Construction Technology

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1 Nov 2024

Residential Housing in Melbourne

Source: https://www.yourhome.gov.au/materials/lightweight-framing

Residential Housing in Malaysia

Source: https://myhome.my/gallery/construction-works/greentown-1-sl15-21/

Multi-storey Buildings

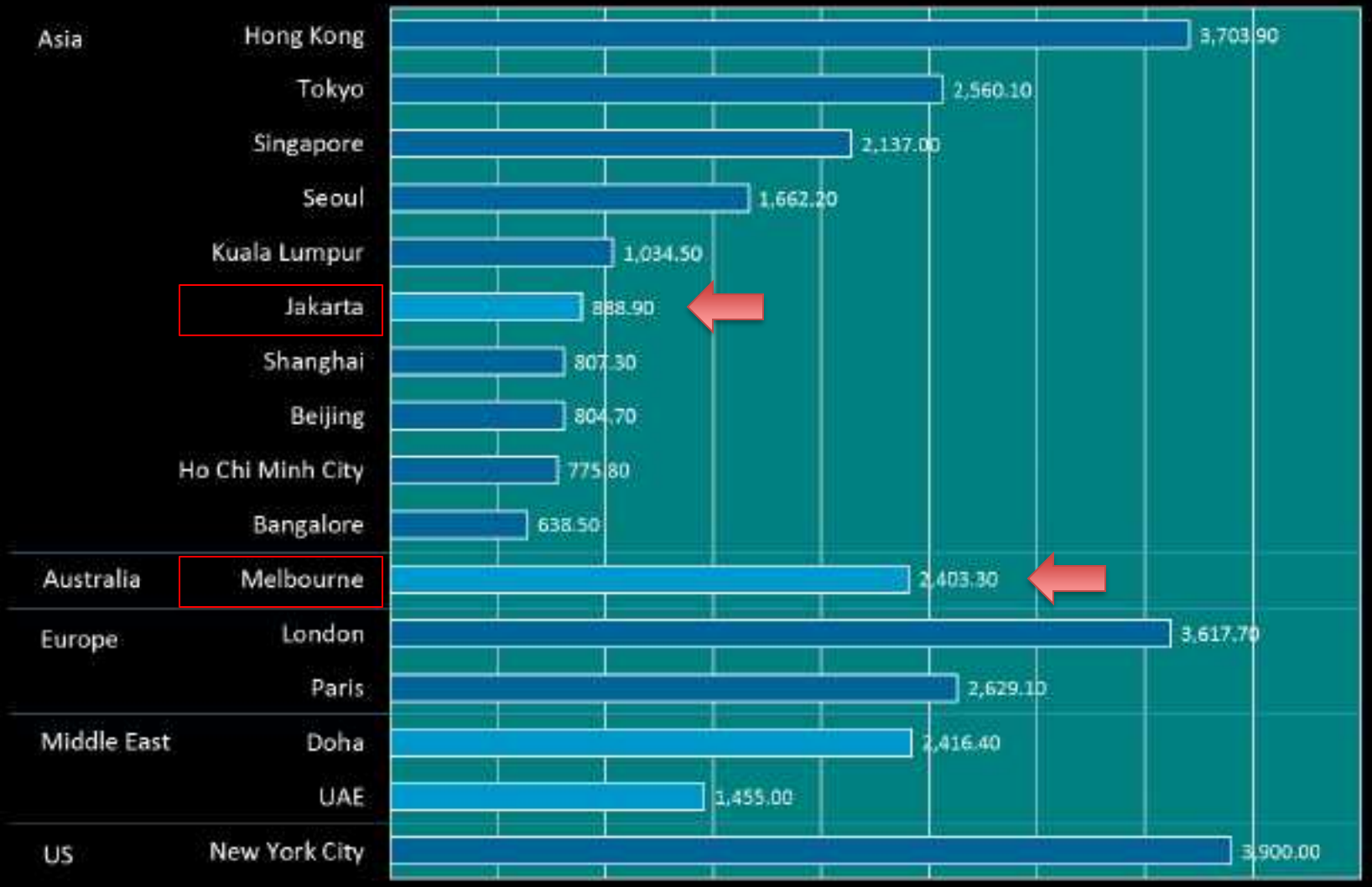
Source: https://www.propsocial.my/topic/1477/unfolding-the-sarawak-property-market-posted-by-propsocial-editor

