



JUNE 2022

HONG KONG REPORT

QUARTERLY CONSTRUCTION
COST UPDATE

RLB
利比

Rider
Levett
Bucknall

OFFICES AROUND THE WORLD

AFRICA

Angola

Luanda

Botswana

Gaborone

Kenya

Nairobi

Maldives

Hulhumale

Mauritius

Quatre Bornes

Mozambique

Maputo

Namibia

Windhoek

Nigeria

Lagos

Seychelles

Victoria

South Africa

Cape Town

Durban

Pretoria

Stellenbosch

ASIA

North Asia

Beijing

Chengdu

Chongqing

Guangzhou

Guiyang

Haikou

Hangzhou

Hong Kong

Macau

Nanjing

Nanning

Seoul

Shanghai

Shenyang

Shenzhen

Wuhan

Wuxi

Xian

Zhuhai

South Asia

Bacolod

Bohol

Cagayan de Oro

Cebu

Clark

Davao

Ho Chi Minh City

Iloilo

Jakarta

Kuala Lumpur

Laguna

Metro Manila

Phnom Penh

Singapore

Yangon

India Alliance

Bangalore

AMERICAS

Caribbean

St. Lucia

North America

Boston

Calgary

Chicago

Denver

Hilo

Honolulu

Kansas City

Las Vegas

Los Angeles

Maui

New York

Phoenix

Portland

San Francisco

San Jose

Seattle

Toronto

Tucson

Waikoloa

Washington DC

America Alliance

Mexico City

EUROPE

United Kingdom

Belfast

Birmingham

Bristol

Cardiff

Cumbria

Leeds

Liverpool

London

Manchester

Sheffield

Thames Valley

Warrington

Euro Alliance

Austria

Belgium

Bulgaria

Croatia

Czech Republic

Denmark

France

Germany

Greece

Hungary

Ireland

Italy

Luxembourg

Montenegro

Netherlands

Norway

Poland

Portugal

Romania

Serbia

Spain

Sweden

Turkey

MIDDLE EAST

Qatar

Doha

Saudi Arabia

Riyadh

United Arab Emirates

Abu Dhabi

Dubai

OCEANIA

Australia

Adelaide

Brisbane

Cairns

Canberra

Coffs Harbour

Darwin

Gold Coast

Melbourne

Newcastle

Perth

Sunshine Coast

Sydney

Townsville

New Zealand

Auckland

Christchurch

Hamilton

Palmerston North

Queenstown

Tauranga

Wellington

COST COMMENTARY

REVIEW OF TENDER PRICE MOVEMENTS IN HONG KONG

According to Rider Levett Bucknall's Tender Price Index, which measures tender price movements of builder's works in the private sector in Hong Kong, there was an increase of 2.11% in tender prices in the first quarter of 2022. On a year-on-year basis, the tender price rose by 5.91%.

The following are the first quarter year-on-year tender price movements of builder's works in the private sector in the past five years:

2017 - 2018	2018 - 2019	2019 - 2020	2020 - 2021	2021 - 2022
-1.9%	-5.3%	-4.0%	-0.7%	5.9%

Hong Kong's economy dropped by 4.0% year-on-year in real terms in the first quarter of 2022, compared with the 4.7% increase in the fourth quarter of 2021. On a seasonally adjusted quarter-to-quarter comparison basis, real GDP declined by 3.0% in the first quarter of 2022 over the previous quarter. According to the Composite Consumer Price Index, overall consumer prices rose by 1.2% in May 2022 over the same month a year earlier, following a year-on-year increase of 1.3% in April 2022. From February - April 2022 to March - May 2022, the seasonally adjusted unemployment rate decreased from 5.4% to 5.1% and the underemployment rate also decreased from 3.8% to 3.5%.

The fifth wave of COVID-19 epidemic had posed multiple challenges to Hong Kong's economy. As a result of weak domestic demand from anti-epidemic measures, economic activities slowed down along with setback of business confidence. Expenditure on building and construction fell by 0.2% in real terms year-on-year, compared with 1.5% increase in the previous quarter. The total gross value of construction works for private sector dropped by 9.8% while that for public sector increased by 12.2% in real terms year-on-year. With weak business sentiment, it is expected that public funded project will remain the main contributor to the gross construction output in coming quarters. Looking forward,

inflationary pressure on commodity prices, supply chain disruption and tight monetary policy will continue to cloud the outlook of Hong Kong's economy. Meanwhile, the change of term of government in July is expected to bring new housing policy which may stimulate the construction industry. It is expected that the tender prices will continue to rise moderately for the second half of 2022.

MACAU

Macau's Gross Domestic Product fell by 8.9% year-on-year in real terms in the first quarter of 2022, compared with 4.4% decrease in the previous quarter. The general unemployment rate for February to April 2022 stood at 3.5%, which is the same as that in January to March 2022 while the underemployment rate rose by 0.2% to 3.0%.

