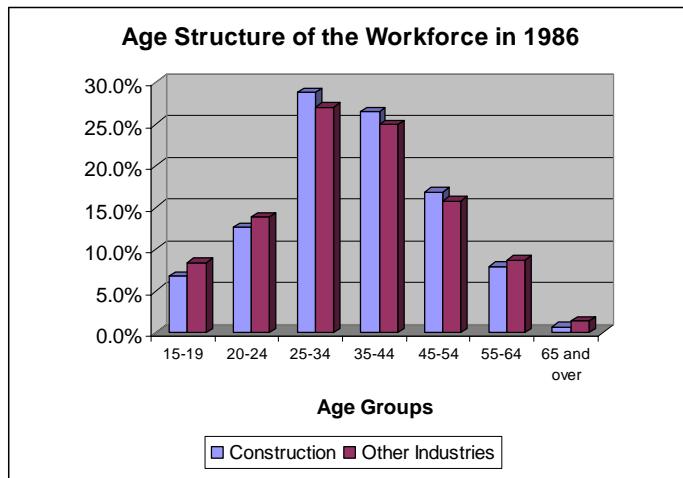
	15-19	20-24	25-34	35-44	45-54	55-64	65 and over	Total
<b>1986</b>								
Construction	28,723	53,679	122,585	112,808	71,960	33,673	2,731	426,159
Other Industries	493,348	815,982	1,592,392	1,472,117	933,574	514,536	80,654	5,902,603
<b>2001</b>								
Construction	26,727	55,311	141,065	151,585	120,758	55,713	7,427	558,586
Other Industries	507,040	771,925	1,785,304	1,927,803	1,724,279	737,078	141,985	7,595,414

**Table 4.**

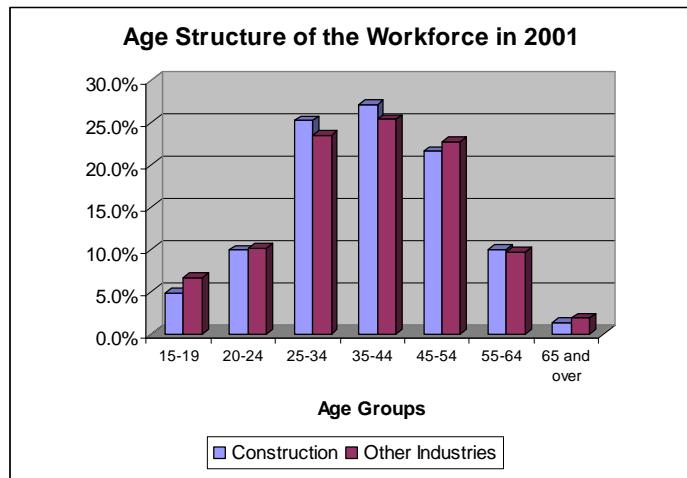
**Age Structure of the Workforce for Construction and Other Industries, 1986 and 2001**  
**Percent**

	15-19	20-24	25-34	35-44	45-54	55-64	65 and over	Total
<b>1986</b>								
Construction	6.7%	12.6%	28.8%	26.5%	16.9%	7.9%	0.6%	100.0%
Other Industries	8.4%	13.8%	27.0%	24.9%	15.8%	8.7%	1.4%	100.0%
<b>2001</b>								
Construction	4.8%	9.9%	25.3%	27.1%	21.6%	10.0%	1.3%	100.0%
Other Industries	6.7%	10.2%	23.5%	25.4%	22.7%	9.7%	1.9%	100.0%

**Graph 3.**



**Graph 4.**



The number of 15 to 24 year olds in Construction was almost static over the 1986 to 2001 period. A large proportion of this younger group consisted of apprentices and recently qualified tradespersons. Total employment in Construction grew significantly in this period. The fact that the young worker cohort did not increase during this time reflects an apparent lack of responsiveness in the apprenticeship training system. Virtually all the growth in people working in Construction was comprised of job changers from other industries and by overseas migrants.

Table 5 below shows the numbers and percentages of employed persons in the Construction industry (by Occupation Major Groups and three broad age groupings) for 1986 and 2001. At this broad occupation level, it can be clearly seen that there has been a significant fall in the proportion of construction workers in the younger age group in all occupation groups. The trade group stands out as maintaining a relatively young workforce and there has been considerable ageing in the Clerical, Professional and Managerial groups.

**Table 5.**

Occupation Age Breakdown - 1986 and 2001 - NUMBER											
Occupation	15-34			35-44			45 and over			Total	
	1986	2001	Change	1986	2001	Change	1986	2001	Change	1986	2001
<b>Managers</b>	<b>10,337</b>	<b>12,491</b>	<b>2,154</b>	<b>13,437</b>	<b>17,942</b>	<b>4,505</b>	<b>14,613</b>	<b>26,383</b>	<b>11,770</b>	<b>38,387</b>	<b>56,816</b>
<b>Professionals</b>	<b>5,334</b>	<b>5,853</b>	<b>519</b>	<b>3,962</b>	<b>4,056</b>	<b>94</b>	<b>2,953</b>	<b>5,456</b>	<b>2,503</b>	<b>12,249</b>	<b>15,365</b>
<b>Associate Professionals</b>	<b>7,108</b>	<b>9,117</b>	<b>2,009</b>	<b>5,382</b>	<b>8,615</b>	<b>3,233</b>	<b>5,339</b>	<b>10,762</b>	<b>5,423</b>	<b>17,829</b>	<b>28,494</b>
<b>Trades</b>	<b>107,240</b>	<b>126,207</b>	<b>18,967</b>	<b>47,240</b>	<b>66,908</b>	<b>19,668</b>	<b>45,351</b>	<b>75,843</b>	<b>30,492</b>	<b>199,831</b>	<b>268,958</b>
<b>Clerical, Sales &amp; Service</b>	<b>22,877</b>	<b>20,939</b>	<b>-1,938</b>	<b>15,669</b>	<b>20,061</b>	<b>4,392</b>	<b>12,300</b>	<b>24,035</b>	<b>11,735</b>	<b>50,846</b>	<b>65,034</b>
<b>Sub Trades &amp; Labourers</b>	<b>49,380</b>	<b>46,909</b>	<b>-2,471</b>	<b>24,904</b>	<b>32,462</b>	<b>7,558</b>	<b>25,085</b>	<b>39,070</b>	<b>13,985</b>	<b>99,369</b>	<b>118,441</b>
<b>Other (Inad Descr, Not Stated, etc.)</b>	<b>2,711</b>	<b>1,587</b>	<b>-1,124</b>	<b>2,214</b>	<b>1,542</b>	<b>-672</b>	<b>2,723</b>	<b>2,349</b>	<b>-374</b>	<b>7,648</b>	<b>5,478</b>
<b>Total</b>	<b>204,987</b>	<b>223,103</b>	<b>18,116</b>	<b>112,808</b>	<b>151,585</b>	<b>38,777</b>	<b>108,364</b>	<b>183,898</b>	<b>75,534</b>	<b>426,159</b>	<b>558,586</b>
Occupation Age Breakdown - 1986 and 2001 - PERCENTAGES											
Occupation	15-34			35-44			45 and over			Total	
	1986	2001	Change	1986	2001	Change	1986	2001	Change	1986	2001
<b>Managers</b>	<b>26.9%</b>	<b>22.0%</b>	<b>-4.9%</b>	<b>35.0%</b>	<b>31.6%</b>	<b>-3.4%</b>	<b>38.1%</b>	<b>46.4%</b>	<b>8.4%</b>	<b>100.0%</b>	<b>100.0%</b>
<b>Professionals</b>	<b>43.5%</b>	<b>38.1%</b>	<b>-5.5%</b>	<b>32.3%</b>	<b>26.4%</b>	<b>-5.9%</b>	<b>24.1%</b>	<b>35.5%</b>	<b>11.4%</b>	<b>100.0%</b>	<b>100.0%</b>
<b>Associate Professionals</b>	<b>39.9%</b>	<b>32.0%</b>	<b>-7.9%</b>	<b>30.2%</b>	<b>30.2%</b>	<b>0.0%</b>	<b>29.9%</b>	<b>37.8%</b>	<b>7.8%</b>	<b>100.0%</b>	<b>100.0%</b>
<b>Trades</b>	<b>53.7%</b>	<b>46.9%</b>	<b>-6.7%</b>	<b>23.6%</b>	<b>24.9%</b>	<b>1.2%</b>	<b>22.7%</b>	<b>28.2%</b>	<b>5.5%</b>	<b>100.0%</b>	<b>100.0%</b>
<b>Clerical, Sales &amp; Service</b>	<b>45.0%</b>	<b>32.2%</b>	<b>-12.8%</b>	<b>30.8%</b>	<b>30.8%</b>	<b>0.0%</b>	<b>24.2%</b>	<b>37.0%</b>	<b>12.8%</b>	<b>100.0%</b>	<b>100.0%</b>
<b>Sub Trades &amp; Labourers</b>	<b>49.7%</b>	<b>39.6%</b>	<b>-10.1%</b>	<b>25.1%</b>	<b>27.4%</b>	<b>2.3%</b>	<b>25.2%</b>	<b>33.0%</b>	<b>7.7%</b>	<b>100.0%</b>	<b>100.0%</b>
<b>Other (Inad Descr, Not Stated, etc.)</b>	<b>35.4%</b>	<b>29.0%</b>	<b>-6.5%</b>	<b>28.9%</b>	<b>28.1%</b>	<b>-0.8%</b>	<b>35.6%</b>	<b>42.9%</b>	<b>7.3%</b>	<b>100.0%</b>	<b>100.0%</b>
<b>Total</b>	<b>48.1%</b>	<b>39.9%</b>	<b>-8.2%</b>	<b>26.5%</b>	<b>27.1%</b>	<b>0.7%</b>	<b>25.4%</b>	<b>32.9%</b>	<b>7.5%</b>	<b>100.0%</b>	<b>100.0%</b>

The age break-up for the larger individual occupations is presented in Table 6 below. The table is reproduced in Appendix 2 at considerably greater Occupational detail, as well as comparative graphs for selected on-site Construction occupations.

At individual occupation level there are a number of trends which are somewhat different to the occupation group totals above. There were actual declines in the numbers of Bricklayers, Office Secretaries, Carpenters and Excavating Plant Operators in the 15-34 age group. The proportions in the younger age group fell in all cases except Concrete Workers. The most marked falls were for Trades Assistants (-17.5 percentage points), Office Secretaries (-15.4 % points) and Electricians (-13.3 % points).

There was also considerable variation in the change between 1986 and 2001 in the 45+ age group. A number of these key occupations had small increases in the proportion of older workers, although there were some which had quite large increases. The most prominent were Office Secretaries (+17.4 % points), Excavating plant Operators (+14.8 % points), Business Professionals (+ 14.0 % points) and Electricians (+10 % points).