Source: Unitised Building

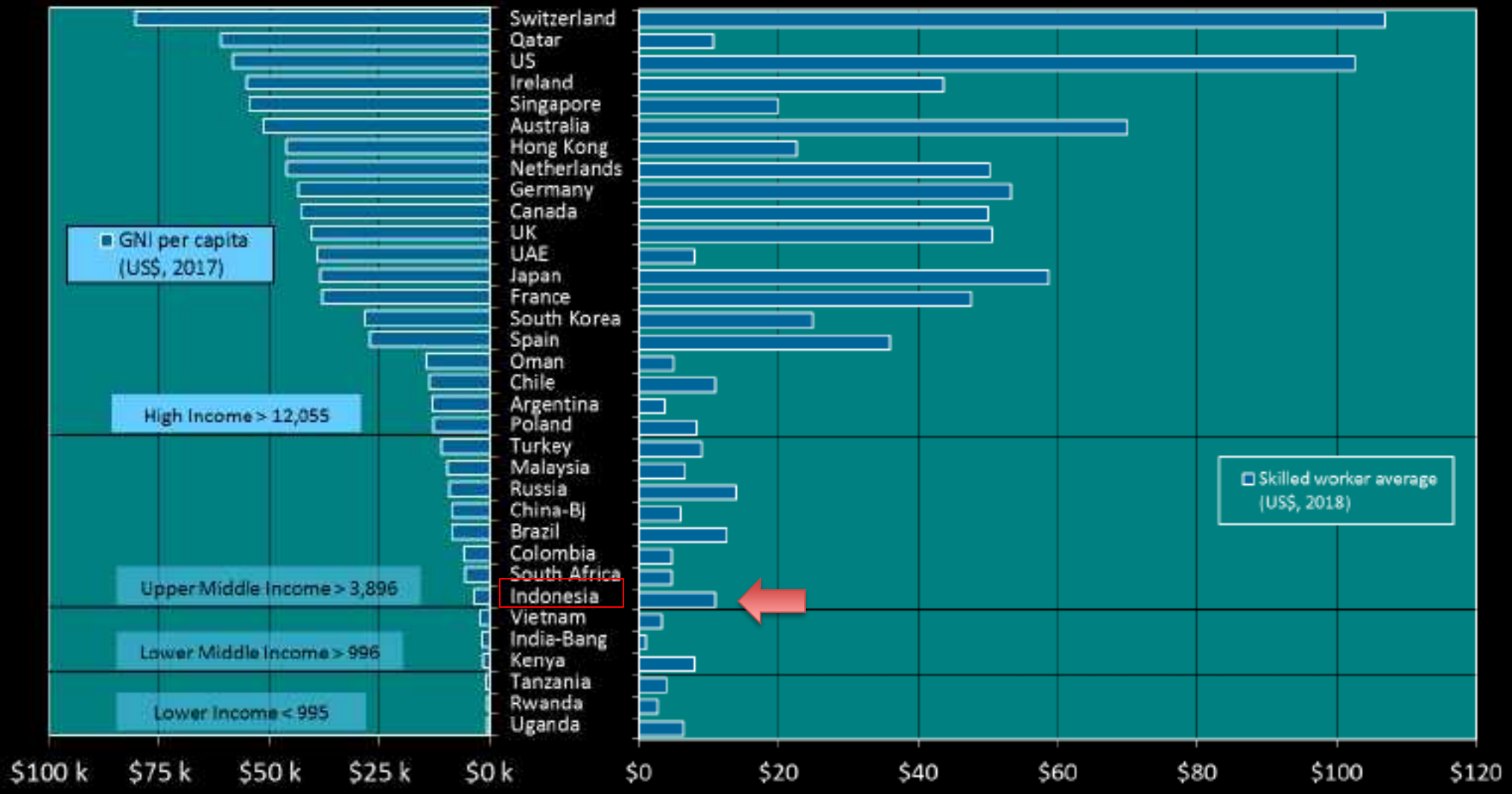
Contents

- How do we explain the differences in construction technology?
- Is there an optimum mix, technology adoption, construction system?
- Implications for industry