With the on-going travel restrictions and continuous lockdown in mainland China, Macau's visitor arrivals remained at a low level as tourists from mainland China were the major source of visitors before the pandemic. This has a great impact on Macau's economy as it relies heavily on gaming and tourism. In the first quarter of 2022, the private construction investment fell by 19.4% year-on-year. On the other hand, there is a significant increase of 40.6% year-on-year in the public construction investment as a result of the government's investment in transport infrastructure and public housing projects. For 2022, one of the major tasks for the government would be the development of Guangdong-Macau Intensive Cooperation Zone in Hengqin. The development is expected to boost Macau's economic diversification and will bring new opportunities to Macau's construction industry with infrastructure developments. While there is still uncertainty regarding the global economic outlook, it is anticipated that the tender price will rise gradually in the coming quarters due to global material inflation resulting from geopolitical tensions.

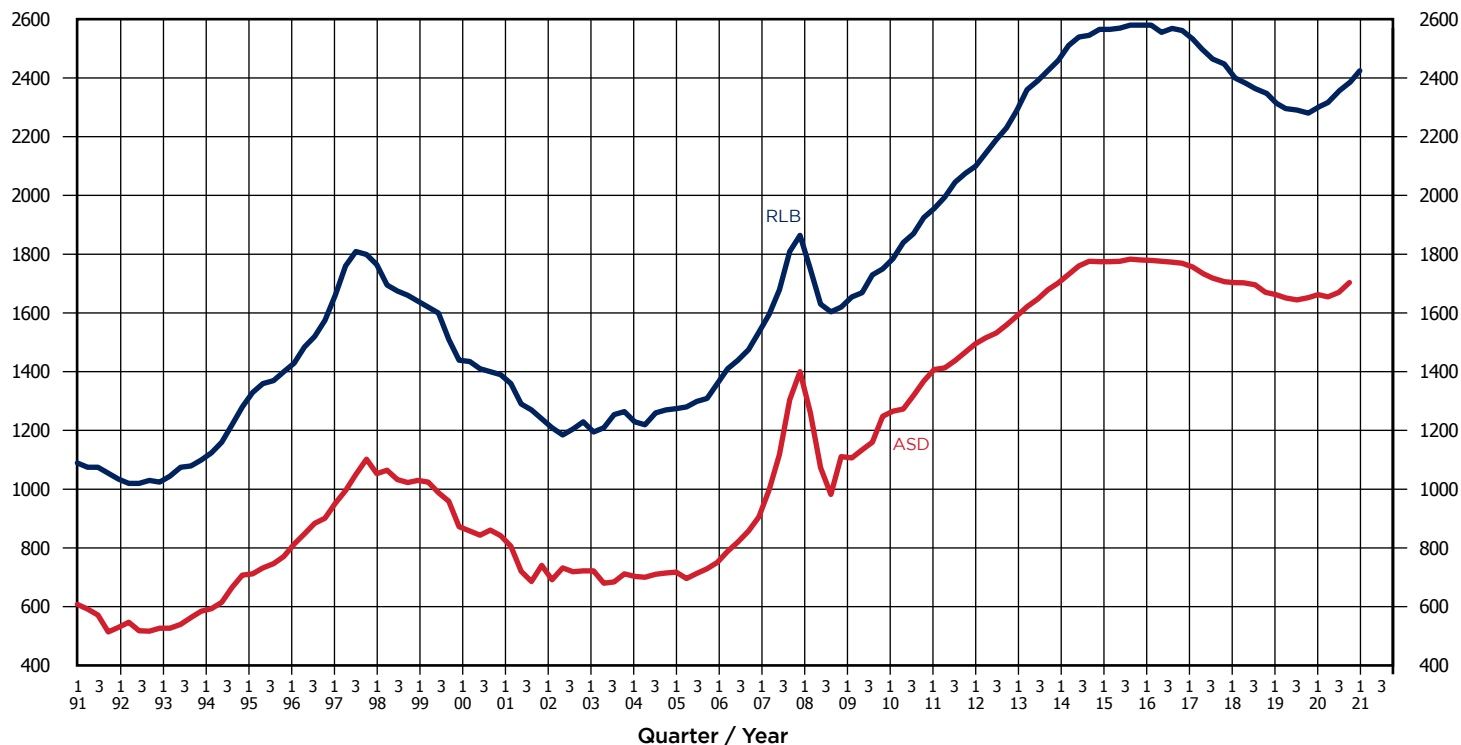
Disclaimer:

While the information in this publication is believed to be correct at the time of publishing, no responsibility is accepted for its accuracy. Persons desiring to utilize any information appearing in the publication should verify its applicability to their specific circumstances. Cost information in this publication is indicative and for general guidance only and is based on rates at **1st Quarter 2022.**

HONG KONG REPORT | JUNE 2022

TENDER PRICE INDICES IN HONG KONG

RLB = Rider Levett Bucknall (Private Sector)
ASD = Architectural Services Department (Public Sector)



Graph showing cost trends in the construction industry in Hong Kong based on Tender Prices for Builder's Works