**Table 6.**

Occupation Age Breakdown - 1986 and 2001 - NUMBER											
Occupation	15-34			35-44			45and over			Total	
	1986	2001	Change	1986	2001	Change	1986	2001	Change	1986	2001
<b>Business professionals</b>	<b>1,014</b>	<b>2,222</b>	<b>1,208</b>	<b>611</b>	<b>1,751</b>	<b>1,140</b>	<b>456</b>	<b>2,225</b>	<b>1,769</b>	<b>2,081</b>	<b>6,198</b>
Building, arch. associates & tech.	3,548	5,328	1,780	2,853	4,960	2,107	3,137	6,186	3,049	9,538	16,474
Electrical fitters, Electrical mechanics	16,462	20,158	3,696	5,741	10,287	4,546	4,413	11,036	6,623	26,616	41,481
Refrigeration & air-conditioning mechanics	1,405	3,677	2,272	475	1,742	1,267	295	1,509	1,214	2,175	6,928
Carpenters and joiners	27,665	27,362	-303	10,406	12,331	1,925	11,941	14,297	2,356	50,012	53,990
Plasterers (all types)	6,055	9,244	3,189	2,949	4,912	1,963	2,538	4,671	2,133	11,542	18,827
Bricklayers	9,829	7,406	-2,423	5,333	5,069	-264	4,892	6,434	1,542	20,054	18,909
Wall and floor tilers	2,093	4,607	2,514	1,406	2,910	1,504	1,207	3,217	2,010	4,706	10,734
Painters, decorators & signwriters	8,415	10,846	2,431	5,963	7,870	1,907	6,945	11,723	4,778	21,323	30,439
Plumbers	17,586	18,984	1,398	7,395	9,674	2,279	6,584	11,132	4,548	31,565	39,790
Office secretaries & stenographers	5,395	4,230	-1,165	4,452	5,171	719	2,942	6,375	3,433	12,789	15,776
Excavating & earthmoving plant operator	6,172	6,140	-32	4,713	6,402	1,689	3,659	8,360	4,701	14,544	20,902
Trades assistants & factory hands	7,168	10,227	3,059	1,580	4,551	2,971	1,342	4,306	2,964	10,090	19,084
Concrete workers	5,514	7,452	1,938	3,234	4,469	1,235	3,726	4,611	885	12,474	16,532
Occupation Age Breakdown - 1986 and 2001 - PERCENTAGES											
Occupation	15-34			35-44			45and over			Total	
	1986	2001	Change	1986	2001	Change	1986	2001	Change	1986	2001
<b>Business professionals</b>	<b>48.7%</b>	<b>35.9%</b>	<b>-12.9%</b>	<b>29.4%</b>	<b>28.3%</b>	<b>-1.1%</b>	<b>21.9%</b>	<b>35.9%</b>	<b>14.0%</b>	<b>100.0%</b>	<b>100.0%</b>
Building, arch. associates & tech.	37.2%	32.3%	-4.9%	29.9%	30.1%	0.2%	32.9%	37.6%	4.7%	100.0%	100.0%
Electrical fitters, Electrical mechanics	61.9%	48.6%	-13.3%	21.6%	24.8%	3.2%	16.6%	26.6%	10.0%	100.0%	100.0%
Refrigeration & air-conditioning mechanics	64.6%	53.1%	-11.5%	21.8%	25.1%	3.3%	13.6%	21.8%	8.2%	100.0%	100.0%
Carpenters and joiners	55.3%	50.7%	-4.6%	20.8%	22.8%	2.0%	23.9%	26.5%	2.6%	100.0%	100.0%
Plasterers (all types)	52.5%	49.1%	-3.4%	25.6%	26.1%	0.5%	22.0%	24.8%	2.8%	100.0%	100.0%
Bricklayers	49.0%	39.2%	-9.8%	26.6%	26.8%	0.2%	24.4%	34.0%	9.6%	100.0%	100.0%
Wall and floor tilers	44.5%	42.9%	-1.6%	29.9%	27.1%	-2.8%	25.6%	30.0%	4.3%	100.0%	100.0%
Painters, decorators & signwriters	39.5%	35.6%	-3.8%	28.0%	25.9%	-2.1%	32.6%	38.5%	5.9%	100.0%	100.0%
Plumbers	55.7%	47.7%	-8.0%	23.4%	24.3%	0.9%	20.9%	28.0%	7.1%	100.0%	100.0%
Office secretaries & stenographers	42.2%	26.8%	-15.4%	34.8%	32.8%	-2.0%	23.0%	40.4%	17.4%	100.0%	100.0%
Excavating & earthmoving plant operator	42.4%	29.4%	-13.1%	32.4%	30.6%	-1.8%	25.2%	40.0%	14.8%	100.0%	100.0%
Trades assistants & factory hands	71.0%	53.6%	-17.5%	15.7%	23.8%	8.2%	13.3%	22.6%	9.3%	100.0%	100.0%
Concrete workers	44.2%	45.1%	0.9%	25.9%	27.0%	1.1%	29.9%	27.9%	-2.0%	100.0%	100.0%

The extent to which the 45+ age group has grown in certain key onsite trade and sub-trade occupations is cause for concern. The following trade occupations had 30% or more of their workforce aged 45 or over: Structural Steel Trades (30%), Automotive trades (31.6%), Bricklayers (34%), Wall & Floor Tilers (30%), Painters (38.5%).

With perhaps a quarter or more of the workforce approaching retirement age in the decade ahead, a huge challenge is posed for the training system if further undue reliance on overseas migration is to be avoided and construction activity levels are not to be impeded by significant labour shortages.

## SOURCES OF LABOUR SUPPLY

The main sources of inflow of new labour to an industry are

- (1) formal education and training,
- (2) On-the-job training,
- (3) Overseas migration and
- (4) Job changers who previously worked in other industries.

The focus of this paper is the use of descriptive Population Census data analysis to provide a foundation for other research which can probe for the reasons behind the patterns evident in the data and which will guide economic and social policy development.

The Census is not often used as a source of information for labour market flow indicators. However it does provide a basis for estimating supply of new labour through formal training and migration. The Census essentially constitutes a point-in-time stocktake, but because data is collected on the time at which migrants arrived in Australia, the Census data can be used for migration flow estimates. In the present study, the estimate of the number of annual migrant workforce additions was obtained by averaging the Census (year of arrival) figures of persons born overseas for 1996 to 2001.

Labour inflow through training is more difficult to estimate using Census data, although several Census data variables provide useful pointers. Attendance at an educational institution is recorded in the Census and this may be used as a guide to the numbers involved in formal training programs, but informal on-the-job training is not included in this. For the trades, which have been traditionally regulated by governments, Occupation and age can be used to estimate the number of younger apprentices. For instance, most employed persons in trade occupations who are aged 15 to 19 would be apprentices in training. However, in recent years many apprentices start after completing their secondary schooling and may still be in their apprenticeships in their early 20s. Adult apprentices are also becoming much more common. In this study the inflow of newly qualified construction workers was estimated using data provided by the National Centre for Vocational Education Research [NCVER unpublished data].

Apprenticeship training (often over a 4 year term) is the traditional source of skilled tradespersons for the Construction Industry. However, the take-up rate for this form of training has not been sufficient for the needs of the industry for much of the reference period for this study. Training in contracts of shorter duration, usually 2 or 3 years, for a variety of occupations grew very rapidly in the late 1990s.

Table 7 (and Graph 5) below presents NCVER data on apprenticeship and traineeship commencements for Construction Industry occupations over the period 1995 to 2003. In 2001 nearly 12,000 apprentices and trainees commenced training contracts. The 2001 figure represents an increase of nearly 45% on the 1995 figure. The most spectacular growth in training contract commencements was for the non-trade on-site construction occupations. There was very little formal training for these occupations prior to the expansion of traineeships (especially for adult workers already employed in the industry) from 1996. Previously much of the training was carried out on-the-job. The occupation of Mobile Construction Plant Operator was most prominent. Only minor growth was evident for some trades. The trades Carpenters, Plumbers, Bricklayers and Painters attracted the largest numbers of apprentice commencements in the 9 year period, although in each trade there were often significant variations from one year to the next.

The statistics of training commencements are often used for monitoring trends in training rather than training completions, as the completion statistics are often understated because of delays by completing apprentices and trainees in notifying this to the training authorities.

**Table 7.**

<b>National Centre for Vocational Education Research</b>								
<b>Preliminary apprentice/trainee commencements by ASCO, 12 months ending 31 December 1995-2003</b>								
<b>Based on December quarter estimates 2003</b>								
<b>ASCO</b>	<b>1995</b>	<b>1996</b>	<b>1997</b>	<b>1998</b>	<b>1999</b>	<b>2000</b>	<b>2001</b>	<b>2002</b>
<b>Building and construction trades</b>								
4411 Carpentry and Joinery Tradespersons	3,860	3,520	3,930	4,770	5,790	5,360	4,770	6,090
4412 Fibrous Plasterers	310	220	280	410	490	500	370	620
4413 Roof Slaters and Tilers	230	210	250	370	510	360	230	390
4414 Bricklayers	500	430	490	690	960	870	510	880
4415 Solid Plasterers	130	90	110	140	170	160	100	140
4416 Wall and Floor Tilers and Stonemasons	370	320	300	430	460	450	390	520
4421 Painters and Decorators	770	650	730	900	1,100	1,030	840	970
4422 Signwriters	170	130	140	140	160	160	140	150
4423 Floor Finishers	130	110	120	150	190	190	140	160
4431 Plumbers	1,800	1,510	1,700	1,480	1,740	1,440	1,190	1,590
<b>Sub-total Building and construction trades</b>	<b>8,260</b>	<b>7,190</b>	<b>8,060</b>	<b>9,450</b>	<b>11,560</b>	<b>10,520</b>	<b>8,680</b>	<b>11,480</b>
<b>Non-trade on-site construction occupations</b>								
7111 Mobile Construction Plant Operators	50	150	170	190	930	1,730	2,520	2,700
7122 Crane, Hoist and Lift Operators	0	0	0	0	0	110	20	20
7913 Structural Steel Construction Workers	0	0	0	10	(a)	(a)	0	(a)
7914 Insulation and Home Improvements Installers	0	0	0	0	(a)	50	50	20
9912 Earthmoving Labourers	0	0	10	10	10	20	(a)	0
9913 Paving and Surfacing Labourers	(a)	10	10	(a)	0	0	(a)	10
9914 Survey Hands	(a)	(a)	(a)	0	0	0	0	(a)
9916 Construction and Plumber's Assistants	30	490	750	900	750	700	640	730
9917 Concreters	0	0	0	10	110	60	50	120
<b>Sub-total Non-trade on-site construction occs</b>	<b>90</b>	<b>660</b>	<b>940</b>	<b>1,130</b>	<b>1,820</b>	<b>2,680</b>	<b>3,280</b>	<b>3,600</b>
<b>Other occupations</b>	<b>56,240</b>	<b>81,920</b>	<b>105,260</b>	<b>144,350</b>	<b>185,310</b>	<b>196,920</b>	<b>211,860</b>	<b>248,710</b>
<b>All occupations</b>	<b>64,590</b>	<b>89,770</b>	<b>114,260</b>	<b>154,940</b>	<b>198,690</b>	<b>210,120</b>	<b>223,820</b>	<b>263,790</b>
<b>Due to confidentiality reasons (a) represents figures 1 to 9 inclusive</b>								
<b>Due to rounding some figures may not sum</b>								

