MANAGEMENT AND ECONOMICS OF CONSTRUCTION SAFETY IN HONG KONG

S.W. Poon
S. L. Tang
Francis K. W. Wong

香港大學出版社
HONG KONG UNIVERSITY PRESS

Hong Kong University Press
14/F Hing Wai Centre
7 Tin Wan Praya Road
Aberdeen
Hong Kong

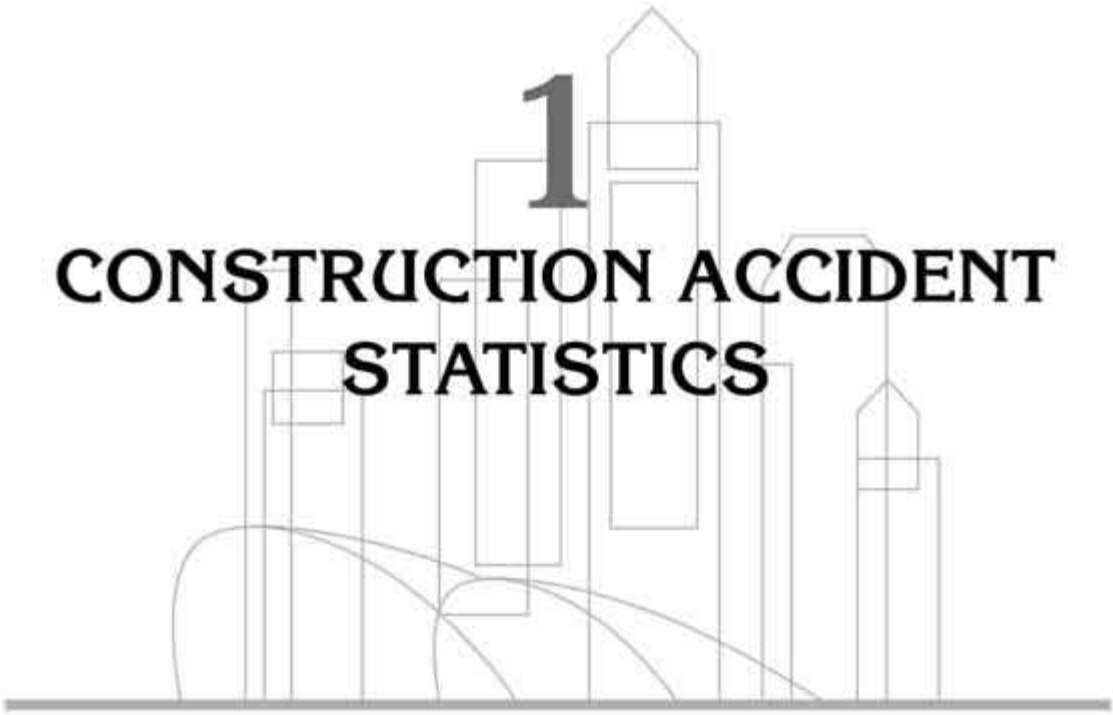
ISBN 978-962-209-906-7

British Library Cataloguing-in-Publication Data
A catalogue record for this book is available from the British Library.

Secure On-line Ordering
http://www.hkupress.org

Printed and bound by Colorprint Production Ltd., Hong Kong, China

CONTENTS



1 CONSTRUCTION ACCIDENT STATISTICS

1 Introduction

This chapter presents the construction accident statistics of Japan, South Korea, Singapore, Taiwan and the Hong Kong Special Administrative Region from the mid-1990s to the mid-2000s. Data from relevant organizations' reports have been extracted for study. Reference will also be made to the data from the UK.

2 Construction accidents in five Asian countries or regions

The construction accident statistics recorded since 1997 in Hong Kong are reviewed with those available in the region including Japan, South Korea, Singapore and Taiwan. These countries or regions have been chosen because of their close vicinity and their comparable performance in economy (Table 1). Some of them have provided only basic data while others have included more details. In many cases, the statistics have been interpreted indirectly such as by backward calculation, and their correctness rests entirely with the authors. As far as possible, the original terms and descriptions will be retained when quoted. Finally the overall data will be compared with those

available in the UK where the construction industry can be regarded as a developed and mature one.

Table 1 Estimated population and nominal GDP per capita.

Country/ Region	Estimated population in 2006/07 (million)	Nominal GDP in 2007 (US$ per capita)
Japan	127.8	40,044
South Korea	48.2	16,797
Singapore	4.7	29,475
Taiwan	23.0	16,243
Hong Kong	7.0	29,296
UK	60.6	40,674

Source: www.en.wikipedia.org/wiki

2.1 Japan

2.1.1 Definition

According to reports published by the Japan Construction Occupational Safety and Health Association, Japan had a total of 5.6 million construction workers in 2006, representing about 12% of the entire industrial workforce of 63.8 million people. With 26,872 accidents and 308 fatalities recorded, the construction industry accounted for 22% of all industrial accidents and 35% of fatal cases.

The accident rate per 1,000 workers is calculated as the number of casualties per 1,000 workers in a year, involving four days of absence or longer. The number of accidents in the construction industry and in all industries during the 10-year period 1997–2006 is shown in Table 2.

Table 2 Accident rates in Japan 1997–2006.

	1997	1998	1999	2000	2001
Construction industry	41,688 (0.266)	38,117 (0.257)	35,310 (0.257)	33,599 (0.251)	32,608 (0.244)
All industries	156,726	148,248	137,316	133,948	133,598

	2002	2003	2004	2005	2006
Construction industry	30,650 (0.243)	29,263 (0.233)	28,414 (0.231)	27,193 (0.226)	26,872 (0.221)
All industries	125,918	125,750	122,804	120,354	121,378

Source: Statistics of occupational accidents in the construction industry 2007, Japan Construction Occupational Safety and Health Association (www.kensaibou.or.jp)

In Table 2, the figures in brackets represent the ratio of number of accidents in the construction industry to number of accidents in all industries. This ratio has declined slightly yet steadily from 0.266 in 1997 to 0.221 in 2006.

Besides depicting the accident rate per 1,000 workers, the frequency of accidents is also presented as the number of workers killed or injured by accidents per million working hours. The figure is calculated by dividing the number of casualties (multiplied by 1,000,000) in accidents that have occurred during the statistical period by the total number of working hours of all workers exposed to danger in the same period. The formula is shown below.

$$\text{Frequency} = \frac{\text{Number of casualties}}{\text{Total No. of working hours}} \times 1{,}000{,}000$$

Table 3 shows the frequency of accidents per million working hours. A big drop has been registered in the construction industry in 2005, and the figure indicates a slightly upward trend in the recent few years. The figure for all industries, on the other hand, has relatively small fluctuations during the 10-year period.

Table 3 Frequency of accidents per million working hours in Japan 1997–2006.

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Construction industry	1.11	1.32	1.44	1.10	1.61	1.04	1.60	1.77	0.97	1.55
All industries	1.78	1.72	1.80	1.82	1.79	1.77	1.78	1.85	1.95	1.90

Source: Statistics of occupational accidents in the construction industry 2007, Japan Construction Occupational Safety and Health Association (www.kensaibou.or.jp)

Serious accidents have also been on the decline in Japan. By definition, serious accidents are those involving death, injury or disease affecting three or more workers while working on a single occasion.

The severity rate is represented by the number of lost working days per 1,000 working hours. The figure is determined by dividing the number of lost working days (multiplied by 1,000) during the statistical period by the total number of working hours of all workers exposed to danger in the same period. The formula is as follows:

$$\text{Severity rate} = \frac{\text{Number of lost working days}}{\text{Total number of working hours}} \times 1{,}000$$

The lost working days for death cases is taken as 7,500 days. If disability is involved it will be assessed based on the degree of disability as shown below.

Table 4 Degree of disability and lost working days.

Degree of disability	1–3	4	5	6	7	8
Lost working days	7,500	5,500	4,000	3,000	2,200	1,500

Degree of disability	9	10	11	12	13	14
Lost working days	1,000	600	400	200	100	50

Source: Statistics of occupational accidents in the construction industry 2007, Japan Construction Occupational Safety and Health Association (www.kensaibou.or.jp)

In case of injuries involving no disability, the following formula is used:

Working days lost = No. of days absent from work × (300/365)

Table 5 illustrates the severity rate of construction accidents and of all industries in Japan between 1997 and 2006. The severity rate for the construction industry in 2005 was significantly reduced. Comparing the rates in the construction industry with the rates in all industries, the construction industry is indeed more hazardous.