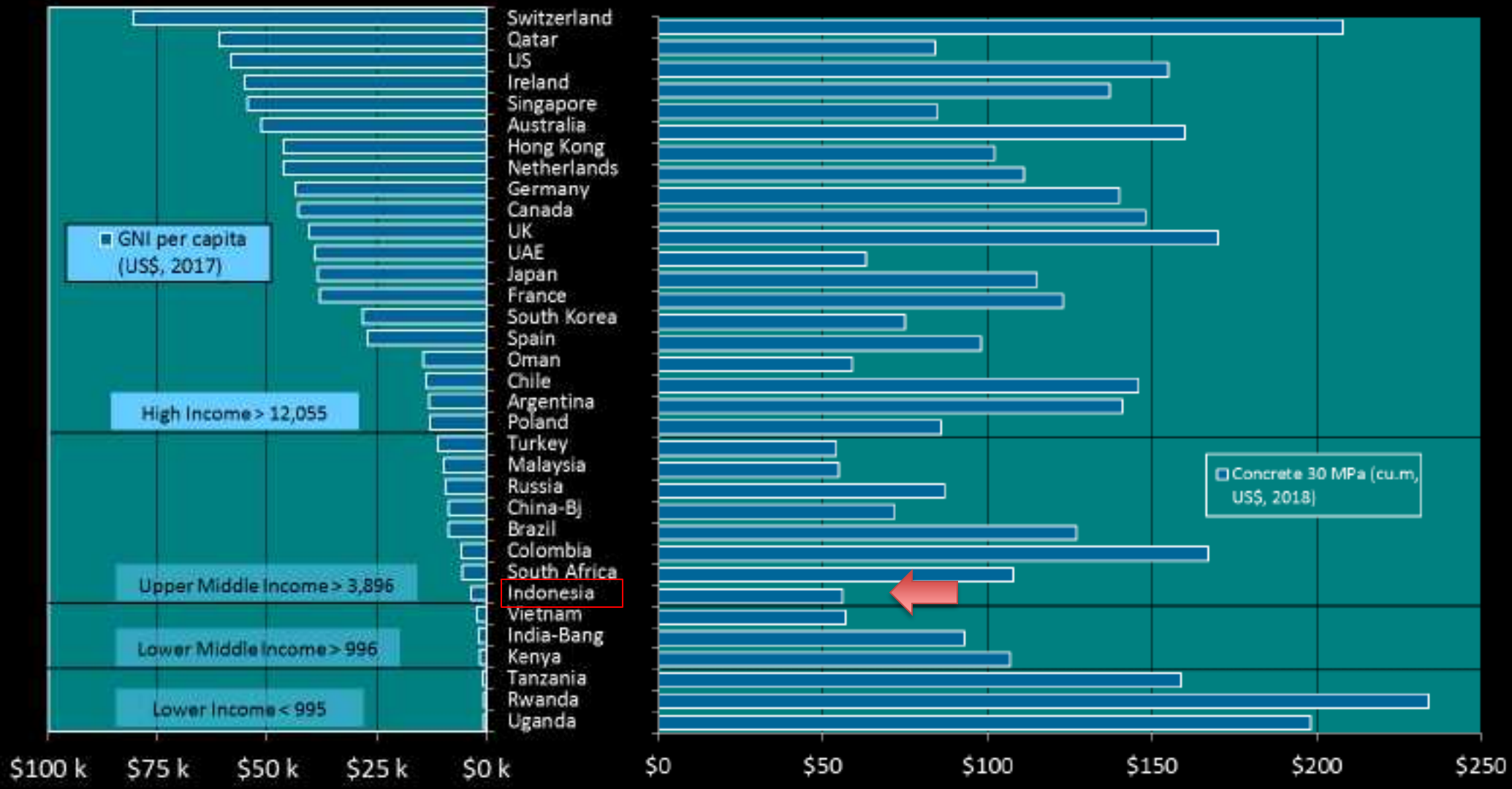
variation in building cost across major cities (US$)



skilled worker wages (per hr) vs GNI per capita (US$)



concrete cost vs GNI per capita (US$)



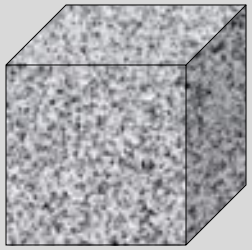
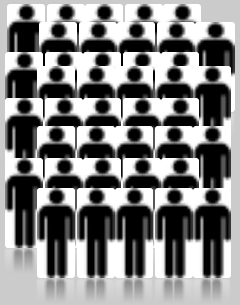
Existing comparisons:

- US$ comparison
- PPP adjustments?