TENDER PRICE INDICES

	RLB	ASD	RLB	ASD	RLB	ASD	RLB	ASD	RLB	ASD	RLB	ASD	RLB	ASD	RLB	ASD	RLB	ASD	RLB	ASD	RLB	ASD	RLB	ASD
Quarter	1968		1969		1970		1970		1972		1973		1974		1975		1976		1977		1978		1979	
1	100		104		160	100	210	140	238	144	258	160	345	206	275	145	221	150	270	164	320	203	460	262
2			112		173	106	222	143	236	146	275	167	345	213	258	145	238	153	270	174	350	208	500	285
3			130		185	124	230	144	238	158	300	190	318	203	243	137	255	153	273	185	380	230	535	304
4			148		198	131	238	143	245	158	325	199	290	191	228	140	263	149	300	201	420	238	550	329
	1980		1981		1982		1983		1984		1985		1986		1987		1988		1989		1990		1991	
1	570	347	620	389	630	364	560	298	570	328	560	326	605	376	665	385	785	479	960	542	1020	574	1090	608
2	570	353	620	393	620	370	560	298	570	332	555	335	615	392	690	403	820	510	960	548	1030	561	1075	592
3	600	369	630	375	600	342	540	317	570	323	565	344	630	373	700	411	865	521	985	552	1045	582	1075	573
4	610	381	630	376	580	327	560	326	560	337	585	351	655	380	740	438	925	541	1000	559	1080	596	1055	515
	1992		1993		1994		1995		1996		1997		1998		1999		2000		2001		2002		2003	
1	1035	531	1025	527	1100	586	1280	708	1400	772	1575	902	1800	1103	1660	1024	1510	959	1400	862	1270	687	1205	720
2	1020	548	1045	527	1125	594	1330	712	1430	813	1660	953	1765	1054	1640	1031	1440	873	1390	842	1240	742	1230	723
3	1020	519	1075	541	1160	615	1360	733	1485	848	1760	996	1695	1065	1620	1025	1435	858	1360	807	1210	692	1195	722
4	1030	518	1080	563	1220	666	1370	747	1520	885	1810	1051	1675	1034	1600	989	1410	844	1290	721	1185	733	1210	681
	2004		2005		2006		2007		2008		2009		2010		2011		2012		2013		2014		2015	
1	1255	685	1260	711	1300	714	1440	821	1680	1118	1630	1074	1670	1134	1840	1273	1995	1414	2145	1516	2360	1621	2510	1732
2	1265	712	1270	716	1310	730	1475	859	1810	1305	1605	983	1730	1161	1870	1320	2045	1438	2190	1532	2390	1648	2540	1761
3	1230	704	1275	718	1360	751	1535	906	1865	1401	1620	1111	1750	1249	1925	1369	2075	1467	2230	1559	2425	1679	2545	1777
4	1220	701	1280	697	1410	789	1595	998	1750	1262	1655	1107	1785	1266	1955	1408	2100	1496	2290	1590	2460	1703	2565	1775
	2016		2017		2018		2019		2020		2021		2022		2023		2024		2025		2026		2027	
1	2565	1775	2580	1779	2530	1755	2395	1695	2300	1641	2285	1631	2420											
2	2570	1776	2555	1776	2495	1727	2385	1686	2265	1623	2300	1620												
3	2580	1783	2565	1773	2465	1708	2355	1675	2260	1618	2345	1640												
4	2580	1781	2560	1768	2440	1698	2340	1652	2250	1625	2370	1679												

COMMON UNIT RATES IN HONG KONG

Description	Unit	Average Rates in HK\$			
		2Q2021	3Q2021	4Q2021	1Q2022
Reinforced concrete Grade 40	m ³	1,200.00	1,230.00	1,290.00	1,350.00
Sawn formwork	m ²	370.00	390.00	420.00	440.00
Deformed high yield steel bar reinforcement	kg	10.70	11.90	12.20	12.50
105 mm Solid concrete block wall	m ²	290.00	300.00	310.00	320.00
Mastic asphalt roofing overall 20 mm thick (2-coat work) on horizontal surfaces	m ²	163.00	168.00	170.00	174.00
20 mm (Finished) Timber strip flooring including plywood sub-floor, sanding and wax polishing	m ²	780.00	800.00	810.00	830.00
Timber skirting 100 mm high x 13 mm thick	m	114.00	116.00	117.00	120.00
50 mm Solid core flush door faced both sides with 5 mm timber veneered plywood including door frame, architrave, mouldings and painting (excluding ironmongery)	No.	6,000.00	6,100.00	6,200.00	6,300.00
Galvanised mild steel in balustrades, railings and general welded and framed work	kg	32.00	33.00	33.00	34.00
Structural steelwork - standard sections	kg	31.00	32.00	33.00	34.00
Fluorocarbon coated aluminium windows - frame and hardware including clear float glass and glazing (single-glazed windows)	m ²	2,670.00	2,720.00	2,800.00	2,880.00
20 mm Cement and sand (1:3) paving	m ²	105.00	110.00	111.00	114.00
Coloured unglazed ceramic mosaic floor tiling	m ²	280.00	285.00	290.00	295.00
Marble slab flooring (mid-range, European origin)	m ²	2,870.00	2,930.00	2,960.00	3,020.00
Two coats internal lime cement plaster to soffit and beams	m ²	102.00	105.00	108.00	112.00
Metal panel suspended ceiling	m ²	620.00	630.00	640.00	655.00
Ceramic / homogeneous wall tiling; internal work	m ²	525.00	535.00	540.00	550.00
Ceramic mosaic external wall tiling; adhesive fixed (45 x 45 or 45 x 95 mm tiles)	m ²	410.00	420.00	420.00	430.00
Alkali resistant primer and two coats of emulsion paint on plastered walls and ceilings	m ²	64.00	66.00	68.00	70.00