Table 5 Severity rates of accidents in Japan 1997–2006.

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Construction Industry	0.37	0.39	0.30	0.70	0.47	0.28	0.25	0.57	0.14	0.37
All industries	0.16	0.14	0.14	0.18	0.18	0.12	0.12	0.12	0.12	0.12

Source: Statistics of occupational accidents in the construction industry 2007, Japan Construction Occupational Safety and Health Association (www.kensaibou.or.jp)

2.1.2 Accident rates and death rates 1997–2006

Table 6 presents a summary of accident rates and death rates in Japan's construction industry for the period 1997 to 2006. The number of accidents per 1,000 workers has dropped consistently, and the accident rate per million working hours has also shown a downward trend albeit with certain fluctuations. The death rate has fluctuated between 0.19 and 0.13 person per 1,000 workers.

Table 6 Construction accidents and deaths in Japan's construction industry 1997–2006.

	1997	1998	1999	2000	2001
Number of labour accidents	41,688	38,117	35,310	33,599	32,608
Number of deaths	848	725	794	731	644
Number of workers (10,000)	563	548	544	533*	526*
No. of accidents per 1,000 workers	6.7	6.3	6.5	6.3	6.2
Accidents per million working hours	1.11	1.32	1.44	1.1	1.61
Number of deaths per 10,000 workers	1.5	1.3	1.5	1.8	1.9

	2002	2003	2004	2005	2006
Number of labour accidents	30,650	29,263	28,414	27,193	26,872
Number of deaths	607	548	594	497	508
Number of workers (10,000)	503*	488*	498*	n/a	n/a
No. of accidents per 1,000 workers	6.1	6.0	6.0	5.8	n/a
Accidents per million working hours	1.04	1.61	n/a	n/a	n/a
Number of deaths per 10,000 workers	1.8	1.5	1.3	n/a	n/a

Source: Statistics of occupational accidents in the construction industry 2007, Japan Construction Occupational Safety and Health Association (www.kensaibou.or.jp)

* estimates

n/a not available

2.1.3 Categorization of occurrence of accident deaths in construction

Table 7 categorises the occurrence of deaths in construction in Japan in 1997, 2003 and 2006. The frequency of the various causes for fatalities has remained about the same. Fall from height has ranked the most severe cause with about 40% of all fatal cases. Other important causes are mainly due to hazards arising from crushing by moving objects or materials such as automobiles, machines, flying or falling objects and soils. The risks leading to fatalities

also include collapse of temporary works and contact with electricity, which are characteristic of construction sites.

Table 7 Categorization of occurrence of accident deaths in Japan's construction industry 1997, 2003 and 2006.

Category	Number in 1997	Rank in 1997	Number in 2003	Rank in 2003	Number in 2006	Rank in 2006
Fall from height	359 (42.3%)	1	236 (43.1%)	1	190 (37.4%)	1
Construction machinery, etc.	127 (15.0%)	2	76 (13.9%)	2	70 (13.8%)	2
Automobiles, etc.	117 (13.8%)	3	75 (13.7%)	3	67 (13.2%)	3
Flying and falling objects	56 (6.6%)	4	26 (4.7%)	6	35 (6.9%)	4
Collapsing of soil	35 (4.1%)	5	32 (5.8%)	4	20 (3.9%)	6
Construction of temporary works and facilities	30 (3.5%)	6	31 (5.7%)	5	30 (5.9%)	5
Electricity	26 (3.1%)	7	4 (0.7%)	7	4 (0.8%)	7
Others	92 (11.4%)		68 (12.4%)		90 (17.7%)	
Total	848 (100%)		548 (100%)		508 (100%)	
No. of deaths per 10,000 employees/ workers	1.3		1.3		n/a	

n/a not available

Source: Statistics of occupational accidents in the construction industry 2007, Japan Construction Occupational Safety and Health Association (www.kensaibou.or.jp)

2.2 South Korea

2.2.1 Definition

In 2005 the total number of construction workers in South Korea was slightly in excess of 2.1 million, and 15,918 accidents and 609 fatalities were recorded, representing 18.6% of accidents and 24.4% of fatalities of all industries respectively. In South Korea an accident is defined as an event which causes an injury to a worker who requires more than 3 days absence from work.

2.2.2 Accident rates and death rates 1996–2005

According to reports of the Korea Occupational Safety and Health Agency (KOSHA), the number of accidents and deaths in construction is shown in the following table.

Table 8 Construction accidents and deaths in South Korea 1996–2005.

	1996	1997	1998	1999	2000
Number of labour accidents	19,762	18,291	13,172	10,955	13,359*
Number of deaths	789	798	650	583	614
Number of workers (10,000)	245	254	179	181	219*
No. of accidents per 1,000 workers	8.1	7.2	7.3	6.0	6.1
Number of deaths per 10,000 workers	3.2	3.1	3.6	3.2	2.8

	2001	2002	2003	2004	2005
Number of labour accidents	16,771	19,925	22,680	18,896	15,918
Number of deaths	659	667	762	779	609
Number of workers (10,000)	244	277	263	201	213
No. of accidents per 1,000 workers	6.9	7.2	8.6	9.4	7.5
Number of deaths per 10,000 workers	2.7	2.4	2.9	3.9	2.9

Source: Statistics on industrial accidents and occupational diseases, Korea Occupational Safety and Health agency (www.kosha.or.kr); Lee, 2000; Lee, 2005; Jung, 2005; Kim, 2003

* estimates

Construction accidents and deaths were at the lowest in 1999, which were due to the shrinkage in construction activities following the economic and financial crisis in 1997. With the gradual recovery of the economy, the figures have gone up in the 2000s. It should be noted that the death rate was reduced from 0.38 in 1994 to 0.24 in 2002 but rose again since 2003.

2.2.3 Categorization of occurrence of accident victims and deaths in construction

The following table categorizes the occurrence of accident victims and deaths in 2003. The number of deaths due to fall from height is more than half of all fatal cases. The other causes are similar to those in Japan, with

the exception that occupational disease is included here and is the second major cause for death.

Table 9 Categorization of occurrence of accident victims and deaths in South Korea's construction industry 2003.

Category	Accidents in 2003	Ranking	Deaths in 2003	Ranking
Dropping/Fall from height	7,117 (31.4%)	1	386 (50.6%)	1
Turnover	3,928 (17.3%)	2	20 (2.6%)	5
Falling and flying objects	3,421 (15.1%)	3	48 (6.3%)	3
Caught in	2,597 (11.5%)	4	16 (2.1%)	6
Collision	2,506 (11.0%)	5	13 (1.7%)	7
Collapse and destruction	442 (1.9%)	6	47 (6.2%)	4
Occupational disease	398 (1.7%)	7	124 (16.3%)	2
Electric shock	291 (1.3%)	8	47 (6.2%)	4
Others	1,981 (8.8%)		61 (8.0%)	
Total	22,680 (100%)		762 (100%)	
No. of accidents per 1,000 workers/No. of deaths per 10,000 workers	8.6		2.9	

Source: Lee, 2005

2.3 Singapore

2.3.1 Definition

In 2006, Singapore had a total of about 254,500 workers employed in the construction sector, roughly 10% of the nation's labour force. A total of 2,415 persons were injured or killed in construction accidents.

In Singapore, an accident is one which causes loss of life to a person, or disables a person from work for more than 3 days, or causes an injury to a person resulting in the person being detained in a hospital for at least 24 hours for observation or treatment.

The frequency rate is defined by the following formula:

$$\text{Frequency rate} = \frac{\text{Total number of accidents}}{\text{Total number of manhours worked}} \times 1{,}000{,}000$$

The frequency rates in the construction, shipbuilding and repairing, and other factories are shown in the table below.

Table 10 Accident frequency rates per million manhours in Singapore 1997–2006.

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Construction	3.0	2.7	2.8	2.6	2.8	2.8	2.7	3.0	3.0	3.5
Shipbuilding and repairing	7.3	6.1	5.1	3.8	4.1	3.1	3.4	3.0	2.8	2.2
Other factories	2.1	2.0	2.0	1.8	1.9	1.7	1.7	1.8	1.6	1.3
All industries	2.6	2.5	2.4	2.1	2.3	2.2	2.2	2.2	2.1	1.9

Source: Annual Report 2006, Occupational Safety and Health Division, Ministry of Manpower, Singapore (www.mom.gov.sg)

In the period 1997–2006, the accident frequency rate was worst in shipbuilding and repairing, but significant improvement can be seen in the last five years. The construction industry ranked second in terms of accident frequency rate, but relatively little progress has been achieved throughout the period.