**Graph 5.**

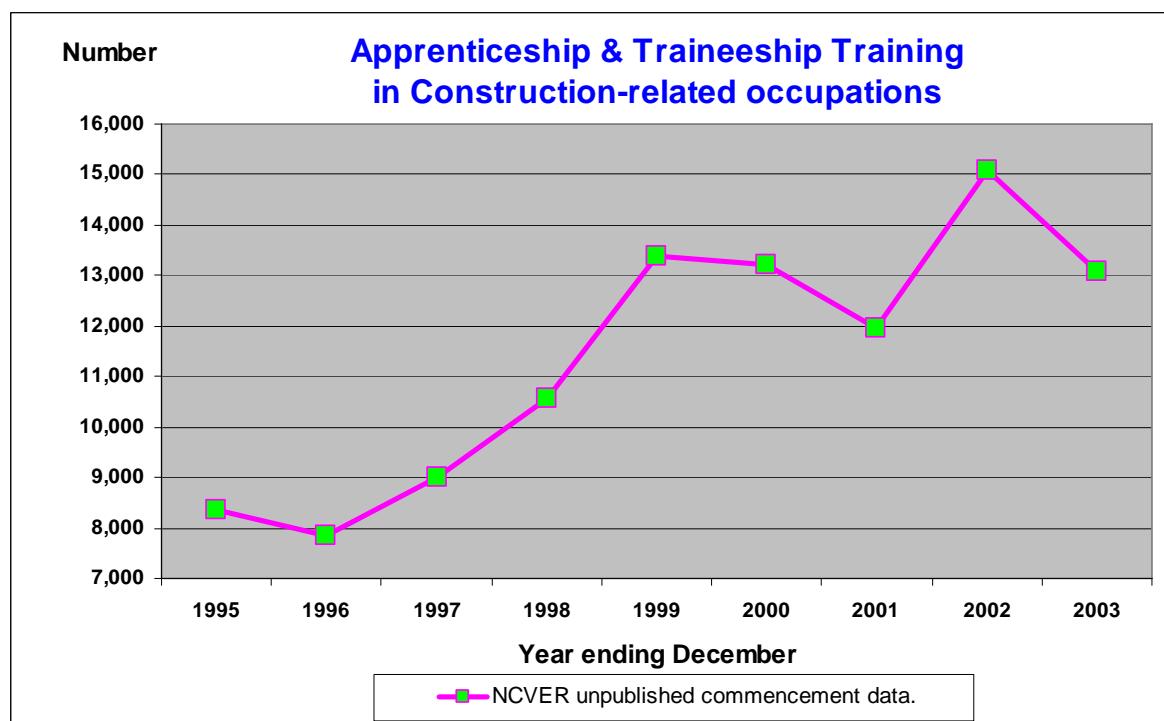


Table 8 below shows training completions notified to training authorities for the years 2001 to 2003 is provided below and it can be easily seen that the figures are considerably below the levels of commencements.

**Table 8.**

<b>Preliminary apprentice/trainee completions by ASCO, 12 mths ending 31 Dec. 2001-2003</b>			
<b>Based on December quarter estimates 2003</b>			
<b>ASCO</b>	<b>2001</b>	<b>2002</b>	<b>2003</b>
<b>Building and construction trades</b>			
4411 Carpentry and Joinery Tradespersons	2,490	2,950	3,100
4412 Fibrous Plasterers	110	160	160
4413 Roof Slaters and Tilers	120	160	150
4414 Bricklayers	240	340	330
4415 Solid Plasterers	80	80	60
4416 Wall and Floor Tilers and Stonemasons	150	180	170
4421 Painters and Decorators	390	470	490
4422 Signwriters	70	80	70
4423 Floor Finishers	50	60	60
4431 Plumbers	1,060	930	900
<b>Sub-total Building and construction trades</b>	<b>4,760</b>	<b>5,410</b>	<b>5,490</b>
<b>Non-trade on-site construction occupations</b>			
7111 Mobile Construction Plant Operators	290	660	760
7122 Crane, Hoist and Lift Operators	0	80	(a)
7913 Structural Steel Construction Workers	(a)	(a)	0
7914 Insulation and Home Improvements Installers	(a)	(a)	(a)
9912 Earthmoving Labourers	(a)	(a)	(a)
9913 Paving and Surfacing Labourers	0	0	(a)
9914 Survey Hands	0	0	0
9916 Construction and Plumber's Assistants	420	220	230
9917 Concreters	20	30	30
<b>Sub-total Non-trade on-site construction occupations</b>	<b>740</b>	<b>1000</b>	<b>1,020</b>
<b>Other occupations</b>	<b>88,550</b>	<b>105,810</b>	<b>97,070</b>
<b>All occupations</b>	<b>94,050</b>	<b>112,220</b>	<b>103,580</b>
<b>Due to confidentiality reasons (a) represents figures 1 to 9 inclusive</b>			
<b>Due to rounding some figures may not sum</b>			

Whilst trends in apprenticeship training commencements are useful indicators of likely new supply from training, unfortunately there is a serious problem of high attrition rates during training. The Author conducted detailed studies of Apprentice and Trainee training trends for the state of NSW in 2004 and 2005. The Apprentice study, *Statistical Trends in Apprenticeships in NSW - 1997 to 2003*, Workforce Research, July 2004, [Morgan 2004] included estimation of completion rates for each proclaimed trade (Vocation). This study employed detailed cohort analysis (rather than using completion notifications). The table below shows the number of completed apprenticeships and the rate of completion for the 1997 commencing cohort by individual construction trade.

In NSW in the period under study, somewhat less than half of commencing Apprentices (in all trades) completed their Apprenticeship. Completion rates for Apprenticeships fell during the late 1990s from nearly 50% for Apprenticeships commenced in 1997 to under 43% for those commenced in 1999 (the latest year for which fully up-to-date Completion records for Apprenticeships had been available).

In Construction Trades the completion rates in NSW were generally in the range 40-50% although some trades had significantly lower rates (e.g. Bricklaying 31.5%, Plastering 35.2% and Metal Roofing 34.1%).

These NSW rates of completion are consistent with the findings of a later National study by Katrina Ball and David John in 2005, *Apprentice and trainee completion rates*, NCVER, 2005 [Ball & John 2005]. The NCVER study looked at completion rates for trade groupings Australia-wide. The traditional construction trades group were shown to have had completion rates of 64.4% for 1995 commencing apprentices and 40.2% for those commencing in 1999.

**Table 9.**

<b>Completion Rates of NSW Apprenticeships Commenced in 1997 – by Vocation</b>		
<b>VOCATION</b>	<b>Number</b>	<b>Completion Rate</b>
Carpentry & Joinery	1,148	45.3%
Plumbing, Gasfitting & Draining	493	54.8%
Electrical (Fitter-Mechanic)	384	59.4%
Electrical (Mechanic)	333	57.7%
Painting and Decorating	207	43.0%
Shopfitting & Joinery	183	54.6%
Bricklaying	181	31.5%
Refrigeration/Air-Conditioning (Mechanic)	140	47.1%
Roof Tiling	81	42.0%
Plastering, Fibrous & Plasterboard	54	35.2%
Wall & Floor Tiling	52	44.2%
Metal Roofing & Roof Plumbing	44	34.1%

Source: NSW Department of Education and Training IVETS database  
Workforce Research, *Statistical Trends in Apprenticeships in NSW - 1997 to 2003 - July 2004.*

For the purposes of comparing the occupational workforce contributions of training and migration, only those occupations which are predominantly in the Construction industry were included. The structured training data from NCVER included all Apprentices and Trainees, irrespective of the industry that they are employed in. Electricians were excluded, as the 2001 Census data indicates that 45% of employed Electricians worked in industries other than Construction. These estimates relate to the average number of trades qualified migrants who have successfully gained employment in their trade within a few years of their arrival in Australia. The time lag in finding construction industry employment would mean that the later migrant intake estimates (e.g. for 2001) are underestimated somewhat. Also the 2001 figure is for the year to August.

Table 10 below compares estimates of annual contributions to new labour supply for key construction occupations in 2001. For the larger trades of Carpenters and Plumbers migration was a much less important source of supply than training. For these trades, migration only amounted to 10% and 7% of the number of training completions respectively. On the other hand, supply from migration for Fibrous Plasterers was almost at the same level as from training (46%). Migration amounted to nearly 40% of training completions for Floor Finishers (39%), Wall and Floor Tilers (38%) and Painters (37%).

**Table 10.**

2001 Census – Construction Trade Migration by Year of Arrival in Australia and NCVER Apprentice and Trainee Completions				
	A	B	C	
	Migration Annual Av 96-2001	Training Completions 2001	Training Plus Migration	Migration as % of New Supply
Carpenters and Joiners	281	2,490	2,771	10.2%
<b>Fibrous Plasterers</b>	<b>95</b>	<b>110</b>	<b>205</b>	<b>46.4%</b>
Roof Tilers	29	120	149	19.2%
Bricklayers	65	240	305	21.3%
Solid Plasterers	34	80	114	29.7%
<b>Wall and Floor Tilers</b>	<b>93</b>	<b>150</b>	<b>243</b>	<b>38.3%</b>
<b>Painters and Decorators</b>	<b>234</b>	<b>390</b>	<b>624</b>	<b>37.5%</b>
<b>Floor Finishers</b>	<b>33</b>	<b>50</b>	<b>83</b>	<b>39.6%</b>
Plumbers	84	1,060	1,144	7.3%

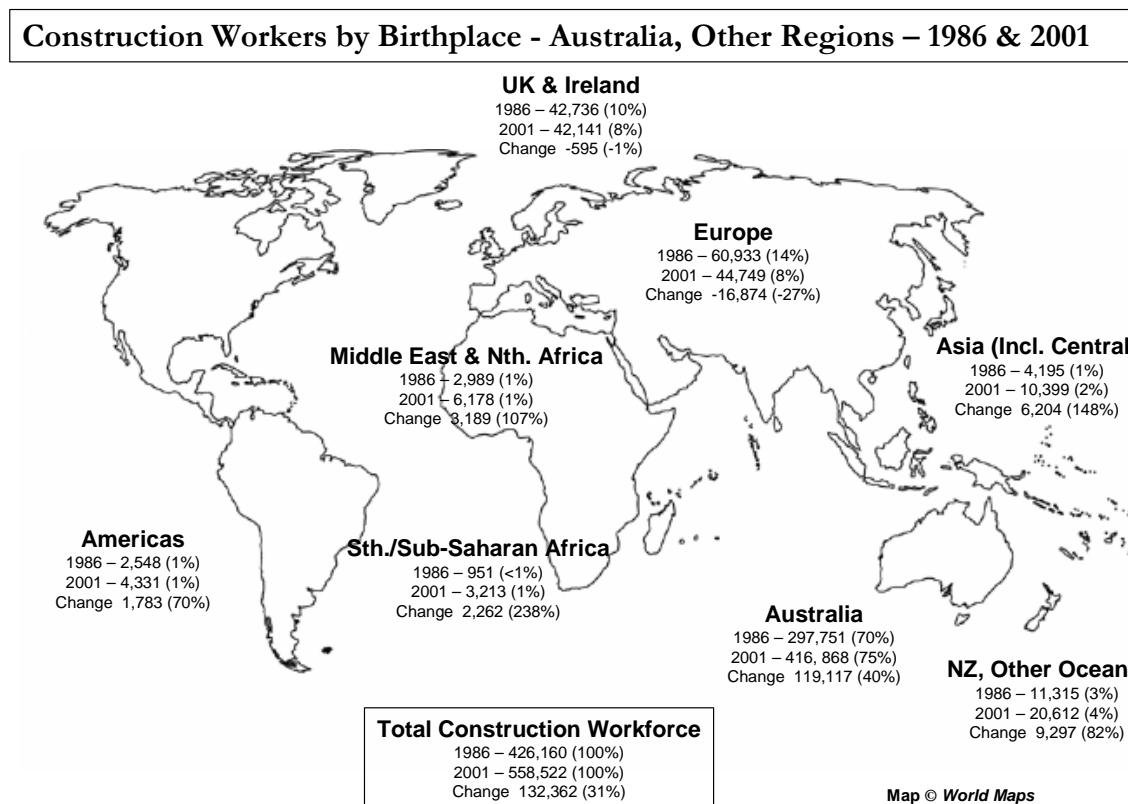
These figures highlight the huge reliance of the Australian Construction industry on overseas migration for skilled workers. They also show that there should be considerable scope for increasing training effort for a range of trades in the Construction industry.