Notes:

- The unit rates above are for general guidelines of likely tendered rates obtained by competitive tendering for lump sum fixed price contracts with a normal contract period.
- The rates are also based on normal site conditions, locations and normal working hours.

2022 年第1季中国主要城市单方造价指标
Approximate Order of Construction Costs in Hong Kong and Selected Cities in China
(Cost per Square Metre Construction Floor Area at 1st Quarter 2022 Prices)

建筑物种类 Type of Building	香港 Hong Kong HK\$	澳门 Macau MOP	北京 Beijing RMB	成都 Chengdu RMB	广州 Guangzhou RMB	上海 Shanghai RMB	深圳 Shenzhen RMB	天津 Tianjin RMB	武汉 Wuhan RMB	无锡 Wuxi RMB	西安 Xian RMB	珠海 Zhuhai RMB
Office 办公楼												
High Quality 高档次	25,100 - 34,200+	18,000 - 24,000+	9,200 - 13,400	8,000 - 11,500	8,500 - 12,900	9,200 - 13,300	8,500 - 12,800	8,850 - 12,900	8,000 - 11,950	9,000 - 13,200	8,100 - 12,100	8,000 - 11,900
Medium Quality 中档次	21,600 - 25,500	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Ordinary Quality 普通档次	18,600 - 22,800	11,300 - 15,600	4,700 - 6,600	4,200 - 5,700	4,450 - 6,200	4,700 - 6,450	4,450 - 6,200	4,550 - 6,100	4,150 - 5,600	4,650 - 6,100	4,150 - 5,600	4,050 - 5,600
Shopping Centre 商场												
High Quality 高档次	30,500 - 36,300+	23,100 - 28,200+	9,000 - 14,100	8,300 - 12,900	9,000 - 13,800	9,000 - 14,000	9,000 - 13,800	N/A	N/A	N/A	N/A	N/A
Medium Quality 中档次	25,100 - 30,000	N/A	7,300 - 9,100	6,600 - 8,300	7,200 - 8,800	7,300 - 9,200	7,300 - 8,800	N/A	N/A	N/A	N/A	N/A
Residential 住宅												
High Rise; High Quality 高层; 高档次	25,900 - 36,600+	15,100 - 21,600+	5,350 - 7,500	4,550 - 6,250	5,200 - 7,100	5,400 - 7,500	5,100 - 6,900	5,150 - 7,200	4,600 - 6,450	5,100 - 7,050	4,500 - 6,500	4,600 - 6,450
High Rise; Better Quality 高层; 中档次	19,500 - 22,700	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
High Rise; Ordinary Quality 高层; 普通档次	18,100 - 19,100	8,450 - 10,500	3,200 - 4,150	2,700 - 3,600	3,000 - 3,950	3,200 - 4,150	3,000 - 3,950	3,050 - 3,950	2,750 - 3,650	3,000 - 3,900	2,650 - 3,650	2,700 - 3,550
House; High Quality 别墅; 高档次	36,500 - 53,400+	N/A	5,700 - 8,000	4,800 - 6,750	5,250 - 7,050	6,000 - 8,300	5,250 - 7,150	5,550 - 7,800	4,950 - 7,100	5,700 - 7,950	4,950 - 7,150	4,900 - 7,050
House; Medium Quality 别墅; 中档次	25,900 - 31,800	N/A	3,950 - 5,050	3,400 - 4,450	3,600 - 5,000	4,150 - 5,300	3,600 - 4,950	3,950 - 5,100	3,400 - 4,450	3,950 - 5,050	3,450 - 4,500	3,400 - 4,450
Clubhouse 会所	32,800 - 52,000+	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
External works & landscaping 室外工程 (cost/m ² external area)	4,200 - 9,100+	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Hotel (including FF&E) 酒店 (包括家具及设备)												
5-Star 五星	36,400 - 44,200+	30,500 - 37,400+	15,400 - 20,300	13,450 - 17,150	15,350 - 19,700	15,600 - 20,500	15,000 - 19,550	15,000 - 19,700	14,200 - 18,300	15,500 - 20,200	14,100 - 18,450	13,950 - 18,300
3-Star 三星	30,500 - 35,300	24,400 - 28,100	11,350 - 14,650	10,000 - 12,600	10,800 - 13,850	10,900 - 14,600	11,200 - 13,850	10,600 - 14,200	10,350 - 13,250	10,900 - 14,600	10,100 - 13,200	10,100 - 13,250
Industrial 厂房												
Landlord; High Rise 租用; 高层	12,800 - 15,100	N/A	3,100 - 4,200	2,750 - 3,950	3,050 - 4,150	3,450 - 4,400	3,050 - 4,200	3,250 - 4,200	2,800 - 3,900	3,300 - 4,350	2,800 - 3,950	2,800 - 3,900
End User; Low Rise 自用; 低层	16,100 - 23,300	N/A	4,350 - 7,750	4,050 - 7,150	4,250 - 7,900	4,400 - 7,800	4,350 - 7,850	4,250 - 7,500	4,000 - 7,100	4,400 - 7,800	4,050 - 7,150	4,000 - 7,050
Carpark 车库												
Basement; up to 2 Levels 地下室; 不多于2层	22,800 - 30,600+	10,900 - 13,800+	4,700 - 7,850	4,350 - 7,200	4,450 - 7,550	4,550 - 7,700	4,550 - 7,550	4,400 - 7,300	4,300 - 7,300	4,450 - 7,600	4,350 - 7,100	4,250 - 7,100
Multi-Storey 地上; 多层	10,900 - 13,500	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