As in Japan, Singapore has also tabulated the severity rate though the components are not exactly the same.

$$\text{Severity rate} = \frac{\text{Total mandays lost}}{\text{Total number of manhours worked}} \times 1{,}000{,}000$$

Table 11 Severity rates in Singapore 1997–2006.

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Construction	968	846	647	654	405	553	510	536	403	272
Shipbuilding and repairing	840	708	680	552	724	394	454	830	173	257
Other factories	196	141	131	176	129	156	163	183	161	86
All industries	466	416	317	349	256	299	288	340	227	125

Source: Annual Report 2006, Occupational Safety and Health Division, Ministry of Manpower, Singapore (www.mom.gov.sg)

According to Table 11, the severity rate in construction peaked in 1997 and dropped since then to its lowest in 2006. A very significant drop has been

recorded in the shipbuilding and repairing industry in 2005. In Singapore the accidents are further classified into three categories according to the degree of injury, i.e., temporary disablement, permanent disablement and fatal cases, as illustrated in Table 12.

Table 12 Categorization of construction accidents in Singapore 1997–2006.

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006*
Temporary disablement	1,417	1,414	1,412	1,309	1,404	1,273	1,133	1,173	1,258	2,364
Permanent disablement	49	51	44	37	24	26	29	19	20	27
Fatal cases	72	67	48	49	27	38	31	24	22	24
Fatal no.	72	73	51	52	28	39	32	30	24	24
Total	1,538	1,532	1,504	1,395	1,455	1,337	1,193	1,216	1,300	2,415

* The figures are victim-based

Source: Annual Report 2006, Occupational Safety and Health Division, Ministry of Manpower, Singapore (www.mom.gov.sg)

2.3.2 Accident rates and death rates 1997–2006

Table 13 shows the accident rates per 1,000 workers and per million working hours, and deaths per 1,000 workers in Singapore between 1997 and 2006.

Table 13 Construction accidents and deaths in Singapore 1997–2006.

	1997	1998	1999	2000	2001
Number of labour accidents	1,538	1,532	1,504	1,395	1,455
Number of deaths/death cases	72/72	73/67	51/48	52/49	28/27
Number of workers (10,000)	21.4	21.3	19.7	20.0	18.4
Accidents per 1,000 workers	7.2	7.2	7.6	7.0	7.9
Accidents per million working hours	3.0	2.7	2.8	2.6	2.8
Number of deaths per 10,000 workers	3.4/3.4	3.4/3.1	2.6/2.4	2.6/2.5	1.5/1.5

	2002	2003	2004	2005	2006
Number of labour accidents	1,337	1,193	1,216	1,300	2,415*
Number of deaths/death cases	39/38	32/31	30/24	24/22	24/24
Number of workers (10,000)	17.2	15.6	14.8	18.4	25.5
Accidents per 1,000 workers	7.8	7.6	8.2	7.1	9.5*
Accidents per million working hours	2.8	2.7	3.0	3.0	3.5
Number of deaths/death cases per 10,000 workers	2.3/2.2	2.1/2.0	2.0/1.6	1.3/1.2	0.9/0.9

Source: Annual Report 2006, Occupational Safety and Health Division, Ministry of Manpower, Singapore (www.mom.gov.sg)

* The figures are victim-based

The two accident rates have shown little or no improvement over the period, however, the death rate has been reduced substantially since 1999.

2.3.3 Categorization of occurrence of accident deaths in construction

Table 14 categorizes the occurrence of accident deaths in 1998 and 2006. In both years, deaths caused by fall from height have accounted for more than half of all construction accident deaths, while cases due to struck by falling objects rank second.

Table 14 Categorization of occurrence of accident deaths in 1998 and 2006 in Singapore's construction industry.

Category	Number in 1998	Rank in 1998	Number in 2006	Rank in 2006
Fall from height	34 (50.7%)	1	15 (62.5%)	1
Struck by falling objects	14 (20.9%)	2	5 (20.8%)	2
Step on/strike against object	9 (13.4%)	3	1 (4.2%)	4
Electrocution	4 (6.0%)	4	-	-
Caught in or between objects	-	-	2 (8.3%)	3
Others	6 (9.0%)	-	1 (4.2%)	-
Total	67 (100%)	-	24 (100%)	-
Deaths per 10,000 workers	3.4		0.9	

Source: Annual Report 2006, Occupational Safety and Health Division, Ministry of Manpower, Singapore (www.mom.gov.sg)

2.4 Taiwan

2.4.1 Definition

In 2006, the number of construction workers in Taiwan was around 830,000 which was about 8% of the total workforce. However, the fatality and accident rates were about three times of those for all industries (see Table 15).

Table 15 Fatality rates per 1,000 workers in Taiwan 1999–2006.

	1999	2000	2001	2002	2003	2004	2005	2006
Construction	0.203	0.223	0.210	0.188	0.175	0.131	0.172	0.161
Manufacturing	0.078	0.063	0.067	0.059	0.041	0.030	0.038	0.035
Mining and Quarrying	0.729	0.517	-	0.489	0.524	0.356	0.190	0.198
All industries	0.085	0.077	0.069	0.065	0.055	0.044	0.045	0.038

Source: Statistics of occupational injuries, Industrial Safety and Health Association of Taiwan (www.isha.org.tw)

The accident rate used in Taiwan refers to absence of workers from work for 3 days or more due to any disease, injury, disabilities or death caused by building structures, equipment, raw materials, etc. in the place of employment, or as a result of the performance of duty or other occupational causes. The rate of injury or illness, disability and death is shown in Table 16.

Table 16 Rates of injury, disability and death per 1,000 workers in Taiwan 1999–2006.

	1999	2000	2001	2002	2003	2004	2005	2006
Injury or illness	10.33	12.14	12.30	11.79	12.13	12.57	12.03	12.51
Disability	0.96	1.03	1.07	1.02	0.84	0.81	0.77	0.72
Death	0.20	0.22	0.21	0.19	0.18	0.18	0.17	0.16
Total in construction	11.5	13.4	13.6	13.0	13.1	13.5	13.0	13.4
Total for all industries	4.4	5.0	4.9	4.7	4.6	4.6	4.4	4.5

Source: Statistics of occupational injuries, Industrial Safety and Health Association of Taiwan (www.isha.org.tw)

2.4.2 Accident rates and death rates 1994–2005

Based on the reports of the Industrial Safety and Health Association of Taiwan (ISHA), information relevant to construction accidents in Taiwan is compiled

in the table below. The accident rate has remained at a high level since 1995. Over the years the death rate has been around 2 workers per 10,000 workers, and in 2004 a remarkably improved death rate of 1.3 was recorded.

Table 17 Construction accidents and deaths in Taiwan's construction industry 1994–2005.

	1994	1995	1996	1997	1998	1999
Number of labour accidents	5,230*	4,734	4,962	5,531	6,750	8,257
Number of deaths	186	176	160	188	183	146
Number of site workers (10,000)	88.66	84.54	75.66	72.47	72.08	71.08
Number of accidents per 1,000 workers (injury + disability + death)	5.9	5.6	6.6	7.6	9.4	11.5
Number of deaths per 10,000 workers	2.1	2.1	2.1	2.6	2.5	2.0

	2000	2001	2002	2003	2004	2005
Number of labour accidents	n/a	n/a	n/a	n/a	n/a	n/a
Number of deaths	n/a	n/a	n/a	n/a	n/a	n/a
Number of site workers (10,000)	n/a	n/a	n/a	n/a	72*	n/a
Number of accidents per 1,000 workers (injury + disability + death)	13.4	13.6	13.0	13.1	12.6	13.0
Number of deaths per 10,000 workers	2.2	2.1	1.9	1.8	1.3	1.7

Source: Statistics of occupational injuries, Industrial Safety and Health Association of Taiwan (www.isha.org.tw)

* estimates

n/a not available

2.4.3 Categorization of occurrence of accident deaths in construction

Table 18 depicts the ranking of causes of accident deaths in 1998 and 1999 in Taiwan, and the results are quite similar for both years. Fall from height has ranked top of the list with a frequency below 40%. Taiwan has also recorded the highest number of deaths due to contact with electricity.

Table 18 Categorization of occurrence of accident deaths in Taiwan's construction industry 1998 and 1999.