Training was a key focus of the broader project of which the Census statistical analysis was a part. A number of in-depth studies of apprenticeship by Dr Phil Toner in recent years have also reported serious under-training in the skilled trades in various industries, including Construction (see list of research papers on p2 of this conference paper). In a later report [Toner 2005], annual average apprentice training rates across all industries were presented: “over the eleven years between 1982 and 1992 [the rate] as 12.8%; between 1993 and 2003 it declined to 10.8%.” For many Construction trades the apprenticeship training rate was much lower than this.

## OVERSEAS-BORN CONSTRUCTION WORKERS: KEY TRENDS 1986-2001

One of the key objectives of the *Labour Force Challenges in the Australian Building and Construction Industry* project was to document developments over time, in particular, the contribution of Migrant Workers to the Industry's skills infrastructure. The achievement of this objective proved to be difficult because of changes to the Occupation and Industry coding systems employed by ABS in the Censuses during the project's data analysis reference period of 1986 to 2001, as well as procedural changes in applying the Industry codes. These difficulties are outlined in the later sections of this paper. Despite the problems, some analysis of broad changes in the Construction Industry Migrant Workforce between 1986 and 2001 was able to be undertaken. In addition, more detailed analysis was carried out for individual Occupations which were not unduly influenced by inter-censal coding changes.

Map Chart 1 below shows the Construction Industry workforce in 1986 and 2001 broken down by Major Birthplace Region. This map is used with permission [Graphic Maps]. Along with the numbers in each Census year are included the percentage of the total in brackets, as well as the change over the period in numeric and percentage terms.



**Map Chart 1.**

Of interest is the fact that the Australia-born proportion increased from 70% to 75% over the period. There was also a striking fall in the number (and proportion) of persons in the Industry born in Europe (down 16,000 or 27%). There was also a very slight fall in the number of UK/Ireland-born Construction workers. On the other side of the ledger, persons from New Zealand/Other Oceania rose by 9,000 (82%), Asian-born persons increased by over 6,000 (148%), Middle Eastern-born persons rose by over 3,000 (107%) and those born in South/Sub-Saharan Africa rose by over 2,000 (238%).

Tables 11, 12 and 13 below show changes in the composition of the Construction Industry workforce between 1986 and 2001 for the three key on-site Major Occupation Groups. In each case significant declines in the number of workers born in the UK/Ireland and Europe are compensated by major increases in persons born elsewhere, particularly New Zealand/Other Oceania and Asia. Note that Totals include the inadequately described and not stated residuals.

**Table 11.**

<b>Construction Industry Workforce by Birthplace Region/Country – 1986 and 2001</b>				
<b>Trades and Related Workers</b>				
<b>Region/Country</b>	<b>1986</b>	<b>2001</b>	<b>Change</b>	<b>% Change</b>
Australia	136,466	200,684	64,218	47%
NZ and Other Oceania	4,924	8,859	3,935	80%
UK and Ireland	21,985	20,988	-997	-5%
Europe	30,751	22,731	-8,020	-26%
Middle East & North Africa	1,311	3,085	1,774	135%
Asia	1,440	3,889	2,449	170%
Americas	1,150	2,089	939	82%
South Africa	496	1,395	899	181%
Total	199,831	268,935	69,104	35%

**Table 12.**

<b>Construction Industry Workforce by Birthplace Region/Country – 1986 and 2001</b>				
<b>Intermediate Production &amp; Transport Workers</b>				
<b>Region/Country</b>	<b>1986</b>	<b>2001</b>	<b>Change</b>	<b>% Change</b>
Australia	32,081	40,873	8,792	27%
NZ and Other Oceania	1,535	3,088	1,553	101%
UK and Ireland	3,514	3,256	-258	-7%
Europe	4,946	3,204	-1,742	-35%
Middle East & North Africa	188	331	143	76%
Asia	227	643	416	183%
Americas	237	272	35	15%
South Africa	21	147	126	600%
Total	43,020	52,828	9,808	23%

**Table 13.**

<b>Construction Industry Workforce by Birthplace Region/Country – 1986 and 2001</b>				
<b>Labourers &amp; Related Workers</b>				
<b>Region/Country</b>	<b>1986</b>	<b>2001</b>	<b>Change</b>	<b>% Change</b>
Australia	36,669	47,818	11,149	30%
NZ and Other Oceania	1,933	3,114	1,181	61%
UK and Ireland	4,576	3,784	-792	-17%
Europe	11,337	6,713	-4,624	-41%
Middle East & North Africa	347	811	464	134%
Asia	546	1,049	503	92%
Americas	443	558	115	26%
South Africa	65	264	199	306%
Total	56,369	65,590	9,221	16%

## Construction Workers in Selected Occupations by Birthplace Region – 1986 to 2001

A number of key individual Occupations (13) were selected for analysis of trends in employment (in the Construction Industry) of persons born overseas, as reported in the Censuses carried out in 1986, 1991, 1996 and 2001. The largest on-site Occupations were included, along with Civil Engineers and Business Professionals. Some Occupations were not included because of excessive difficulties in aligning ASCO1 and ASCO2 Occupation codes over the period of analysis. The notes below and tables following summarise the trends.

With the exception of Bricklayers (-1,000 or -6%), all the largest on-site Occupations selected for analysis at this level of detail increased over the 15 year period. By far the biggest increase was for Electricians (+15,000 or +56%) and there were also significant increases (of between 7,000 to 9,000) for Painters, Construction Assistants, Plumbers and Plasterers. Much smaller numeric increases were recorded for Carpenters and Concreters.

<b>Civil Engineers</b> (Decrease of 1,199 or -28%)	The decline in numbers occurred for nearly all the major Overseas Birthplace Regions, but was especially marked (around 50%) for UK, Ireland and Europe.
<b>Business Professionals</b> (+4,113 or +197%)	There were increases in the numbers of Business Professionals for all the major Overseas Birthplace Regions, with Asia being the most prominent (up 365%).
<b>Structural Steel Trades</b> (-1,138 or -20%)	Very large declines were recorded over the 15 year period for persons born in UK, Ireland and Europe, but there were small increases in persons born in New Zealand and Asia.
<b>Electricians</b> (+14,883 or +56%)	Increases were apparent for all the major Overseas Birthplace Regions, particularly New Zealand (+100%), Asia (+240%) and South Africa (+500%).
<b>Carpenters</b> (+3,979 or 8%)	There was a significant decline in the numbers of Carpenters born in the UK, Ireland and Europe (e.g. Europe was down nearly 50%), although this was offset by large increases in those born in New Zealand and Asia.
<b>Plasterers</b> (+7,290 or 63%)	There were strong increases in employment of persons born in most of the major Overseas Birthplace Regions, especially Asia, New Zealand and the Middle East.
<b>Bricklayers</b> (-1,157 or -6%)	Significant declines in the numbers of Bricklayers born in the UK, Ireland and Europe were evident, with very small partially offsetting increases in other Overseas Birthplace Regions such as New Zealand.
<b>Floor and Wall Tilers</b> (+6,030 or +128%)	Sizeable increases were recorded for most of the major Overseas Birthplace Regions, but there was an overwhelming increase for Tilers born in Asia ( <b>up over 3,000%</b> ).
<b>Painters</b> (+9,107 or 43%)	Employment increases were recorded for Painters born in all of the major Overseas Birthplace Regions, with the exception of Europe. The major increases were for those born in the Middle East (up 300%), New Zealand and Asia.
<b>Plumbers</b> (+8,230 or 26%)	Significant declines were recorded for Plumbers born in the UK, Ireland and Europe, although this was offset somewhat by increases for those born in New Zealand and South Africa.
<b>Cleaners</b> (+288 or +15%)	Over the reference period there were increases in Cleaners born in most of the major Overseas Birthplace Regions (except Europe), with the most prominent being for Asia and New Zealand.
<b>Construction Assistants</b> (+9,001 or +89%)	The increase for Construction Assistants may be influenced by ASCO alignment problems. All of the major Overseas Birthplace Regions showed increased employment, with the biggest proportional increases being for persons born in New Zealand and the Middle East.
<b>Concreters</b> (+4,053 or +33%)	There were significant declines in the numbers of Concreters born in the UK, Ireland and Europe, although this was partially offset by a sizeable increase for those born in New Zealand.

## **INDUSTRY DATA COMPARABILITY: CENSUS 1986 TO CENSUS 2001**

The Australian Bureau of Statistics (ABS) regularly revises and updates their main classification systems for economic and social data. There are several reasons why ABS does this, but the main one, of course, is that the world is constantly changing and least of all the world of work. Most classifications are even partly out-of-date at the time they are introduced and published.

Technological change, in its many manifestations, is a key determinant of the tasks and duties which characterise an occupation. As new materials, processes and management methods are introduced into the workplace, new jobs come into being. Whole new industries may evolve over a period of a decade or so and others may decline or cease to exist in their previous form. While this change is going on, established industries and occupations coexist with the newly emerging forms of work. It is very important that ABS keeps as up-to-date with these changes as possible, to enable their statistics to depict the world as closely to reality as possible. The downside is that as each new classification is introduced, comparability with previous data series is compromised in some ways.

The present construction industry data analysis covered a reference period of 15 years and involved four Census data sets: 1986, 1991, 1996 and 2001. Major changes were made to the Industry and Occupation classifications in this period which had to be taken account of, in some way, in the process of data analysis. ABS publishes concordances which link a previous classification with the previous one. The production of the concordances also usually involves "double-coding" a sample data set with both the old and new classification codes. In this way, the areas of industry and the labour market where the classification change impacts most can be clearly seen.

While concordances can be very useful tools for aligning data sets coded to different classifications, they rarely enable the job to be done perfectly and some alignment has to be done on a "best guess" basis. A real problem in cross-classified micro-analysis at a detailed coding level, such as ANZSIC class and ASCO unit group, is that a cross-classified concordance is not available. For instance the ASCO1 and ASCO2 data concordance is for all industries combined. An occupation concordance is not available for the Construction industry. The greatest problem is where an occupation or occupation group contains jobs which are not homogeneous from industry to industry. This problem arose in the present study in relation to certain offsite managerial, sub-professional and clerical occupations, which fortunately were not the main focus of the study.

In addition to the problems caused by changes in classifications and which necessitated the use of concordances, the results of some inter-censal data comparisons indicated that there is also an associated problem related to the application of new classifications. Where new classifications were introduced, larger proportions of workers were coded to the residual "not further defined" categories in the immediately following Census data set, as compared to the next Census. It appears that coding to new classification systems need time for "bedding in" and this can be a problem in micro-analysis over several Census periods.

In processing data from the 2001 Census, the Australian Bureau of Statistics (ABS) used an Industry coding methodology which was different from that used in 1996, 1991 and 1986. Because of these changes the most detailed 2001 Census data for employed persons by Industry data is not comparable, in the strictest sense, with data from earlier Censuses. Consequently, inter-censal comparisons at 4 digit ANZSIC/ASIC level have been interpreted very cautiously in this report.