NOTES 注：

- The construction costs above are based on prices obtained by competitive tendering for lump sum fixed price contracts with a normal contract period and are based on normal site conditions and locations. Extra costs should be allowed for projects with fast track programme, non-traditional procurement approaches and multi-phasing completion, etc. 以上单方造价指标按竞价价格下之包干合约编制，并按正常工期、工地状况等为准。如项目采用快速施工、非传统式采购合约、分期施工等，应考虑增加额外预算成本。

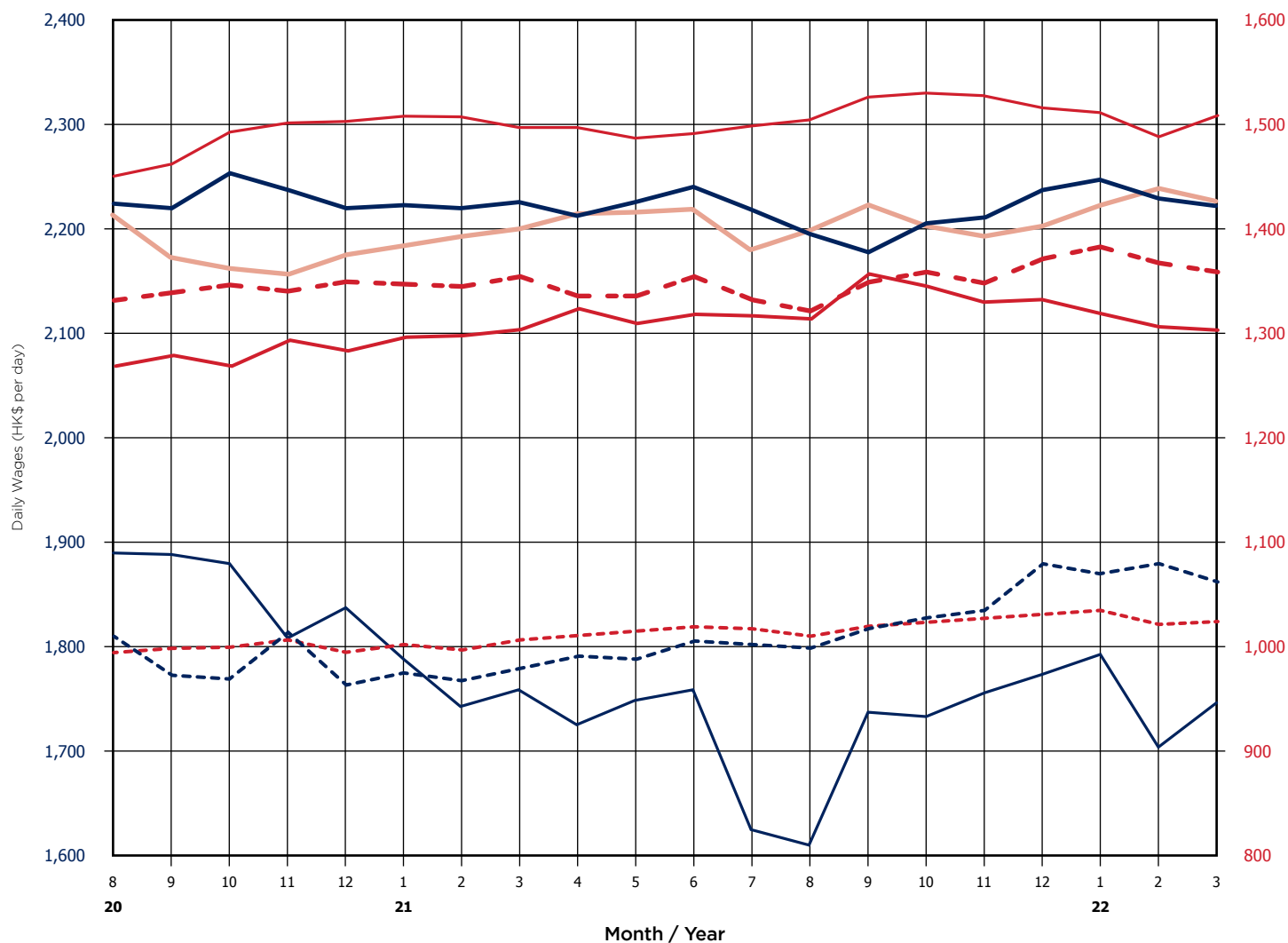
• The costs are average square metre unit costs only not based on any specific drawings / design. Therefore they provide nothing more than a rough guide to the probable cost of a building. Figures outside the given ranges may be encountered. When information is required on a specific project, it is essential that professional advice be sought. 平均单方造价并不是参考图纸或设计而编制。只可作为建筑造价之约算，亦可能出现范围外之单价。若有特定之工程资料，理应参考专业顾问之意见。