Category	Deaths in 1998	Rank in 1998	Deaths in 1999	Rank in 1999
Falling from height	65 (34.5%)	1	54 (37.2%)	1
Electrical accident	33 (17.4%)	2	18 (12.4%)	2
Collapsing, cave-in	17 (9.0%)	3	11 (9.4%)	3
Flying and falling objects	16 (8.5%)	4	3 (6.3%)	4
Crashed	14 (7.4%)	5	12 (3.7%)	6
Tumble	4 (2.1%)	6	4 (4.7%)	5
Others	39 (20.7%)	-	44 (30.1%)	-
Total	188 (100%)		146 (100%)	
Death rates per 10,000 workers	2.5		2.0	

Source: Yu, 2000

2.5 Hong Kong Special Administrative Region

2.5.1 Definition

In 2006 the number of construction workers in Hong Kong was reduced to around 52,900 compared to the peak of 81,000 in 1997 due to prolonged stagnant construction activities. Likewise, the total number of workers for all industries shrank to 549,100 from 787,000 in 1995. Continuing the downward trend, the accident rate in 2006 went down to 64 per 1,000 workers, accounting for 20% of all industrial accidents. However, 62% of all fatal accidents happened on construction sites.

In Hong Kong an accident in an industrial undertaking is one which results in the death of a person, serious bodily injury to a person or the incapacity for a period exceeding 3 days immediately following the accident of a person, and must be reported to the Commissioner of Labour in accordance with the Factories and Industrial Undertakings Ordinance.

The accident rate per 1,000 workers in the construction industry is calculated by:

$$\frac{\text{Number of all industrial accidents in the construction industry}}{\text{Total number of manual workers at construction sites}} \times 1{,}000$$

(Occupational Safety and Health Statistics 2006, published by Occupational Safety and Health Branch, Labour Department, October 2007)

The number of manual workers refers to the data published in the Quarterly Report of Employment and Vacancies Statistics of the Census and Statistics Department. The figure does not include workers engaged in the construction of village-type houses in the New Territories, minor alterations, repairs, maintenance and interior decoration of existing buildings.

Cheung (2005) has pointed out that the safety performance of public sector sites is much better than that of the private sector ones (Table 19).

Table 19 Accident rates per 1,000 workers on public/private sector sites.

	2000	2001	2002	2003	2004
Public sector sites	81.7	68.9	53.6	40.4	29.4
Private sector sites	233.7	154.0	107.5	89.0	83.7

Source: Cheung, 2005

In Table 19, the accident rates on public sector sites were less than half of those on private sector sites. There have been many new safety systems undertaken by the stakeholders such as safety management and the pay for safety scheme. Contractors responsible for public sector sites are normally large organisations which have the resources to run these systems. Thus, safety performance would be better on public sector sites.

2.5.2 Accident rates and death rates 1998–2007

The statistics for the period 1998–2007 (Table 20) have revealed a great improvement in site safety. The number of accidents reached the maximum of over 19,000 cases in 1998, and the peak accident rate was recorded in the early 1990s with over 300 accidents per 1,000 workers per year. The rate has gradually decreased, and the figure of 60 per 1,000 was recorded in 2004 and 2005. The death rate has also improved from almost 10 workers per 10,000 in the early 1990s to between 3 and 4 since 2000. The improvement can be attributed to recent measures on mandatory training for site workers and implementation of new self-regulated legislation such as site safety supervision plan and safety management. Subject to verification, the improvement was also due to fewer activities in construction during the last six years or so. A more recent means to further improve site safety is the clients' or developers' initiative in implementing the "payment for safety scheme" (Lau, 2006).

Table 20 Construction accidents and deaths in Hong Kong 1998–2007.

	1998	1999	2000	2001	2002
Number of labour accidents	19,588	14,078	11,925	9,206	6,239
Number of deaths	56	47	29	28	24
Number of workers on sites (10,000)	7.90	7.09	7.96	8.03	7.32
Number of accidents per 1,000 construction workers	247.9	198.4	149.8	114.6	85.2
Number of accidents per 1,000 workers of all industries	64.7	55.1	51.7	44.6	37.4
Number of deaths per 10,000 construction workers	7.1	6.6	3.6	3.5	3.3
Number of deaths per 10,000 workers of all industries	1.02	0.80	0.66	0.53	0.42

	2003	2004	2005	2006	2007
Number of labour accidents	4,367	3,833	3,548	3,400	3,042
Number of deaths	25	17	25	16	19
Number of workers on sites (10,000)	6.41	6.35	5.93	5.29	5.02*
Number of accidents per 1,000 construction workers	68.1	60.3	59.9	64.3	60.6
Number of accidents per 1,000 workers of all industries	31.3	31.5	30.6	31.5	29.3
Number of deaths per 10,000 construction workers	3.9	2.7	4.2	3.0	3.8*
Number of deaths per 10,000 workers of all industries	0.51	0.43	0.53	0.47	0.46*

* estimates

Sources: Occupational safety and health statistics 2006 and 2007, Occupational Safety and Health Branch, Labour Department (www.labour.gov.hk); Cheung, 2005

Construction site safety is one of the contractual obligations of the contractor who has to allow for the cost of meeting the obligation in the tender. However, such allowance is normally not separated or identified in the tender rates. As an incentive to the contractor, a schedule of specified safety-related items can be included in the Bills of Quantities so that these items can be certified and paid to the contractor if the specified activities have been satisfactorily performed. Such an incentive scheme has been promulgated by the government in late 1990 and some developers also provide similar schemes to the contractors of their projects. The impact of implementing such a scheme is yet to be investigated.

In the private sector, the Real Estate Developers Association of Hong Kong (REDA) and the Hong Kong Construction Association (HKCA) have in 2005 introduced a similar scheme which is adopted voluntarily by developers to show their will of providing continuous improvement in safety performance. The developer employs a representative, e.g., Project Architect/ Engineer, or resident professional staff to implement the scheme. The contractor will enter into a construction contract and records of progress in safety performance to benchmark industry index are kept.

Upon certification by the developer's representative on contractor's satisfactory completion of the safety related items, the contractor will be paid at the pre-determined rates and prices set out in the schedule of rates for site safety (0.5 – 2% of the contract sum).

While the effect of implementing the scheme is yet to be assessed, in October 2005, 17 core developers participated in PFSS and in July 2006, 24 projects have been enrolled in the scheme. Table 21 shows the year of implementing various safety measures.

Table 21 Safety measures and year of implementation.

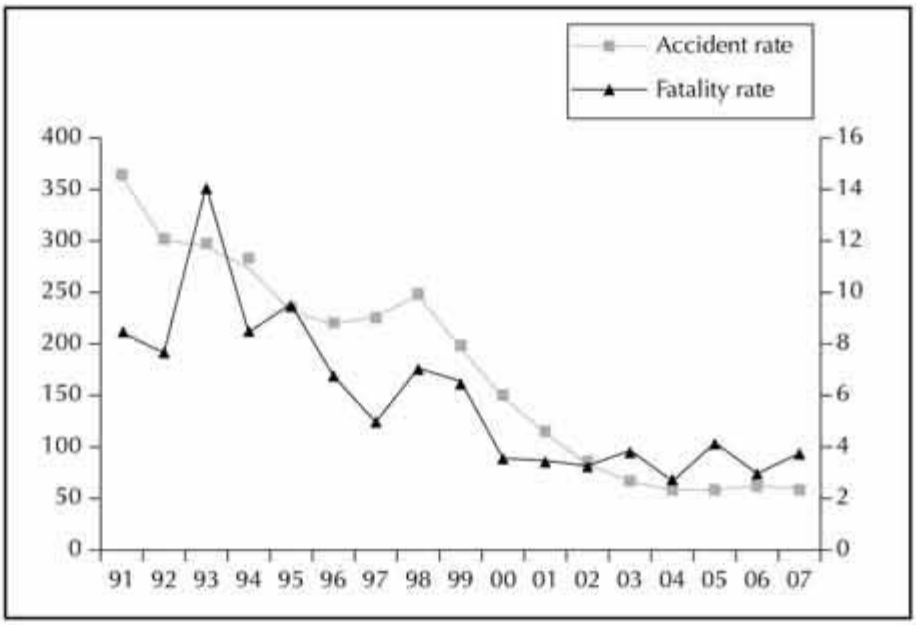
Year of Implementation (Accumulated No.)	Abbreviation	Safety Measures
1991 (1)	PASS1	Performance Assessment Scoring System
1994 (4)	PFSS	Pay for Safety Scheme
1994 (4)	PASS2	Performance Assessment Scoring System
1994 (4)	SP	Safety Plan
1995 (5)	CPOSR	Consulting Paper on Self-Regulatory SMS
1996 (6)	GCS	Green Card Scheme: Mandatory Safety Training Programme
1997 (9)	CSR	Construction Sites (Safety) Regulations
1997 (9)	FIUR1	Factories & Industrial Undertakings Regulations
1997 (9)	OSHO	Occupational Safety & Health Ordinance Cap 509
1998 (12)	CSSMH	Construction Site Safety Manual & Handbook
1998 (12)	SSPS	Site Supervision Plan System
1998 (12)	OSHR	Occupational Safety & Health Regulation
1999 (13)	FIUO2	Factories & Industrial Undertakings (Amendment) Ordinance