The procedures used to code Industry can also have a direct effect on the suitability of the resultant data on employed persons by Industry category for analysis such as carried out in this research project. It is probable that the new procedures used in coding 2001 Census Industry data would provide more precise coding of individuals at the higher levels of Industry sector detail. This is because in the Business Register coding (used in the past), only one Industry code was allocated per business, relating to the main sector of business activity, even where a significant minority of employees may have been working in another sector. Whilst the precise extent to which

Construction businesses operate in more than one sector is not known, it is likely that a significant proportion of businesses do operate in this way. Basing Industry codes on Census form responses (rather than from matched Business Register records) would allow for more precise coding to detailed Construction sector for persons in these businesses.

## **Background**

In the preparatory stages leading up to the conduct of the 2001 Census ABS flagged the possibility of several changes relating to Industry of employment involving differences in the wording of questions on the Census form and variations in the procedures used for processing this information.

*For the 2001 Census a question asking person's rather than employer's workplace address will be tested, as this should be more successful in encouraging respondents to give their actual workplace address rather than their head office address.*

*Also, further testing will be undertaken to try to find a more effective direct industry question that would enable more reliable industry coding in those cases where matching to the Business Register is not possible. [ABS 2001(a) p52].*

Also coinciding with the years immediately prior to the 2001 Census was the introduction of wide ranging changes to the Australian tax system by the Federal Government. The New Tax System had an immediate and significant effect on the ABS Business Register, which had been the primary source of information for coding an employed person's Industry of employment in the Census in previous years.

*With changes to the ABS Business Register, it will not be possible to use employers' addresses for the purposes of Industry coding. [ABS 2001(b) p48].*

In 1996 and previously, the names and addresses of employers, as stated on the Census form were matched with employer records on the ABS Business Register. The Business Register is a large database of enterprises primarily used for sampling in business surveys. Where matches were found, the individual was assigned the industry code of the employer. The Industry codes assigned to businesses on the Register were based on information gathered by ABS from the Australian Tax Office (Group Employer details) and in the course of running various Business Surveys. Details of the types of products made or services provided by the businesses were included.

For large complex companies with many branches, locations and types of operations, Industry coding was quite a complicated undertaking. The principles for such coding were outlined in considerable detail in the 1983 Australian Standard Classification of Industries (ASIC) Volume 1 [ABS 1983]. If a match with a Business Register record was not found, Industry coding was based on the description of the goods produced or services provided by the employer, as given by the individual in another question on the Census form. Generally ABS found that in more than 50% of cases, the requisite match could be made with Business Register records.

In 2001 the Business Register was not used as the primary source for coding employed persons to Industry. Instead, several automated and manual processes were employed using the description provided by the individuals on their Census forms.

## **Effect of the New Tax System on the Business Register**

ABS indicated prior to conducting the 2001 Census that the New Tax System would impact heavily in various ways on its economic statistics. ABS has endeavoured to document these effects as best they could be anticipated in the transition period 2000 to 2002. The indirect effects on aspects of the Population Census have also been documented in a special 2001 Census Evaluation Paper: *Industry* [ABS 2004(b)].

Many of the statistical series produced by the ABS will be affected in some way by the New Tax System.... Some will occur as a result of unavoidable changes to the statistical infrastructure.... One statistical result [of reporting changes] could be a change to the reported industry breakdown of the businesses' activities. [ABS 2000 Pp 8-10].

ABS previously had access to their own Business Register data for matching Census employer details on a basis consistent with previous Censuses (apart from the effect of changes to Industry Classifications). They were now reliant to an increasing degree on the Australian Tax Office ABN-related Australian Business Register where detailed industry coding could vary from past ABS practice. This is referred to as the ATO Maintained Population (ATOMP) of businesses. A much scaled-back ABS Register is now being kept only for a relatively small number of large and more complex businesses (the ABS Maintained Population of businesses).

The ABS is now introducing the use of Australian Tax Office ANZSIC codes for all businesses in the ATAMP, replacing the code previously stored on the ABS Business Register. The ATO codes differ from the ABS codes for some businesses for a number of reasons... Hence, the adoption of ATO codes will result in changes to estimates produced on an industry basis. [ABS 2002(b) P7].

## **Evaluation of 2001 Census processing changes in relation to Industry Coding**

ABS conducted a series of evaluation studies on various data items in the 2001 Census. In *Census Paper No. 03/08, Industry*, [ABS 2004(b)] ABS provides an interesting and thorough treatment of the Industry coding procedures carried out in relation to the 2001 Census, as well as some treatment of the procedures used previously. While the scope of the paper is fairly broad, covering data quality generally, changes made to questions on the Census form, coding procedure changes, levels of undefined coding and comparisons with Labour Force Survey data, unfortunately the scope of the paper is insufficient for the focus of this project. The paper is primarily concerned with Census data coded to Industry Division level. The project aims to cover aspects of employment in the Construction Industry at (the most detailed) Industry Class level.

One key focus of the paper is the degree to which the processes adopted result in allocation of a code and the degree of detail achieved (1 to 4 digit ANZSIC). It also looks at the proportion of records having to be allocated a "dump" code at the various levels of the classification hierarchy, with (in the case of Construction) the least coding precision being achieved where Division level is coded (E000 Construction undefined). The paper draws attention to the fact that greater precision (in this sense) in Industry coding was achieved in 2001 than in 1996.

These observations tally with the present analysis of Census data in the Construction Industry at the level of ANZSIC Class. The number of persons allocated Division level codes has more than halved between 1986 and 2001 and in the Subdivision 41 General Construction undefined, an 80% fall was evident.

While this increased precision in coding between Censuses is a desirable outcome, gross changes in the proportions in "undefined" categories make it difficult to undertake time series analysis with precision. The changes of this nature between 1986 and 1991 were much more extreme (than between 1996 and 2001) and this problem was compounded by a very high level of coding to the "Industry not stated" category.

The Census Evaluation Paper does not attempt a comparison of coding achieved at ANZSIC Class level, using the 2001 methodology, with what would have been the outcome if the Business Register had been used (the primary method used in 1996). The method of allocating an Industry code to Enterprises, establishments and locations for the Business Register is fundamentally different to a method using key words etc. in Census responses.

An example may be helpful to illustrate the point. Consider an individual who is included in the 1996 and 2001 Censuses and who has carried out the same work activities over the entire period, "house building" (as stated on the Census form). This person would have been almost certainly coded to House Construction in 2001. In the 1996 Census if the employing business of this individual was on the Register and the turnover for the business from Non-Residential Building Construction was (say) 70% of the total, the individual would have been likely to have been coded to this ANZSIC category for that Census.

Unfortunately, it appears that ABS has not been able to investigate the extent to which this sort of coding inconsistency may have occurred.

## OCCUPATION DATA COMPARABILITY: CENSUS 1986 TO CENSUS 2001

It was decided at an early stage in the project that it would be most practical to base data comparisons over Census periods on the earlier of the classifications ASIC industry and ASCO1 occupation. This meant that the 1986 and 1991 data could be presented as is, but the 1996 and 2001 data sets would have to be realigned using the appropriate concordances provided by ABS.

The project required that construction employment trends be analysed to the highest degree possible. Initially it was thought possible to use Census cross-classified tables with the industry variable at the level of ASIC/ANZSIC 4 digit class and the occupation variable at ASCO unit group 4 digit level. Such a table would have contained 21 industry categories and 282 occupation categories, a total table cell count of nearly 6,000. This level of occupation detail was ruled out because of the data requirements for a 4 way table intended for analysis of migrant workers in construction (industry x occupation x country of birth x year of arrival). Even after the county of birth categories were collapsed into 23 countries and regions and year of arrival collapsed into 7 individual years and groups of years, the table cell count using occupation at unit group level was over 45,000. It was impractical to use a table such as this and the project budget would not support the purchase of these huge data sets.

The level of occupation detail was then pared down to the bare necessities, keeping as many on-site construction-related occupations as possible at 4 digit unit group level, but collapsing other occupation categories up to minor group or 2 digit level. This brought the industry by occupation table cell count down to a manageable (and affordable) 2,000. The migration table cell count was brought down to just under 17,000.

The Census table data specifications are set out in detail in Appendix 1. Four main tables were ordered from ABS for the 4 Censuses 1986, 1991, 1996 and 2001: industry by occupation, industry by occupation by age, industry by occupation by qualifications as well as industry by occupation by country of birth by year of arrival. When supplied by ABS in Supertable form, the project now had at its disposal a "formidable" array of data. ABS also assisted with advice on classification changes within the study reference period and help in some preliminary alignment of the industry and occupation data.

The need to pare down the occupation categories as mentioned above proved to be the cause of much difficulty in the alignment of occupation data from each of the 4 Censuses. In hindsight it is obvious that it is almost impossible to apply the ASCO 1 to ASCO2 occupation concordance at the 2 digit level with precision across all the categories in the classification.

ABS supplied the ASCO1 to ASCO2 occupation concordance at the individual occupation or 6 digit level. A number of changes were made to the ABS Australian Standard Classification of Occupations (ASCO) between 1986 and 2001 [ABS 1998]. With the kinds of changes that took place in the revision of ASCO, the concordance must be used at least at 4 digit unit group level for good alignment to be able to be achieved. As the prime focus of the construction study was on the on-site workforce occupations, the overall quality of the data analysis was not seriously compromised. The lack of alignment between sub-professional, clerical and managerial occupation groups proved to be a major headache, however.

To enable comparisons to be made between the 2 Census data sets, reference was made to the Concordance prepared by ABS for this purpose. This was supplied by ABS in fine detail as a spreadsheet (ELF3.AUST) and also in more summary form in the Appendices to the ASCO Second Edition [ABS 1997].

A preliminary check of the ABS ASCO Concordance at 4 digit level (looking just at the ASCO 4 Trades group) showed that the biggest mismatch was for Cooks/Chefs and this was of little consequence with Construction Industry only data. When Construction trades were examined specifically, there was mainly a 1 to 1 alignment between the classifications. The only significant break was the splitting of sign writers (ASCO 2 code 4422) from painters (ASCO 1 code 4405).

When the initial analysis of changes in Occupational employment levels between 1986 and 2001 had been undertaken, a problem was encountered in the Associate Professional group. Because of changes between ASCO 1 and ASCO 2 at the Major Group (1 digit) level, adjustments were made to the 2001 data using proportions derived from the ASCO Concordance.

An ASCO1 to ASCO2 matching exercise was carried for all of the 4 digit and 2 digit Occupation categories included in the Census data set specifications for this project, using the ABS Concordance. Most on-site construction occupations were readily matched, but in some cases satisfactory matches were achieved by aggregation of similar occupations, in one Census year or the other. Where this was not possible, residual groups of Occupations were created to enable comparisons for the whole of the Construction Industry to be carried out.

Where possible, link codes were assigned to each ASCO1 and ASCO2 occupation unit groups and minor groups in the data sets. Categories unable to be easily linked were grouped at major group level. Comparisons were then able to be done between 1986 ASCO1 occupations and equivalent data for 1991, 1996 and 2001. A significant problem was found with ASCO2 minor group 32 (Business and Administration Associate Professionals). Because there were changes in ASCO1 and ASCO2 affecting this group at the major group level, a special estimation and adjustment procedure was used with reference to additional 2001 Census construction data by occupation at 4 digit level. This procedure is explained briefly below.