• The standards for each type of building in selected cities in China do not necessarily follow those in Hong Kong due to local design practices and choice of materials. 中国各城市之建筑标准、采纳之物料均有所不同，并不需要与香港单价作比较。
- The building costs exclude furniture, fittings and equipment (except hotel / serviced apartment / clubhouse), site formation and external works, finance and legal expenses, consultants' fees and reimbursables, value of land and fluctuations in prices between the price date as specified above and the time of calling tenders. 建筑物单价并不包括家具及设备（酒店 / 服务式住宅 / 会所除外）、工地平整、室外工程、财务、法律、顾问公司等专业费用，地价及由此单价生效日至投标时间之价格或汇率变动。

• Construction floor area is the summation of covered floor areas contained within the outer surface of external wall or external perimeter, whichever is larger, measured at each floor level. It includes all floor areas occupied by stairwells, lift shafts, vertical duct wells, plant rooms, covered external floors, but excludes floor areas occupied by the atrium voids, light wells, and the areas covered by canopies and architectural features such as air conditioners (ACs) platforms, projected planters, sunshades, etc. 建筑面积乃有盖面积总和并量度至建筑物外墙外面或量度至边周界，以较大者为准；包括楼梯井、电梯井、管线井、机电间、有盖室外面积，但不包括大堂上部空间、光井及雨棚、建筑装饰如空调机平台、花槽、遮阳棚等。
- Other Specific Exclusions 其它不包括项目：
HOTEL 酒店：pre-opening expenses, operating expenses, working capital, staff training and administrative costs 开幕前费用、营运费用、开办费、员工培训及行政费等。
SHOPPING CENTRE 商场：fit out to tenant areas 租户之装修工程。
INDUSTRIAL; LANDLORD 厂房（租用）：security system, air conditioning, electrical distribution in tenant areas; production and warehousing equipment; special M&E provisions 保安、空调、租户内之电器布线、生产及仓库装备，特别机电配套等。
PROJECTS IN SELECTED CITIES IN CHINA 中国主要城市：utilities to the site beyond site boundary, connection charges and capital contribution; local authority levies and taxation; import duties 工地外之主干线、接驳费、增容费、当局行政费用、税项、入口税。