2000 (16)	PASS3	Performance Assessment Scoring System (Revised to include PFSS Provision)
2000 (16)	CPIS	Contractor Performance Index System (The scorecard system)
2000 (16)	CPSSS	Code of Practice for Site Safety Supervision
2001 (17)	ASTS	Automatic Suspension from tendering System
2002 (20)	SSC	Site Safety Cycle
2002 (20)	FIUR2	Factories & Industrial Undertakings (Safety Management) Regulation
2002 (20)	CPOSM	Code of Practice on Safety Management
2003 (21)	CSR	Construction Sites (Safety) (Amendment) Regulation

The graph in Figure 1 shows the accident rate and fatality rate with respect to the time frame of implementing various safety measures since 1991.

Figure 1 Accident and fatality rates in Hong Kong since 1991.

Year	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07
Accident rate	364	302	295	275	233	220	227	248	198	150	115	85	68	60	60	64	61
Fatality rate	8.5	7.7	14.2	8.5	9.6	6.8	5	7.1	6.6	3.6	3.5	3.3	3.9	2.7	4.2	3.0	3.8



There appears a positive linkage between the reduction in both accident and fatality rates with the implementation of various safety measures. However, the effectiveness of these measures requires a research study to confirm.

2.5.3 Categorization of occurrence of accident deaths in construction

Regarding the causes of industrial deaths in the construction industry, Table 22 shows the number of total deaths in 2004, 2005 and 2006. The number of victims fallen from a height has remained the most important concern.

Table 22 Categorization of industrial deaths in the Hong Kong construction industry 2004, 2005 and 2006.

Category	Deaths in 2004	Rank in 2004	Deaths in 2005	Rank in 2005	Deaths in 2006	Rank in 2006
Fall from height	8 (47%)	1	14 (56%)	1	9 (56%)	1
Struck by falling objects	3 (18%)	2	-	-	1 (6%)	3
Contact with electricity or harmful substances	1 (6%)	4	2 (8%)	4	-	-
Striking against or struck by objects or moving vehicles	3 (18%)	2	6 (24%)	2	1 (6%)	3
Trapped by collapsing objects	1 (6%)	4	3 (12%)	3	1 (6%)	3
Trapped in/between objects	1 (6%)	4	-	-	1 (6%)	3
Asphyxiation	-	-	-	-	3 (19%)	2
Total	17 (100%)		25 (100%)		16 (100%)	

Source: Occupational safety and health statistics 2006, Occupational Safety and Health Branch, Labour Department (www.labour.gov.hk)

2.6 United Kingdom

2.6.1 Definition

In 2006/07, there were 1.256 million employees and 0.81 million self-employed workers, making up a total of 2.066 million workers in the UK construction industry. For all industries, the total number of employees and self-employed was 26.413 million and 3.893 million respectively.

As the UK's past records have shown that the accident rate of self-employed workers is much lower, hence, as far as possible the rate here refers to that of the employees only.

In the UK, major injuries include specified serious injuries to workers, including fractures, amputations and other injuries leading to resuscitation or 24-hour admittance to hospital. The over-3-day injuries are other injuries to workers that lead to absence from work, or inability to do their usual jobs for over 3 days.

In 2006/07, the rate of major injuries and over 3-day injuries to employees fell from 9.4 in 2005/06 to 8.6 per 1,000 employees. 77 fatal injuries (50 employees and 27 self-employed workers) in construction were recorded, comared with the figure of 60 fatal injuries (43 employees and 17 self-employed workers) in 2005/06 (Health & Safety Executive, UK).

2.6.2 Accident rates and death rates

Table 23 shows the accident and the death rates per 1,000 employees in the UK between 1997/98 and 2006/07.

Table 23 Accident and death rates in the UK construction industry 1997/98 to 2006/07.

	1997/98	1998/99	1999/00	2000/01	2001/02
Major injuries (M) per 1,000 employees	3.82	4.03	3.96	3.81	3.56
Over-3-day injuries (O) per 1,000 employees	9.66	8.63	9.17	8.29	7.99
M + O injuries per 1,000 employees	13.5	12.7	13.1	12.1	11.6
M + O injuries per 1,000 self-employed workers	n/a	n/a	n/a	n/a	n/a
M + O injuries per 1,000 workers (employees + self-employed workers)	8.5	8.3	8.8	8.2	7.9
Deaths per 10,000 employees	0.57	0.44	0.55	0.65	0.53
Deaths per 10,000 self-employed workers	0.31	0.28	0.32	0.50	0.30

	2002/03	2003/04	2004/05	2005/06	2006/07
Major injuries (M) per 1,000 employees	3.55	3.28	3.27	3.08	2.95
Over-3-day injuries (O) per 1,000 employees	7.88	6.80	6.54	6.28	5.66
M + O injuries per 1,000 employees	11.4	10.1	9.8	9.4	8.6
M + O injuries per 1,000 self-employed workers	1.9	1.9	1.8	2.0	1.8
M + O injuries per 1,000 workers (employees + self-employed workers)	7.0	n/a	n/a	6.4	5.9
Deaths per 10,000 employees	0.49	0.43	0.48	0.36	0.40
Deaths per 10,000 self-employed workers	0.20	0.25	0.17	0.21	0.33

n/a not available

Source: Health and safety statistics 2006/07, Health and Safety Executive, UK (www.hse.gov.uk)

Both the accident rate and death rate with respect to 1,000 employees has generally declined over the period. The death rate per 1,000 workers has also shown a downward trend and has gone down to the lowest in 2004/05 (Statistics of fatal injuries 2006/07, Health and Safety Executive).

2.6.3 Categorization of occurrence of accident deaths in construction

Table 24 categorizes the occurrence of accident deaths to construction workers in 2004/05 and 2006/07.

Table 24 Categorization of accident deaths to construction workers in the UK 2004/05 and 2006/07.

	No. of deaths in 2004/05	Rank in 2004/05	No. of deaths in 2006/07	Rank in 2006/07
Fall from height	28 (38.9%)	1	23 (29.9%)	1
Hit by objects	14 (19.4%)	2	16 (20.8%)	2
Trapped by something collapsing/ overturning	13 (18.1%)	3	8 (10.4%)	4
Hit by moving vehicles	5 (6.9%)	4	6 (7.8%)	5
Contact with electricity or harmful substances	3 (4.2%)	5	12 (15.6%)	3
Slips and trips	2 (2.8%)	6	-	
Handling, lifting and carrying	2 (2.8%)	6	5 (6.5%)	6
Drowning or asphyxiation	-		5 (6.5%)	6
Others	5 (6.9%)		2 (2.6%)	
Total	72 (100%)		77 (100%)	

Source: Statistics of fatal injuries 2006/07, Health and Safety Executive, UK (www.hse.gov.uk)

The number of persons fallen from a height has accounted for the highest fatality rate. The other common fatal injuries to workers are struck by moving or falling objects, and by vehicles, accounting for over 40% of all fatalities.

3 Summary

3.1 Accident rates

The typical expression of the accident frequency rate per 1,000 workers does not reflect the actual scenario of the working atmosphere in the industry. The accident rate expressed as the frequency per million working hours is adopted by Japan and Singapore. Taiwan joins these two countries in identifying the severity rate, which includes death as well as temporary and permanent disablement. Thus, there is a need and trend to present more thorough information by the authorities in different places.