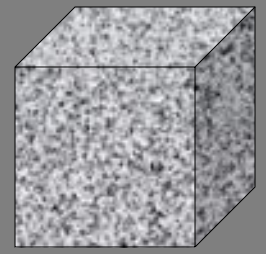
Alternatively, a new measure:

- examine basic input costs – labour, material and technology
- derive cost indices – remove effect of currency!
- correlates technology choice to cost indices
- implications for industry

concrete to labour cost ratio

			Indonesia	
concrete (1 m^3) 			 40	

Example:

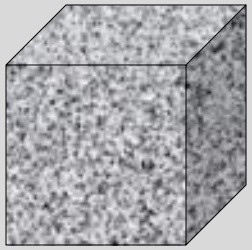
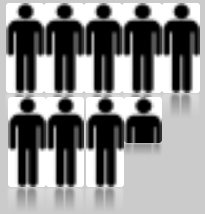
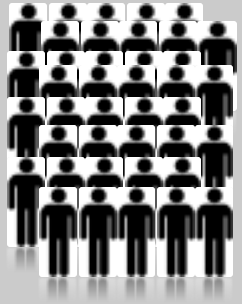
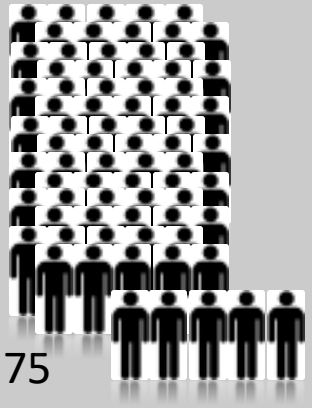


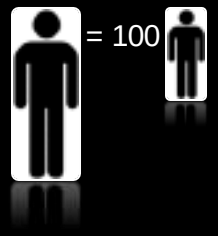
IDR750,000

IDR 18,750/hr

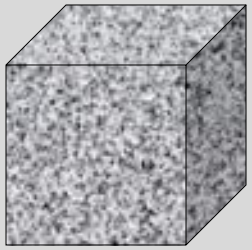
Therefore,
1 cu.m of concrete =
40 hours of labour