The part of the ASCO Concordance dealing with ASCO 2 Minor Group 32 (Business and Administration Associate Professionals) was analysed in detail. It was evident that a very large proportion of 2001 Minor Group 32 employment (amounting to 59% of the Minor Group total) would have been coded to Major Groups 5 (Clerks) and 6 (Salespersons & Personal Service Workers). Only about a quarter of 2001 employment in Minor Group 32 would have been coded to Associate Professional in 1986. Another significant proportion would have been coded to the Managers Major Group in 1986. These proportions were used to adjust the 2001 data presented in this paper, but only in the context of comparisons with 1986 data. Tables showing current (2001) data only were not adjusted.

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## APPENDIX 1

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### VARIABLES AND CATEGORIES FOR ABS UNPUBLISHED CENSUS TABLES

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The variables and categories selected for inclusion in the spreadsheet crosstabs and SuperTables were as follows:

#### INDUSTRY

Within ANZSIC Division E Construction, all twenty one 4 digit classes (e.g. 4111 House Construction, 4112 Residential Building Construction n.e.c., etc. Also any dummy (etc) industry codes required to give a total of all employed persons in Construction.

#### AGE GROUP

15-19, 20-24, 25-34, 35-44, 45-54, 55-64, 65+, (and, if necessary, “age not known”, etc).

#### YEAR OF ARRIVAL (Persons born overseas)

2001, 2000, 1995-1999, 1990-1994, 1980-1989, pre 1980, (and residual categories, “year not known”, etc).

#### LEVEL OF HIGHEST QUALIFICATION OBTAINED

- 1 Postgraduate Degree Level
- 2 Graduate Diploma and Graduate Certificate Level
- 3 Bachelor Degree Level
- 4 Advanced Diploma and Diploma Level
- 5 Certificate Level

Supplementary codes:

- 01 Level of education inadequately described
- && Level of education not stated
- @@ Not applicable
- VV Overseas visitor

#### COUNTRY OF BIRTH

- 1)Australia, New Zealand, Other Oceania [all separately]
- 2)North West Europe
- 3)Southern and Eastern Europe
- 4)North Africa and Middle East
- 5)South-East Asia
- 6)North-East Asia
- 7)Southern and Central Asia
- 8)Americas
- 9)Sub-Saharan Africa
- 10)Residual [not stated, etc]

Plus the country of special interest: Korea.

Plus the top ten individual countries not already included. (Ranking determined by number of overseas-born persons employed in Construction in the 2001 Census). Residual categories also to

be added to the main country groupings in a similar way as Oceania (i.e. individual countries, Other).

## OCCUPATION

The Occupation and Occupation group categories selected for inclusion in the Census data sets were as follows:

All the 2 digit ASCO occupation categories and the ASCO Occupation Unit Groups listed below (which were found to be significantly represented in the Construction Industry workforce in 2001).

- 1191 Building and Construction Managers
- 2100 Science, Building and Engineering Professionals, n.f.d.
- 2110 Natural and Physical Science Professionals, n.f.d.
- 2111 Chemists
- 2112 Geologists and Geophysicists
- 2113 Life Scientists
- 2114 Environmental and Agricultural Science Professionals
- 2115 Medical Scientists
- 2119 Other Natural and Physical Science Professionals
- 2120 Building and Engineering Professionals, n.f.d.
- 2121 Architects and Landscape Architects
- 2122 Quantity Surveyors
- 2123 Cartographers and Surveyors
- 2124 Civil Engineers
- 2125 Electrical and Electronics Engineers
- 2126 Mechanical, Production and Plant Engineers
- 2127 Mining and Materials Engineers
- 2128 Engineering Technologists
- 2129 Other Building and Engineering Professionals
- 3100 Science, Engineering and Related Associate Professionals, n.f.d.
- 3110 Medical and Science Technical Officers, n.f.d.
- 3111 Medical Technical Officers
- 3112 Science Technical Officers
- 3120 Building and Engineering Associate Professionals, n.f.d.
- 3121 Building, Architectural and Surveying Associate Professionals
- 3122 Civil Engineering Associate Professionals
- 3123 Electrical Engineering Associate Professionals
- 3124 Electronics Engineering Associate Professionals
- 3125 Mechanical Engineering Associate Professionals
- 3129 Other Building and Engineering Associate Professionals
- 4121 General Fabrication Engineering Tradespersons
- 4122 Structural Steel and Welding Tradespersons
- 4124 Sheetmetal Tradespersons
- 4311 Electricians
- 4312 Refrigeration and Airconditioning Mechanics
- 4316 Communications Tradespersons
- 4400 Construction Tradespersons, n.f.d.
- 4410 Structural Construction Tradespersons, n.f.d.
- 4411 Carpentry and Joinery Tradespersons
- 4412 Fibrous Plasterers
- 4413 Roof Slaters and Tilers
- 4414 Bricklayers

4415 Solid Plasterers  
4416 Wall and Floor Tilers and Stonemasons  
4420 Final Finishes Construction Tradespersons, n.f.d.  
4421 Painters and Decorators  
4422 Signwriters  
4423 Floor Finishers  
4431 Plumbers  
4982 Glass Tradespersons  
7110 Mobile Plant Operators, n.f.d.  
7111 Mobile Construction Plant Operators  
7112 Forklift Drivers  
7119 Other Mobile Plant Operators  
7122 Crane, Hoist and Lift Operators  
7129 Other Intermediate Stationary Plant Operators  
7912 Blasting Workers  
7913 Structural Steel Construction Workers  
7914 Insulation and Home Improvements Installers  
9910 Mining, Construction and Related Labourers, n.f.d  
9911 Mining Support Workers and Driller's Assistants  
9912 Earthmoving Labourers  
9913 Paving and Surfacing Labourers  
9914 Survey Hands  
9915 Railway Labourers  
9916 Construction and Plumber's Assistants  
9917 Concreters  
9918 Electrical and Telecommunications Trades Assistants  
9919 Other Mining, Construction and Related Labourers

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## APPENDIX 2 - DETAILS OF OCUPATIONAL CHANGE 1986 TO 2001

**Table 14 – Detailed Trade Occupations - Number Employed 1986 and 2001 – Numeric and Percentage Change - Construction Industry.**

Occupation	1986	2001	Numeric Change 1986 - 2001	Percentage Change 1986 - 2001
Carpenters and joiners	50,012	53,990	3,978	8.0%
Electrical fitters, Electrical mechanics	26,616	41,481	14,865	55.8%
Plumbers	31,565	39,790	8,225	26.1%
Painters, decorators & signwriters	21,323	30,523	9,200	43.1%
Bricklayers	20,054	18,909	-1,145	-5.7%
Plasterers (all types)	11,542	18,827	7,285	63.1%
Wall and floor tilers	4,706	10,734	6,028	128.1%
Amenity horticultural tradespersons	4,453	10,705	6,252	140.4%
Refrigeration & air-conditioning mechanics	2,175	6,928	4,753	218.5%
Roof slaters and tilers	3,573	5,466	1,893	53.0%
Floor coverers	2,864	5,338	2,474	86.4%
Metal fitting & machining, Other metal trades	4,534	4,548	14	0.3%
Structural steel, boilermaking and welding	5,573	4,452	-1,121	-20.1%
Tradespersons nfd	1,521	1,667	146	9.6%
Vehicle tradespersons	1,848	1,625	-223	-12.1%
Sheet metal tradespersons	2,762	416	-2,346	-84.9%
Total Selected Trade Occupations	195,121	255,399	60,278	30.9%
Other Trade Occupations Not Included	4,697	13,561	8,864	188.7%
Grand Total Trade Occupations - Construction	199,818	268,960	69,142	34.6%

**Table 15 – Detailed Trade Occupations - Number Employed 1986 and 2001 – Numeric and Percentage Change – Other Industries.**

Occupation	1986	2001	Numeric Change 1986 - 2001	Percentage Change 1986 - 2001
Vehicle tradespersons	111,432	112,820	1,388	1.2%
Metal fitting & machining, Other metal	119,843	106,662	-13,181	-11.0%
Amenity horticultural tradespersons	35,368	58,459	23,091	65.3%
Structural steel, boilermaking and welding	49,027	43,790	-5,237	-10.7%
Electrical fitters, Electrical mechanics	44,414	34,352	-10,062	-22.7%
Carpenters and joiners	27,053	18,628	-8,425	-31.1%
Tradespersons nfd	14,064	11,515	-2,549	-18.1%
Painters, decorators & signwriters	14,410	9,363	-5,047	-35.0%
Plumbers	10,334	7,439	-2,895	-28.0%
Sheet metal tradespersons	13,320	6,798	-6,522	-49.0%
Refrigeration & air-conditioning mechanics	5,894	5,156	-738	-12.5%
Wall and floor tilers	603	2,913	2,310	383.1%
Floor coverers	1,536	1,882	346	22.5%
Plasterers (all types)	1,717	1,098	-619	-36.1%
Bricklayers	1,640	762	-878	-53.5%
Roof slaters and tilers	666	521	-145	-21.8%
Total Selected Trade Occupations	451,321	422,158	-29,163	-6.5%
Other Trade Occupations Not Included	319,638	317,172	-2,466	-0.8%
Grand Total Trade Occupations	770,959	739,330	-31,629	-4.1%

## APPENDIX 2 (Continued)

**Table 16 – Detailed Intermediate Production & Transport Occupations - Number Employed  
1986 and 2001 – Numeric and Percentage Change - Construction Industry.**

Occupation	1986	2001	Numeric Change 1986 - 2001	Percentage Change 1986 - 2001
Excavating & earthmoving plant operator	14,544	20,902	6,358	43.7%
Road and rail transport drivers	8,453	7,834	-619	-7.3%
Structural steel & related labourers	5,080	5,783	703	13.8%
Installation workers	2,554	5,153	2,599	101.8%
Crane operators, Hoist, winch & lift operators	1,628	1,830	202	12.4%
Forklift & related drivers	309	370	61	19.7%
Blasting tradespersons	138	79	-59	-42.8%
Total Selected Intermediate Prod. Occupations	32,706	41,951	9,245	28.3%
Other Intermediate Prod. Occupations	10,271	10,923	652	6.3%
Grand Total Intermediate Prod. Occupations	42,977	52,874	9,897	23.0%

**Table 17 – Detailed Intermediate Production & Transport Occupations - Number Employed  
1986 and 2001 – Numeric and Percentage Change - Other Industries.**

Occupation	1986	2001	Numeric Change 1986 - 2001	Percentage Change 1986 - 2001
Road and rail transport drivers	188,671	226,599	37,928	20.1%
Forklift & related drivers	24,603	28,971	4,368	17.8%
Excavating & earthmoving plant operator	24,922	11,687	-13,235	-53.1%
Crane operators, Hoist, winch & lift operators	10,122	5,418	-4,704	-46.5%
Installation workers	3,130	4,764	1,634	52.2%
Structural steel & related labourers	4,303	3,490	-813	-18.9%
Blasting tradespersons	660	585	-75	-11.4%
Total Selected Intermediate Prod. Occupations	256,411	281,514	25,103	9.8%
Other Intermediate Prod. Occupations	236,770	329,483	92,713	39.2%
Grand Total Intermediate Prod. Occupations	493,181	610,997	117,816	23.9%

## APPENDIX 2 (Continued)

**Table 18 – Detailed Labourer & Related Occupations - Number Employed 1986 and 2001 – Numeric and Percentage Change - Construction Industry.**