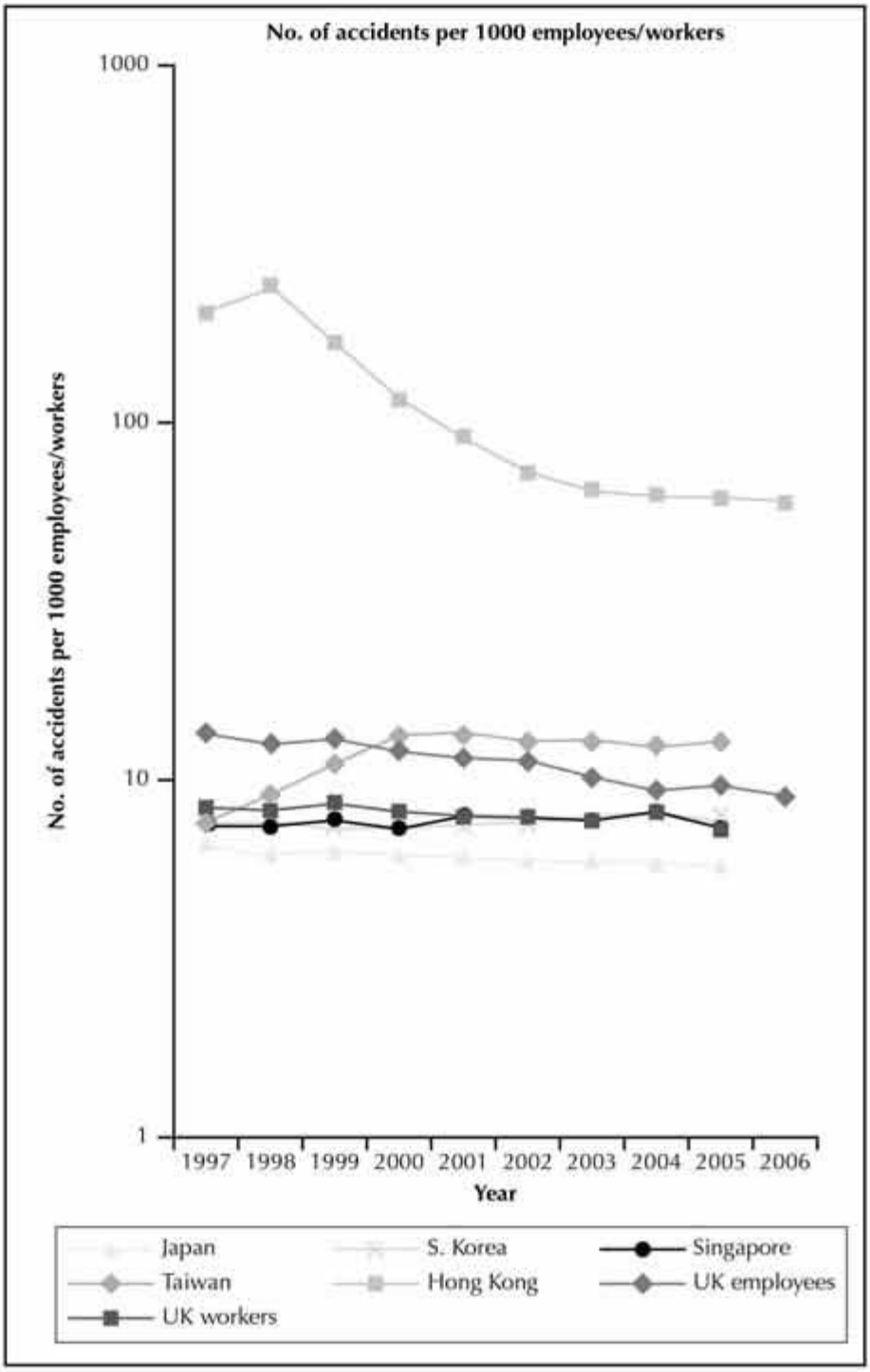
It may not be possible to compare directly the accident rates in different countries or regions as the components that form the statistics vary from place to place in respect of the legal requirements in reporting, the economic sectors covered and the definition of the workforce. However, in individual countries or regions, the accident rates over the last ten years or so can be studied to see if any improvements have been made.

Figure 2 shows the accident rates in these six places and their general trends during the 10-year period 1997 to 2006. The average accident rates during the whole 10-year period as well as the semi-averages for the two 5-year periods are tabulated in Table 25 to illustrate their trend of improvement, if any.

Figure 2 No. of accidents per 1,000 employees/workers

Year	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Japan	6.7	6.3	6.5	6.3	6.2	6.1	6.0	6.0	5.8	n/a
S. Korea	7.2	7.3	6	6.1	6.9	7.2	8.6	9.4	7.5	n/a
Singapore	7.2	7.2	7.6	7	7.9	7.8	7.6	8.2	7.1	n/a
Taiwan	7.6	9.4	11.5	13.4	13.6	13	13.1	12.6	13.0	n/a
Hong Kong	227.4	247.9	198.4	149.8	114.6	85.2	68.1	60.3	59.9	64.3
UK employees	13.5	12.7	13.1	12.1	11.6	11.4	10.1	9	9.4	8.6
UK workers	8.5	8.3	8.8	8.2	7.9	7.8	n/a	n/a	n/a	n/a

n/a not available


No. of accidents per 1000 employees/workers
1000
100
10
1
No. of accidents per 1000 employees/workers
1997 1998 1999 2000 2001 2002 2003 2004 2005 2006
Year
Japan
S. Korea
Singapore
Taiwan
Hong Kong
UK employees
UK workers

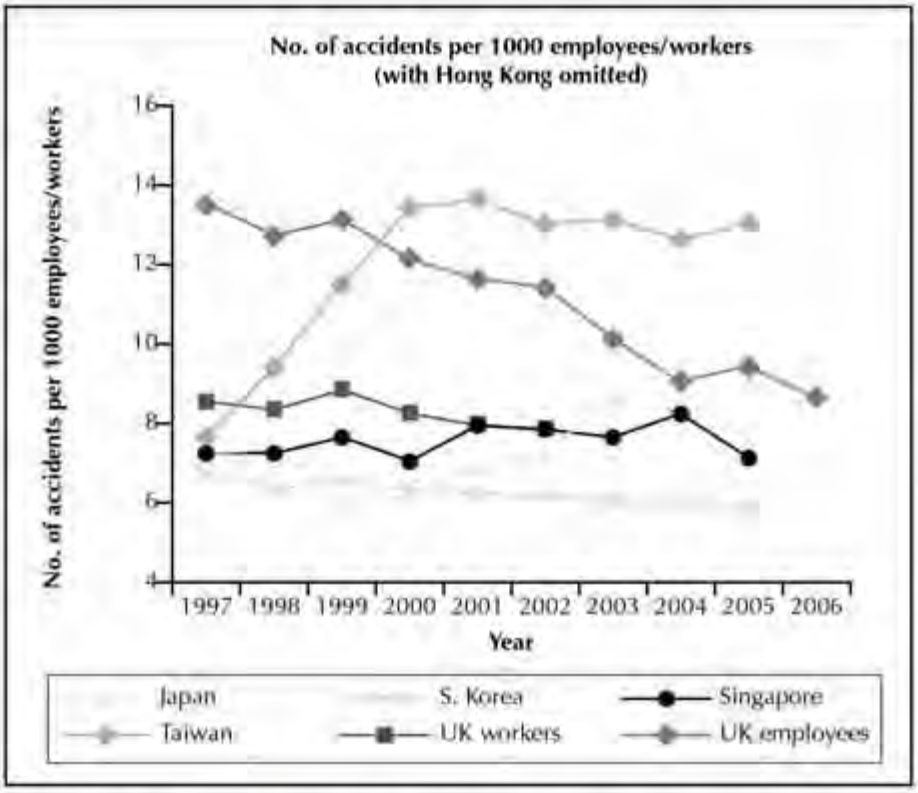


Table 25 Average number of accidents per 1,000 workers 1997–2006.

Average number of accidents per 1,000 workers	Japan	S. Korea	Singapore	Taiwan	Hong Kong	UK (employees/ self-employed workers)
1997–2001 (5-year)	6.4	6.7	7.4	11.1	187.6	12.6/8.3
2002–2006 (5-year)	6.0†	8.2†	7.7*	12.9†	67.6	9.7/7.8†
1997–2006 (10-year)	6.2†	7.5†	7.6†	12.0†	127.6*	11.2/8.3†

† calculation based on data up to 2005

* based on data in 2002

When the average accident rate per 1,000 workers is considered in the two 5-year periods, Japan has shown some slight improvement. Hong Kong has made tremendous improvements particularly during the period 2002–2006. On the other hand, South Korea, Singapore and Taiwan both have recorded an increase in the accident rate in the second 5-year period.

3.2 Death rates

The death rate per 10,000 construction workers in the various places can be directly compared as there should be little, if any, disagreement regarding its definition. Figure 3 shows the death rates in the six places and their general trend during the 10-year period. The average death rates during the whole 10-year period as well as the semi-averages are tabulated in Table 26 to illustrate their trend of improvement, if any.