LABOUR COST TRENDS

AVERAGE DAILY WAGES OF WORKERS ENGAGED IN PUBLIC SECTOR CONSTRUCTION PROJECTS

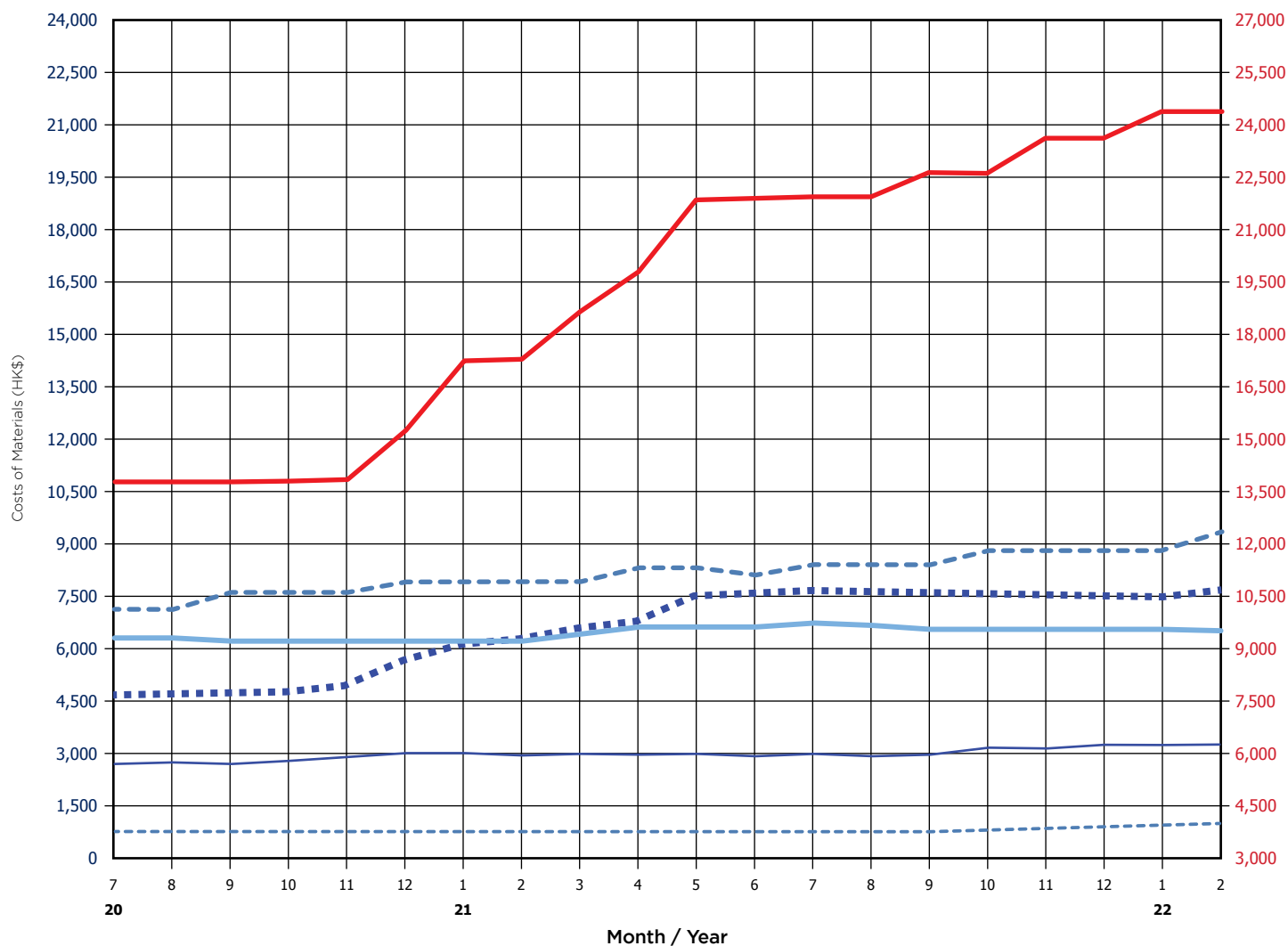


	Average Daily Wages in HK\$ per day																			
Selected Occupations	2020					2021												2022		
	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
Bar Bender and Fixer 	2,222.6	2,217.7	2,250.8	2,234.7	2,217.0	2,220.2	2,217.1	2,222.9	2,209.9	2,223.4	2,237.5	2,215.8	2,193.3	2,175.6	2,204.3	2,210.0	2,235.0	2,246.2	2,223.6	2,220.1
Concretor 	1,889.1	1,887.2	1,878.0	1,807.2	1,837.0	1,787.6	1,742.2	1,758.5	1,725.4	1,748.1	1,759.0	1,625.1	1,610.2	1,736.7	1,731.6	1,754.7	1,772.2	1,791.6	1,702.6	1,740.3
Carpenter (formwork) 	1,809.1	1,771.1	1,768.1	1,814.0	1,761.6	1,773.6	1,767.0	1,779.1	1,789.8	1,787.1	1,804.0	1,800.3	1,796.7	1,815.9	1,826.4	1,833.9	1,876.6	1,866.1	1,876.4	1,855.6
Painter and Decorator 	1,267.0	1,277.8	1,267.0	1,292.0	1,281.7	1,293.8	1,296.0	1,301.2	1,321.6	1,307.2	1,316.2	1,314.4	1,312.4	1,356.0	1,344.4	1,326.3	1,327.2	1,317.8	1,307.4	1,303.2
Plasterer 	1,410.6	1,369.7	1,359.6	1,354.1	1,372.5	1,381.2	1,390.6	1,397.2	1,411.5	1,413.8	1,416.2	1,376.9	1,395.9	1,423.6	1,403.2	1,392.5	1,402.1	1,420.0	1,431.6	1,421.8
Metal Worker 	1,331.2	1,336.6	1,345.2	1,339.6	1,347.5	1,345.3	1,344.4	1,352.1	1,335.3	1,334.9	1,351.9	1,330.5	1,320.7	1,347.8	1,356.4	1,347.0	1,371.4	1,384.1	1,364.9	1,353.4
Plumber 	1,447.8	1,459.8	1,490.1	1,498.3	1,499.9	1,505.3	1,504.4	1,494.7	1,494.4	1,484.5	1,488.3	1,495.7	1,501.7	1,526.9	1,530.3	1,528.4	1,516.7	1,512.1	1,485.1	1,508.4
General Workers 	993.2	998.1	998.2	1,005.6	993.7	1,002.3	995.4	1,006.7	1,010.5	1,014.0	1,018.6	1,016.9	1,008.4	1,019.0	1,023.8	1,026.3	1,032.6	1,033.2	1,018.5	1,019.2

(Source: Census and Statistics Department)

MATERIAL COST TRENDS

AVERAGE WHOLESALE PRICES OF SELECTED BUILDING MATERIALS



(Source: Census and Statistics Department)

Decarbonisation of Buildings in Hong Kong – A Case Study

As an Asia-Pacific Economic Co-operation member, Hong Kong has announced “Climate Action Plan 2050” to outline the Government’s longer-term action in combating climate change and set out the carbon emission reduction target for 2050. To formulate the benchmarking baseline, a typical high-rise residential building is selected as a case to determine the general cradle-to-end of construction embodied carbon baseline. The case building is a 29-storey residential tower of about 40,000 m2 construction floor area.