Occupation	1986	2001	Numeric Change 1986 - 2001	Percentage Change 1986 - 2001
Trades assistants & factory hands	10,090	19,084	8,994	89.1%
Concrete workers	12,474	16,532	4,058	32.5%
Paving & surfacing labourers	4,128	3,185	-943	-22.8%
Cleaners	1,940	2,230	290	14.9%
Earthmoving labourers	1,345	1,297	-48	-3.6%
Railway labourers	246	967	721	293.1%
Survey hands	659	154	-505	-76.6%
Total Selected Labourer etc. Occupations	30,882	43,449	12,567	40.7%
Other Labourer etc. Occupations	25,510	15,994	-9,516	-37.3%
Grand Total Labourer etc. Occupations	56,392	65,567	9,175	16.3%

**Table 19 – Detailed Labourer & Related Occupations - Number Employed 1986 and 2001 – Numeric and Percentage Change - Other Industries.**

Occupation	1986	2001	Numeric Change 1986 - 2001	Percentage Change 1986 - 2001
Cleaners	211,989	181,866	-30,123	-14.2%
Trades assistants & factory hands	151,985	174,969	22,984	15.1%
Earthmoving labourers	5,154	3,967	-1,187	-23.0%
Railway labourers	8,351	2,646	-5,705	-68.3%
Concrete workers	4,373	1,992	-2,381	-54.4%
Survey hands	3,068	1,630	-1,438	-46.9%
Paving & surfacing labourers	1,972	979	-993	-50.4%
Total Selected Labourer etc. Occupations	396,749	368,049	-28,700	-7.2%
Other Labourer etc. Occupations	434,555	271,931	-162,624	-37.4%
Grand Total Labourer etc. Occupations	831,304	639,980	-191,324	-23.0%

## APPENDIX 3 - DETAILS OF AGE COMPOSITION BY OCCUPATION

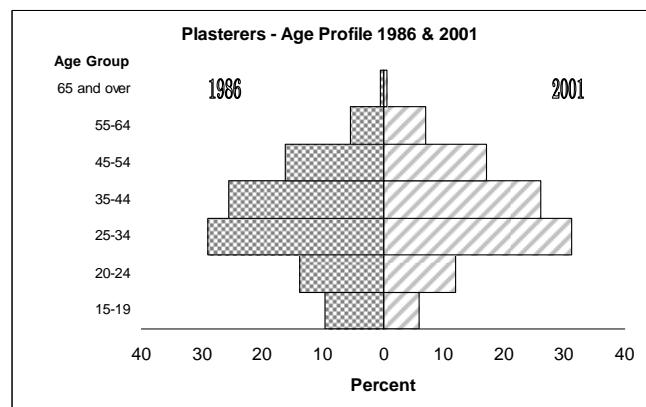
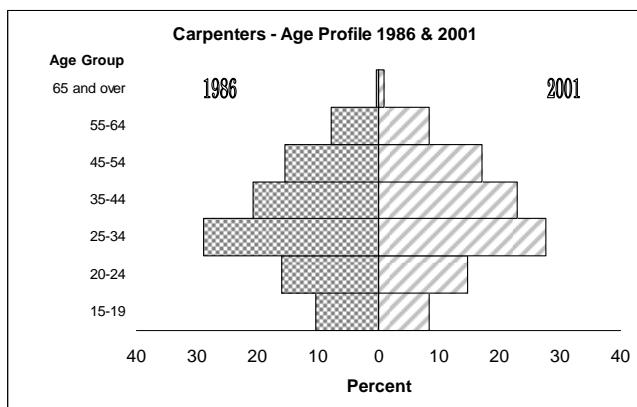
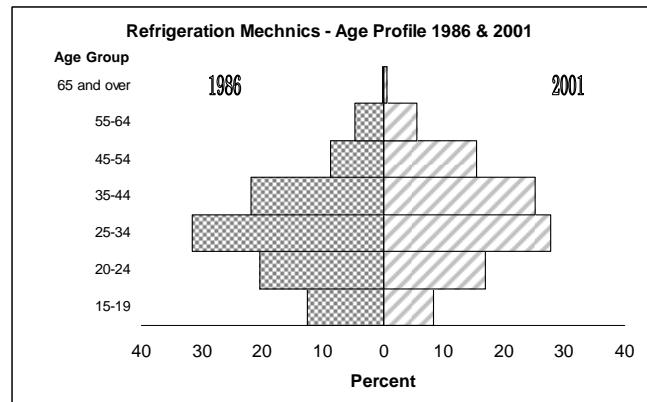
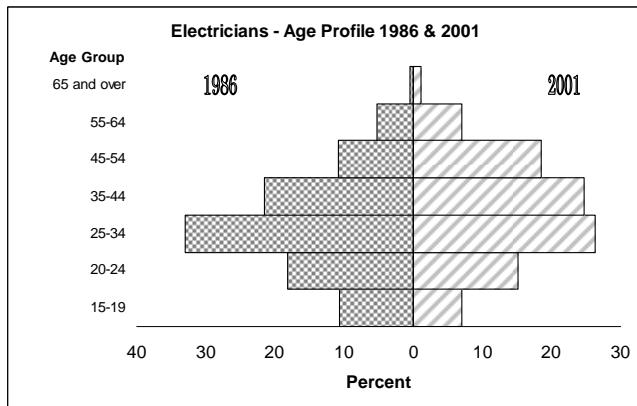
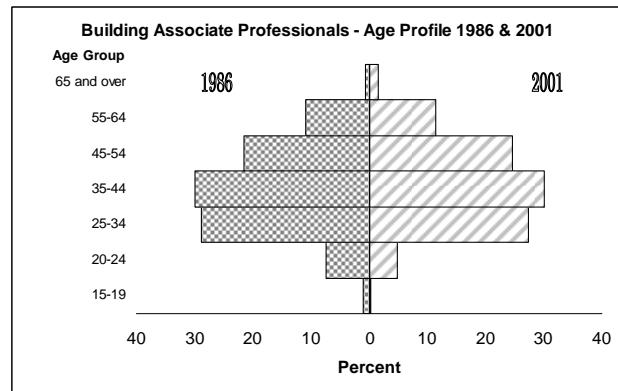
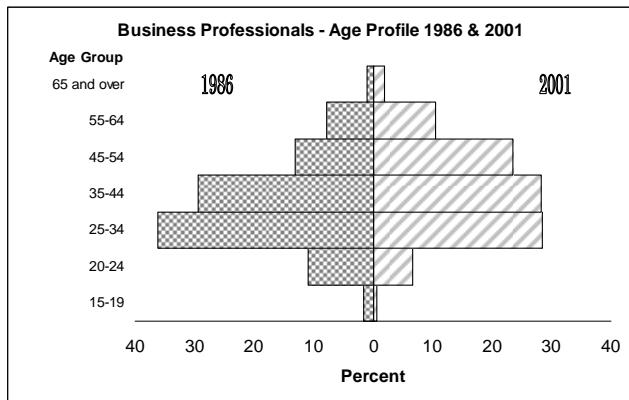
**Table 20.**

Occupation	Occupation Age Breakdown - 1986 and 2001 - NUMBER										
	15-34			35-44			45 and over			Total	
	1986	2001	Change	1986	2001	Change	1986	2001	Change	1986	2001
<b>Managers</b>	<b>10,337</b>	<b>12,491</b>	<b>2,154</b>	<b>13,437</b>	<b>17,942</b>	<b>4,505</b>	<b>14,613</b>	<b>26,383</b>	<b>11,770</b>	<b>38,387</b>	<b>56,816</b>
Building professionals & engineers nfd	174	395	221	124	216	92	128	333	205	426	944
Architects & landscape architects	424	303	-121	479	217	-262	299	295	-4	1,202	815
Civil engineers	1,876	1,396	-480	1,378	629	-749	954	993	39	4,208	3,018
Electrical & electronic engineers	264	241	-23	224	208	-16	203	225	22	691	674
Business professionals	1,014	2,222	1,208	611	1,751	1,140	456	2,225	1,769	2,081	6,198
Social professionals, Artists & Misc.	302	503	201	244	490	246	181	558	377	727	1,551
Other Professional	1,280	793	-487	902	545	-357	732	827	95	2,914	2,165
<b>Professionals</b>	<b>5,334</b>	<b>5,853</b>	<b>519</b>	<b>3,962</b>	<b>4,056</b>	<b>94</b>	<b>2,953</b>	<b>5,456</b>	<b>2,503</b>	<b>12,249</b>	<b>15,365</b>
Engineering & building associates nfd	447	386	-61	194	214	20	154	220	66	795	820
Building, arch. associates & tech.	3,548	5,328	1,780	2,853	4,960	2,107	3,137	6,186	3,049	9,538	16,474
Civil engineering associates & technicians	880	251	-629	454	220	-234	246	323	77	1,580	794
Electrical & electronic eng. Associates	582	375	-207	368	306	-62	268	307	39	1,218	988
Managing supervisors (sales & service)	331	691	360	489	940	451	385	1,322	937	1,205	2,953
Other Associate Professionals	1,320	2,086	766	1,024	1,975	951	1,149	2,404	1,255	3,493	6,465
<b>Associate Professionals</b>	<b>7,108</b>	<b>9,117</b>	<b>2,009</b>	<b>5,382</b>	<b>8,615</b>	<b>3,233</b>	<b>5,339</b>	<b>10,762</b>	<b>5,423</b>	<b>17,829</b>	<b>28,494</b>
Structural steel, boilermaking etc. trades	2,863	1,839	-1,024	1,437	1,276	-161	1,273	1,337	64	5,573	4,452
Sheet metal tradespersons	1,597	177	-1,420	652	117	-535	513	122	-391	2,762	416
Metal fitting & machining trades, etc.	2,366	1,755	-611	1,055	1,298	243	1,113	1,495	382	4,534	4,548
Vehicle tradespersons	983	701	-282	445	411	-34	420	513	93	1,848	1,625
Electrical fitters, Electrical mechanics	16,462	20,158	3,696	5,741	10,287	4,546	4,413	11,036	6,623	26,616	41,481
Refrigeration & air-conditioning mechanics	1,405	3,677	2,272	475	1,742	1,267	295	1,509	1,214	2,175	6,928
Communications equipment tradespersons	419	813	394	165	548	383	118	513	395	702	1,874
Electrical & electronics tradespersons nec	663	1,662	999	262	994	732	190	742	552	1,115	3,398
Carpenters and joiners	27,665	27,362	-303	10,406	12,331	1,925	11,941	14,297	2,356	50,012	53,990
Plasterers (all types)	6,055	9,244	3,189	2,949	4,912	1,963	2,538	4,671	2,133	11,542	18,827
Roof slaters and tilers	2,337	3,318	981	739	1,115	376	497	1,033	536	3,573	5,466
Bricklayers	9,829	7,406	-2,423	5,333	5,069	-264	4,892	6,434	1,542	20,054	18,909
Wall and floor tilers	2,093	4,607	2,514	1,406	2,910	1,504	1,207	3,217	2,010	4,706	10,734
Painters, decorators & signwriters	8,415	10,846	2,431	5,963	7,870	1,907	6,945	11,723	4,778	21,323	30,439
Floor coverers	1,554	2,499	945	800	1,368	568	510	1,471	961	2,864	5,338
Plumbers	17,586	18,984	1,398	7,395	9,674	2,279	6,584	11,132	4,548	31,565	39,790
Amenity horticultural tradespersons	2,854	6,165	3,311	957	2,539	1,582	642	2,001	1,359	4,453	10,705
Other Trades	2,094	4,994	2,900	1,060	2,447	1,387	1,260	2,597	1,337	4,414	10,038
<b>Trades</b>	<b>107,240</b>	<b>126,207</b>	<b>18,967</b>	<b>47,240</b>	<b>66,908</b>	<b>19,668</b>	<b>45,351</b>	<b>75,843</b>	<b>30,492</b>	<b>199,831</b>	<b>268,958</b>
Office secretaries & stenographers	5,395	4,230	-1,165	4,452	5,171	719	2,942	6,375	3,433	12,789	15,776
Other Clerical, Sales & Service	17,482	16,709	-773	11,217	14,890	3,673	9,358	17,660	8,302	38,057	49,258
<b>Clerical, Sales &amp; Service</b>	<b>22,877</b>	<b>20,939</b>	<b>-1,938</b>	<b>15,669</b>	<b>20,061</b>	<b>4,392</b>	<b>12,300</b>	<b>24,035</b>	<b>11,735</b>	<b>50,846</b>	<b>65,034</b>
Excavating & earthmoving plant operator	6,172	6,140	-32	4,713	6,402	1,689	3,659	8,360	4,701	14,544	20,902
Crane operators, Hoist, winch & lift operators	498	388	-110	569	538	-31	561	904	343	1,628	1,830
Road and rail transport drivers	3,214	1,962	-1,252	2,505	2,231	-274	2,734	3,641	907	8,453	7,834
Structural steel & related labourers	2,730	2,447	-283	1,453	1,875	422	897	1,461	564	5,080	5,783
Trades assistants & factory hands	7,168	10,227	3,059	1,580	4,551	2,971	1,342	4,306	2,964	10,090	19,084
Paving & surfacing labourers	1,904	1,219	-685	901	839	-62	1,323	1,127	-196	4,128	3,185
Concrete workers	5,514	7,452	1,938	3,234	4,469	1,235	3,726	4,611	885	12,474	16,532
Other Sub Trades & Labourers	22,180	17,074	-5,106	9,949	11,557	1,608	10,843	14,660	3,817	42,972	43,291
<b>Sub Trades &amp; Labourers</b>	<b>49,380</b>	<b>46,909</b>	<b>-2,471</b>	<b>24,904</b>	<b>32,462</b>	<b>7,558</b>	<b>25,085</b>	<b>39,070</b>	<b>13,985</b>	<b>99,369</b>	<b>118,441</b>
Other (Ind Descr, Not Stated, etc.)	2,711	1,587	-1,124	2,214	1,542	-672	2,723	2,349	-374	7,648	5,478
<b>Total</b>	<b>204,987</b>	<b>223,103</b>	<b>18,116</b>	<b>112,808</b>	<b>151,585</b>	<b>38,777</b>	<b>108,364</b>	<b>183,898</b>	<b>75,534</b>	<b>426,159</b>	<b>558,586</b>