Figure 3 No. of deaths per 10,000 workers (10,000 employees for UK)

Year	1997	1998	1999	2000	2001
Japan	1.5	1.3	1.5	1.8	1.9
S. Korea	3.1	3.6	3.2	2.8	2.7
Singapore	3.4	3.4	2.6	2.6	1.5
Taiwan	2.6	2.5	2.0	2.2	2.1
Hong Kong	5.0	7.1	6.6	3.6	3.5
UK employees/UK workers	0.57	0.44	0.55	0.65	0.53

Year	2002	2003	2004	2005	2006
Japan	1.8	1.5	1.3	n/a	n/a
S. Korea	2.4	2.9	3.9	2.9	n/a
Singapore	2.3	2.1	2.0	1.3	0.9
Taiwan	1.9	1.8	1.3	1.7	n/a
Hong Kong	3.3	3.9	2.7	4.2	3.0
UK employees/UK workers	0.49	0.43	0.48	0.36	0.4

n/a not available

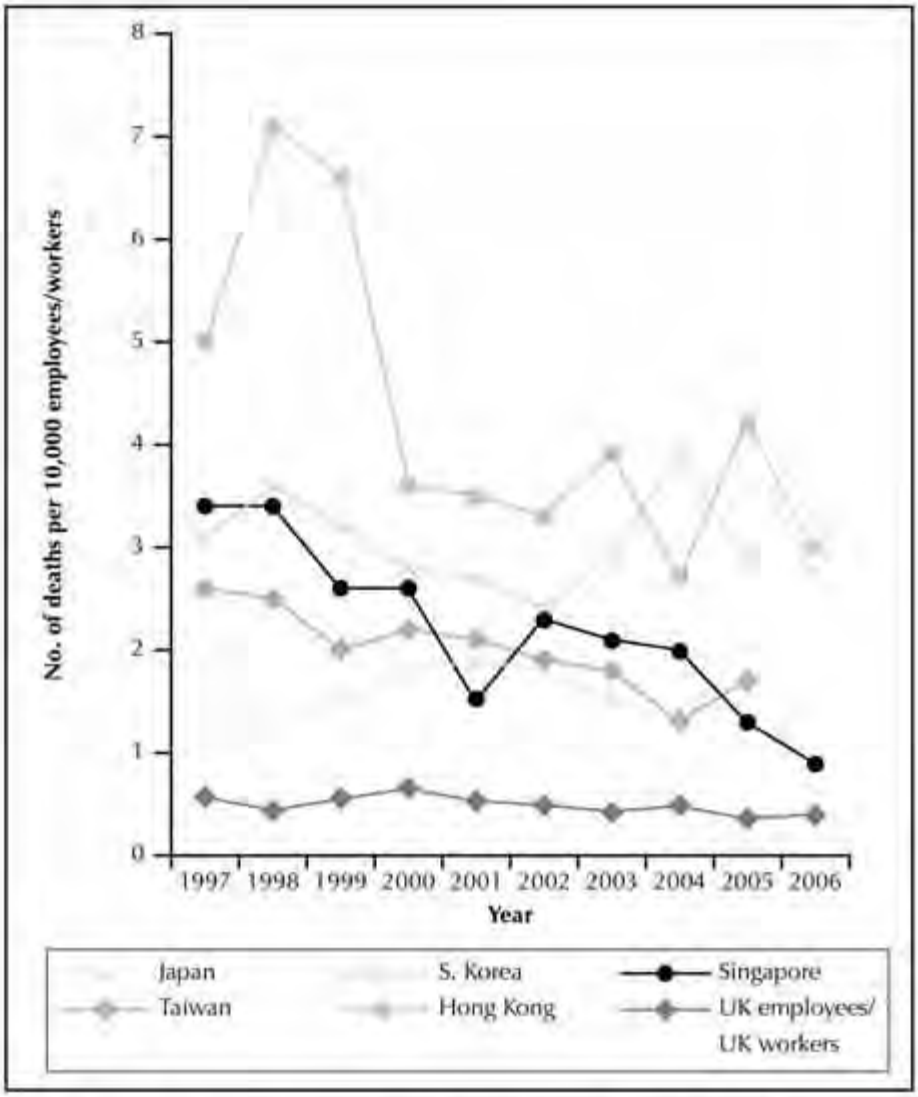


Table 26 Average number of deaths per 10,000 workers 1997–2006.

Average number of deaths per 10,000 workers	Japan	S. Korea	Singapore	Taiwan	Hong Kong	UK (workers)
1997–2001 (5-year)	1.60	3.1	2.7	2.3	5.2	0.47
2002–2006 (5-year)	1.66†	3.0†	1.7†	1.7†	3.4	0.35
1997–2006 (10-year)	1.63†	3.1†	2.2†	2.0†	4.3	0.41

† calculation based on data up to 2005

In Asia, Japan has the lowest average death rates of 1.63 victims per 10,000 workers. Taiwan, despite its high accident rates, has the second lowest death rate. Singapore and South Korea follow closely, though the 10-year average in South Korea is almost double that of Japan. In line with the substantial reduction in its accident rate, Hong Kong's death rate has also dropped over the period. The UK has an unbeatable low rate compared with Asia, and has registered a small improvement possibly due to the difficulty in improving further in a mature industry.

In terms of the semi-averages, most of the Asian countries or regions have recorded an improvement. Hong Kong has reduced the rate by half while Japan has just maintained a steady level. However, there still exists room for improvement when the UK is considered as a benchmark. In terms of the 10-year average, the Asians' rates are between two to eight times that of the UK figure.

3.3 Categorization of occurrence of deaths in construction

The ranking of the categories of occurrence of fatal cases in construction in the six countries or regions is shown in Table 27.

Table 27 Ranking of construction accident deaths.

Ranking	Japan (2006)	S. Korea (2003)	Singapore (2006)	Taiwan (1999)	Hong Kong (2005)	UK (2006/07)
1	Fall from height	Fall from height	Fall from height	Fall from height	Fall from height	Fall from height
2	Machinery	Struck by falling objects	Struck by falling objects	Electrocution	Striking against or struck by objects	Hit by objects
3	Automobiles	Electrocution	Caught in or between objects	Collapsing, cave-in	Trapped by collapsing objects	Electrocution
4	Struck by falling objects	Temporary Construction	Step on/ Strike against object	Struck by falling objects	Contact with electricity	Trapped by collapsing objects

Fall from height has ranked the top in all places, and this cause contributes between 40% and 50% to all accident deaths. More efforts to remind workers of potential dangers while working at a height, including the provision of appropriate safety measures and instructions, would reduce the total number of fatalities dramatically. The other potential dangers are crushing by moving objects or materials, such as struck by falling objects, moving objects and collapsing materials. These causes are associated with the characteristics of activities carried out on construction sites and should require innovative

approaches to reduce their hazards. Electrocution is also another typical hazard arising from most construction activities.

The following are accident examples commonly reported in Hong Kong (Poon 1997–2004):

(a) Fall from height

- Two workers fell to their death inside a lift shaft of an office building under construction. The workers were installing a platform inside the lift for the construction of the wall.
- Two workers were engaged in erecting a working platform formed by bamboo scaffolding on the external wall of a building. The bamboo scaffolding was supported by steel brackets bolted to the external wall. The workers fell to the podium as a result of the insecure fixing of the bolts supporting the platform.
- A worker fell from the unfenced working platform at the top of a 4-m high tower scaffold during the installation of the overhead air-conditioning duct. It was noted that no safety belt was provided to the worker.

(b) Demolition/Removing work

- A worker was dismantling and removing the steel struts at the basement of a building under construction. He was injured by a falling steel member after disconnecting the members. He had removed similar fixings twenty times before but failed this time.
- A worker was hit by a false ceiling which collapsed during the dismantling of a door and door frame.
- A workman was hit by the collapsing wall of a water tank at the roof top of a building during demolition of the tank and the roofing material.

(c) Struck by falling/moving objects

- A man was struck by a falling bamboo pole when waiting at a bus stop. Across the road there was a housing development site, and bamboo scaffolds remained there for final finishing work.
- A worker was crushed to death by the collapse of a power-operated folding working platform during the adjustment of the machine to the tilting position.
- A worker was hit by the descending hoist inside the hoist-way when fixing a water tap.

(d) Collapse

- A concretor fell to his death when the supporting falsework collapsed during concreting. Several bracing members of the falsework scaffolding were found missing.