Cradle-to-end of construction – Embodied carbon

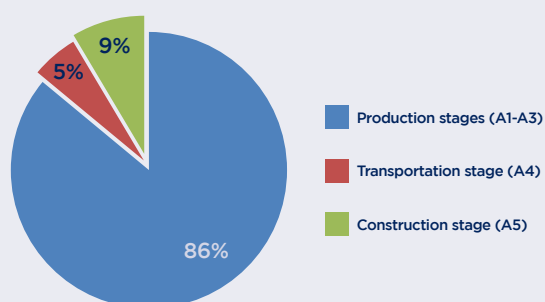


Figure 1: Cradle-to-end of construction embodied carbon in three stages

(Remarks: Further details regarding cradle-to-end construction (A1-A5) is discussed in feature article in March 2022 edition)

- The baseline of cradle-to-end of construction embodied carbon at the whole building level is 24,275 tonnes of carbon dioxide equivalents (tCO₂e), the emissions from various greenhouse gases on the basis of their global-warming potential. Proportion of embodied carbon in each stage is illustrated in Figure 1.
- The baseline of cradle-to-end of construction embodied carbon at the typical floor level is calculated as 610 kg CO₂e/m².
- It is worth noting that carbon emission in the transportation stage is higher than that of other studies, which is caused by the increasing carbon for delivering precast products despite they are more environmentally friendly than in-situ construction.

Embodied carbon of the case building – Production stage

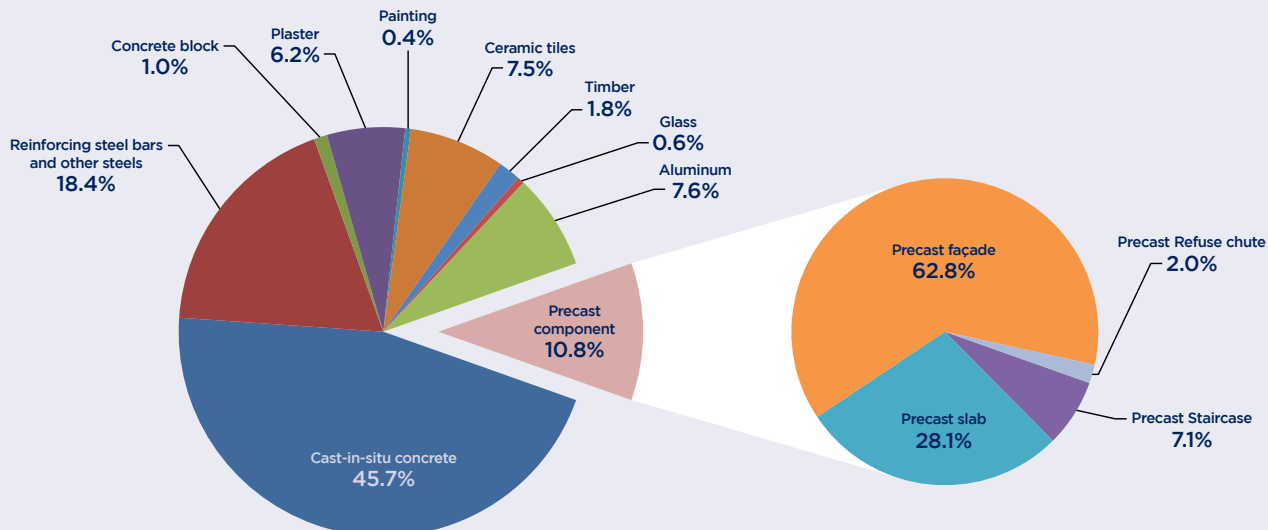


Figure 2: Embodied carbon measurement: material production and prefabrication

- Around 75% of the embodied carbon from the production stage is contributed by the production of concrete and steel, including on-site cast-in-situ components and off-site precast elements. Optimizing the ingredient and production process of concrete should be more effective for reducing the embodied carbon.
- Regarding precast elements, precast façade contributes most carbon emission in production stage, followed by precast slab and staircase. However, precast staircase generates the second highest embodied carbon in terms of kgCO₂ per unit, more than precast slabs. Attention should be paid when considering carbon reduction strategy.
- Aluminum and stainless steel, as well as ceramic tiles also contribute to a large amount of materials’ embodied carbon, followed by plaster. As one of the natural materials, plaster can help reduce embodied carbon. However, the use of it sometimes requires special design and protection, thus restricting the applications in practice.

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