**Table 21.**

Occupation	Occupation Age Breakdown - 1986 and 2001 - PERCENTAGES										
	15-34			35-44			45 and over			Total	
	1986	2001	Change	1986	2001	Change	1986	2001	Change	1986	2001
<b>Managers</b>	26.9%	22.0%	-4.9%	35.0%	31.6%	-3.4%	38.1%	46.4%	8.4%	100.0%	100.0%
Building professionals & engineers nfd	40.8%	41.8%	1.0%	29.1%	22.9%	-6.2%	30.0%	35.3%	5.2%	100.0%	100.0%
Architects & landscape architects	35.3%	37.2%	1.9%	39.9%	26.6%	-13.2%	24.9%	36.2%	11.3%	100.0%	100.0%
Civil engineers	44.6%	46.3%	1.7%	32.7%	20.8%	-11.9%	22.7%	32.9%	10.2%	100.0%	100.0%
Electrical & electronic engineers	38.2%	35.8%	-2.4%	32.4%	30.9%	-1.6%	29.4%	33.4%	4.0%	100.0%	100.0%
Business professionals	48.7%	35.9%	-12.9%	29.4%	28.3%	-1.1%	21.9%	35.9%	14.0%	100.0%	100.0%
Social professionals, Artists & Misc.	41.5%	32.4%	-9.1%	33.6%	31.6%	-2.0%	24.9%	36.0%	11.1%	100.0%	100.0%
Other Professional	43.9%	36.6%	-7.3%	31.0%	25.2%	-5.8%	25.1%	38.2%	13.1%	100.0%	100.0%
<b>Professionals</b>	43.5%	38.1%	-5.5%	32.3%	26.4%	-5.9%	24.1%	35.5%	11.4%	100.0%	100.0%
Engineering & building associates nfd	56.2%	47.1%	-9.2%	24.4%	26.1%	1.7%	19.4%	26.8%	7.5%	100.0%	100.0%
Building, arch. associates & tech.	37.2%	32.3%	-4.9%	29.9%	30.1%	0.2%	32.9%	37.6%	4.7%	100.0%	100.0%
Civil engineering associates & technicians	55.7%	31.6%	-24.1%	28.7%	27.7%	-1.0%	15.6%	40.7%	25.1%	100.0%	100.0%
Electrical & electronic eng. Associates	47.8%	38.0%	-9.8%	30.2%	31.0%	0.8%	22.0%	31.1%	9.1%	100.0%	100.0%
Managing supervisors (sales & service)	27.5%	23.4%	-4.1%	40.6%	31.8%	-8.7%	32.0%	44.8%	12.8%	100.0%	100.0%
Other Associate Professionals	37.8%	32.3%	-5.5%	29.3%	30.5%	1.2%	32.9%	37.2%	4.3%	100.0%	100.0%
<b>Associate Professionals</b>	39.9%	32.0%	-7.9%	30.2%	30.2%	0.0%	29.9%	37.8%	7.8%	100.0%	100.0%
Structural steel, boilermaking etc. trades	51.4%	41.3%	-10.1%	25.8%	28.7%	2.9%	22.8%	30.0%	7.2%	100.0%	100.0%
Sheet metal tradespersons	57.8%	42.5%	-15.3%	23.6%	28.1%	4.5%	18.6%	29.3%	10.8%	100.0%	100.0%
Metal fitting & machining trades, etc.	52.2%	38.6%	-13.6%	23.3%	28.5%	5.3%	24.5%	32.9%	8.3%	100.0%	100.0%
Vehicle tradespersons	53.2%	43.1%	-10.1%	24.1%	25.3%	1.2%	22.7%	31.6%	8.8%	100.0%	100.0%
Electrical fitters, Electrical mechanics	61.9%	48.6%	-13.3%	21.6%	24.8%	3.2%	16.6%	26.6%	10.0%	100.0%	100.0%
Refrigeration & air-conditioning mechanics	64.6%	53.1%	-11.5%	21.8%	25.1%	3.3%	13.6%	21.8%	8.2%	100.0%	100.0%
Communications equipment tradespersons	59.7%	43.4%	-16.3%	23.5%	29.2%	5.7%	16.8%	27.4%	10.6%	100.0%	100.0%
Electrical & electronics tradespersons nec	59.5%	48.9%	-10.6%	23.5%	29.3%	5.8%	17.0%	21.8%	4.8%	100.0%	100.0%
Carpenters and joiners	55.3%	50.7%	-4.6%	20.8%	22.8%	2.0%	23.9%	26.5%	2.6%	100.0%	100.0%
Plasterers (all types)	52.5%	49.1%	-3.4%	25.6%	26.1%	0.5%	22.0%	24.8%	2.8%	100.0%	100.0%
Roof slaters and tilers	65.4%	60.7%	-4.7%	20.7%	20.4%	-0.3%	13.9%	18.9%	5.0%	100.0%	100.0%
Bricklayers	49.0%	39.2%	-9.8%	26.6%	26.8%	0.2%	24.4%	34.0%	9.6%	100.0%	100.0%
Wall and floor tilers	44.5%	42.9%	-1.6%	29.9%	27.1%	-2.8%	25.6%	30.0%	4.3%	100.0%	100.0%
Painters, decorators & signwriters	39.5%	35.6%	-3.8%	28.0%	25.9%	-2.1%	32.6%	38.5%	5.9%	100.0%	100.0%
Floor coverers	54.3%	46.8%	-7.4%	27.9%	25.6%	-2.3%	17.8%	27.6%	9.7%	100.0%	100.0%
Plumbers	55.7%	47.7%	-8.0%	23.4%	24.3%	0.9%	20.9%	28.0%	7.1%	100.0%	100.0%
Amenity horticultural tradespersons	64.1%	57.6%	-6.5%	21.5%	23.7%	2.2%	14.4%	18.7%	4.3%	100.0%	100.0%
Other Trades	47.4%	49.8%	2.3%	24.0%	24.4%	0.4%	28.5%	25.9%	-2.7%	100.0%	100.0%
<b>Trades</b>	53.7%	46.9%	-6.7%	23.6%	24.9%	1.2%	22.7%	28.2%	5.5%	100.0%	100.0%
Office secretaries & stenographers	42.2%	26.8%	-15.4%	34.8%	32.8%	-2.0%	23.0%	40.4%	17.4%	100.0%	100.0%
Other Clerical, Sales & Service	45.9%	33.9%	-12.0%	29.5%	30.2%	0.8%	24.6%	35.9%	11.3%	100.0%	100.0%
<b>Clerical, Sales &amp; Service</b>	45.0%	32.2%	-12.8%	30.8%	30.8%	0.0%	24.2%	37.0%	12.8%	100.0%	100.0%
Excavating & earthmoving plant operator	42.4%	29.4%	-13.1%	32.4%	30.6%	-1.8%	25.2%	40.0%	14.8%	100.0%	100.0%
Crane operators, Hoist, winch & lift operators	30.6%	21.2%	-9.4%	35.0%	29.4%	-5.6%	34.5%	49.4%	14.9%	100.0%	100.0%
Road and rail transport drivers	38.0%	25.0%	-13.0%	29.6%	28.5%	-1.2%	32.3%	46.5%	14.1%	100.0%	100.0%
Structural steel & related labourers	53.7%	42.3%	-11.4%	28.6%	32.4%	3.8%	17.7%	25.3%	7.6%	100.0%	100.0%
Trades assistants & factory hands	71.0%	53.6%	-17.5%	15.7%	23.8%	8.2%	13.3%	22.6%	9.3%	100.0%	100.0%
Paving & surfacing labourers	46.1%	38.3%	-7.9%	21.8%	26.3%	4.5%	32.0%	35.4%	3.3%	100.0%	100.0%
Concrete workers	44.2%	45.1%	0.9%	25.9%	27.0%	1.1%	29.9%	27.9%	-2.0%	100.0%	100.0%
Other Sub Trades & Labourers	51.6%	39.4%	-12.2%	23.2%	26.7%	3.5%	25.2%	33.9%	8.6%	100.0%	100.0%
<b>Sub Trades &amp; Labourers</b>	49.7%	39.6%	-10.1%	25.1%	27.4%	2.3%	25.2%	33.0%	7.7%	100.0%	100.0%
Other (Inad Descr, Not Stated, etc.)	35.4%	29.0%	-6.5%	28.9%	28.1%	-0.8%	35.6%	42.9%	7.3%	100.0%	100.0%
<b>Total</b>	48.1%	39.9%	-8.2%	26.5%	27.1%	0.7%	25.4%	32.9%	7.5%	100.0%	100.0%

## Age Profile charts for Key Construction Industry Occupations – 1986 and 2001



## Age Profile charts for Key Construction Industry Occupations – 1986 and 2001 (Cont'd)