(e) Electrocution

- An electric arc welder was found lying unconsciously on the wet ground between two steel I-beams. Prior to the accident, he and his co-worker were engaged in welding the metal girders. The welding work had been interrupted by rain. He was killed when he resumed the welding operation after the rain had stopped.
- A concretor was electrocuted by lightning while manoeuvring a skip of concrete suspended from a tower crane at the top floor of a building during construction. Before and at the material time of the incident, a thunder storm warning had been issued by the Hong Kong Observatory.

4 Conclusion

This chapter has reviewed the construction accident statistics of five Asian countries or regions: Japan, South Korea, Singapore, Taiwan and Hong Kong. Reference has also been made to the data available in the UK.

In Asia, Japan is the best performing country in construction safety, with lower accident rates than the UK. Hong Kong has made impressive progress during the last 10 years, yet there is still room for further improvement when compared with Japan. A number of safety measures have been implemented in Hong Kong since the 1980s and there is a positive link between their implementation and the drop in accident and fatality rates. However, the effectiveness of the safety measures requires confirmation.

On the death rate issue, the UK data are much lower than all the Asian figures which have shown a fairly consistent downward trend, except South Korea which has performed poorly during the last two years in the 10-year period. Hong Kong's death rate has reduced drastically and should soon rank alongside Singapore and Taiwan.

Fall from height is the main cause for construction deaths, accounting for 40% to 50% of all fatal cases. The other causes are due to crushing by moving objects or unstable materials, and electrocution. These are typical side products of construction activities and require innovative approaches to reduce, if not totally eliminate, their occurrence.

Acknowledgements

A number of individuals have helped in one way or the other in providing the construction accident statistics and relevant information.

The contents of this chapter are based on the information presented at the annual event, "Conference of Safety and Health Organization in the Asia-Pacific Region Construction Industry", organized by

- Japan Construction Occupational Safety & Health Association (JCOSHA) in Tokyo in 1999;
- Safety Specialist Group of The Hong Kong Institution of Engineers in Hong Kong in 2000;
- The Professional Committee of Construction Safety of the China Association of Construction Industry in Beijing in 2003;
- Korea Occupational Safety and Health Association, in Seoul, South Korea, in 2005;
- National Institute of Occupational Safety and Health, in Bandar Baru Bangi, Selangor Malaysia, in 2006.

The authors would like to express their gratitude to all the delegates participating in the above conferences for their contribution of data to this chapter.

References

Cheung, M.K.C. (2005) Speech at the Annual Safety Conference at the Hong Kong Construction Association, Hong Kong.

Construction Industry Safety and Health Report (1999 and 2000) Taiwan.

Health and Safety Executive (2008). Health and safety statistics 2006/07, UK. (www.hse.org.uk)

Ho, S. K. (1999) Report on the Employer Responsibility and Supervision System, Singapore.

Industrial Safety and Health Association of Taiwan (2007) Statistics of occupational injuries. (www.isha.org.tw)

Japan Construction Occupational Safety and Health Association (1999) Guidelines on Occupational Health and Safety Management Systems for the Construction Industry.

Japan Construction Occupational Safety and Health Association (2007) Statistics of occupational accidents in the construction industy (www.kensaibou.or.jp).

Jung, S.H. (2005) Construction safety management system in Korea, in *Proceedings of the 4th Asia-Pacific Region Construction Safety and Health Annual Conference*, June, South Korea, pp. 143–153.

Kao, C.F. (2000) Research of safety of the construction industry in Taiwan, in *Proceedings of the 2nd Conference of Safety and Health Organizations in the Asia-Pacific Region Construction Industry*, December, Hong Kong.

Kim, J.G. (2003) Trends of occupational accidents and harm or danger prevention plan in the construction industry, in *Proceedings of the Asia-Pacific Region 3rd Annual Conference of Construction Safety and Health Organization*, Beijing, China, pp. 1–12.

Korea Occupational Safety and Health Agency (2006) Statistics on industrial accidents and occupational diseases (www.kosha.or.kr).

Lau, C.K. (2006) "RED/HKCA Safety Partnering Programme" at the HKCA Safety Conference 2006 – The Dragon Dance – Are We Playing Together?

Lee, K.B. (2000) Application and expected effort of safety and health management program in Korea, in *Proceedings of the 2nd Conference of Safety and Health Organizations in the Asia-Pacific Region Construction Industry*, December, Hong Kong.

Lee, K.B. (2000) Safety management in Asia's construction industry, in *Proceedings of the 2nd Conference of Safety and Health Organizations in the Asia-Pacific Region Construction Industry*, December, Hong Kong.

Lee, M.H. (2005) Prevention measures against frequent accidents in construction, in *Proceedings of the 4th Asia-Pacific Region Construction Safety and Health Annual Conference*, June, South Korea, pp. 175–205.

National Institute of Occupational Safety and Health (2006) *Proceedings of the 5th Conference of Asia-Pacific Organizations for Construction Safety and Health*, Malaysia, May.

Occupational Safety and Health Branch (2007 and 2008) Occupational safety and health statistics 2006 and 2007, Labour Department, The Government of the Hong Kong SAR.

Occupational Safety and Health Division (2006) Annual Report Ministry of Manpower, Singapore (www.mom.gov.sg).

Poon, S.W. (1997–2004) Expert Reports on Investigation of Construction Accidents.

Report on the Employer Responsibilities and Supervision Systems and Their Relationship with Safety and Health Status 1999 and 2000, Korea.

Singapore Standard CP79:1999, Code of Practice for Safety Management System for Construction Work Sites.

Wong, K.W., Poon, S. W. and Rowlinson, S.M. (1999) Construction safety and health related legislation in Hong Kong, in *Proceedings of the 1999 Conference of Safety and Health Organizations in the Asia-Pacific Region Construction Industry*, May, Japan, 11 pp.

Yu, C.C. (2000) The general situation and counter measures for construction accidents in Taiwan area, in *Proceedings of the 2nd Conference of Safety and Health Organizations in the Asia-Pacific Region Construction Industry*, December, Hong Kong.

Yu, C.C. (2005) Construction safety management system in Taiwan, in *Proceedings of the 4th Conference of Safety and Health Organizations in the Asia-Pacific Region Construction Industry*, South Korea, pp. 75–93.

ABOUT THE AUTHORS

S.W. Poon

S. W. Poon is an Associate Professor in the Department of Real Estate and Construction at the University of Hong Kong. He obtained his M.Sc. in Construction and Ph.D. from Loughborough University, U.K. Besides being a Chartered Structural Engineer and a Corporate Member of the Hong Kong Institution of Engineers, he is also an Expert Member of the Formwork and Falsework Scaffolding Professional Committee, and the Construction Technology Academic Committee of the China Construction Institution, Beijing, China.

Dr. Poon has been appointed over thirty times as an independent safety expert in investigating construction accidents and failures. His research interests include construction and project management, temporary works design and construction, and failures during construction. He has published many papers on construction safety and accidents and is a co-author of *Modern Construction Project Management* and *Construction Quality Management* published by Hong Kong University Press.

S. L. Tang

S. L. Tang is a Chartered Civil Engineer and obtained his B.Sc. in Civil Engineering from the University of Hong Kong in 1972, M.Sc. in Construction Engineering from the National University of Singapore in 1977, and Ph.D. from the Civil Engineering Department of Loughborough University, U.K. in 1989. Dr. Tang had nearly seven years of working experience in civil engineering practice in contracting/consulting firms and government departments before he joined The Hong Kong Polytechnic University, in which he is currently involved in the teaching and research of construction management and water & environmental management. Dr. Tang has written over one hundred journal/conference papers and books/reports related to the areas of his expertise. He has also taught as a Visiting Scholar or Visiting Professor in universities of different countries such as China, Australia and the USA.

Francis K.W. Wong

Francis Wong is the Head of Department of Building and Real Estate (BRE), as well as the Director of Research Centre for Construction and Real Estate Economics (RCCREE) of The Hong Kong Polytechnic University. He has 28 years of academic and practical experiences, and has published more than a hundred papers in the form of refereed journal articles, refereed conference papers, professional journal papers, research monographs, and consultancy reports. Professor Wong is a Fellow Member of the Hong Kong Institution of Engineers (HKIE), a Founding Member as well as the Chairman of the Safety Specialist Group of HKIE in 1999/2000. He is a Fellow Member of the Chartered Institute of Building (CIOB) and the Senior Vice-Chairman of the CIOB (Hong Kong Branch) in 1994/95. He is also a Fellow and a Founding Member of the Hong Kong Institute of Construction Managers (HKICM). His main research areas include construction safety and affordable housing development.