concrete to labour cost ratio

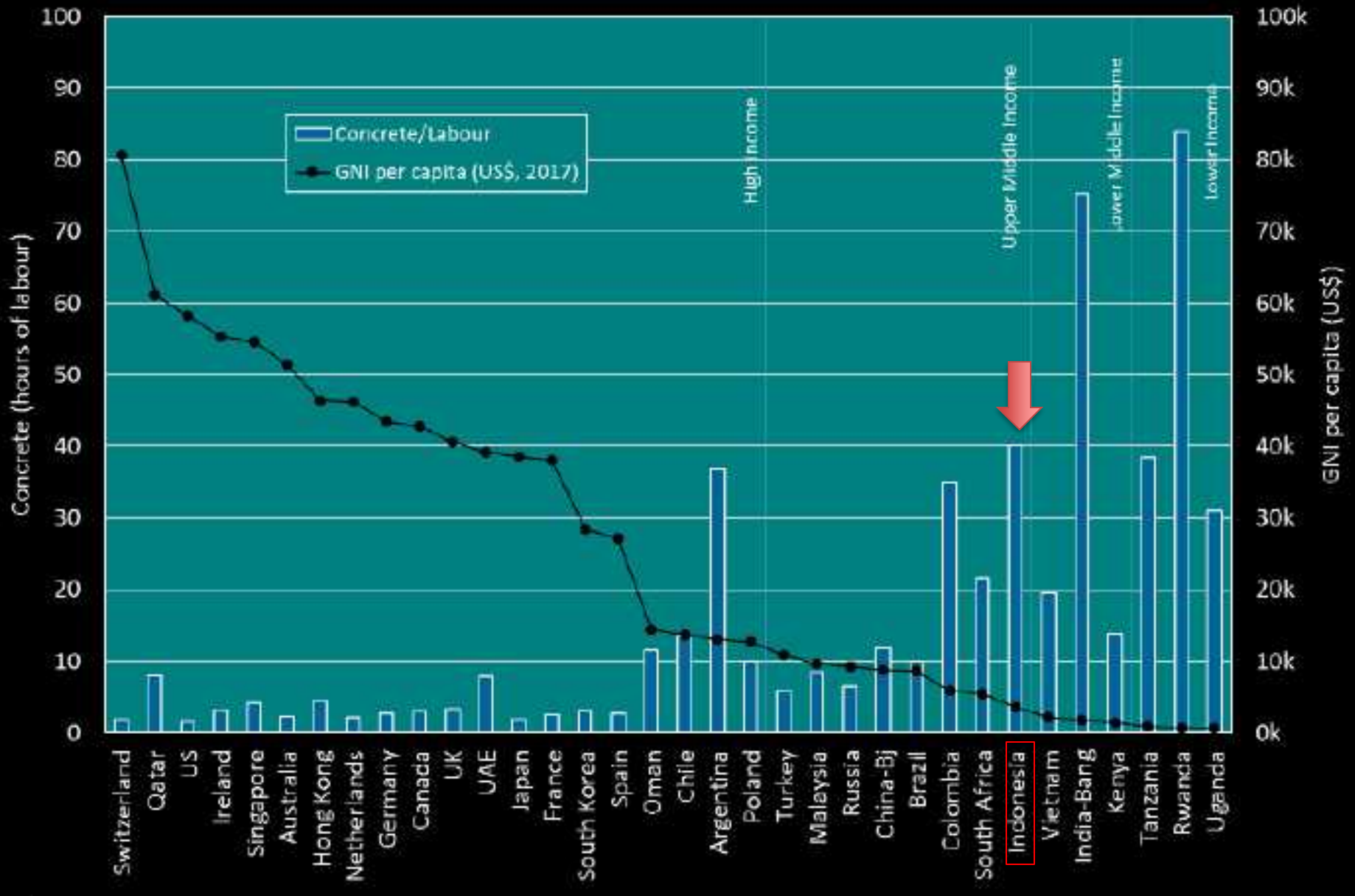
	Australia	Malaysia	Indonesia	India
concrete (1 m^3) 	 2.3	 8.5	 40	 75



concrete to labour cost ratio

	Australia	Malaysia	Indonesia	India
concrete (1 m^3) 	2.3	8.5	40	75
steel (1 m.ton) 	13.6	164	453	527

concrete-to-labour cost ratio



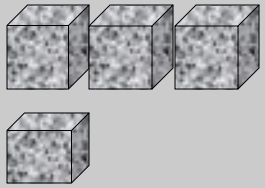
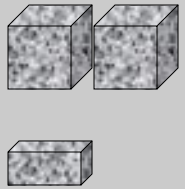
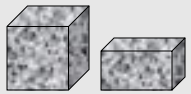
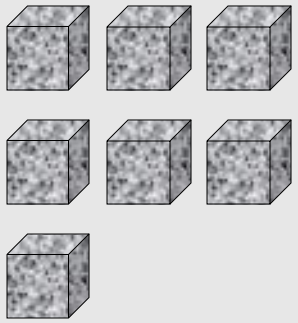
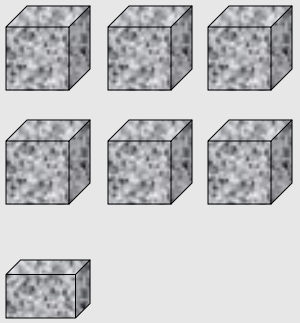
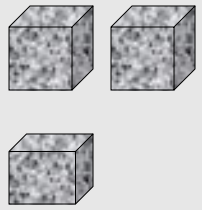
concrete-to-labour cost ratio

- labour is expensive in high-income countries, and
- concrete is expensive in lower-income countries

- utilise more concrete in high-income countries, and
- utilise more labour in lower-income countries

- countries with cheaper migrant labour distort concrete/labour ratio

brick-to-concrete cost ratio

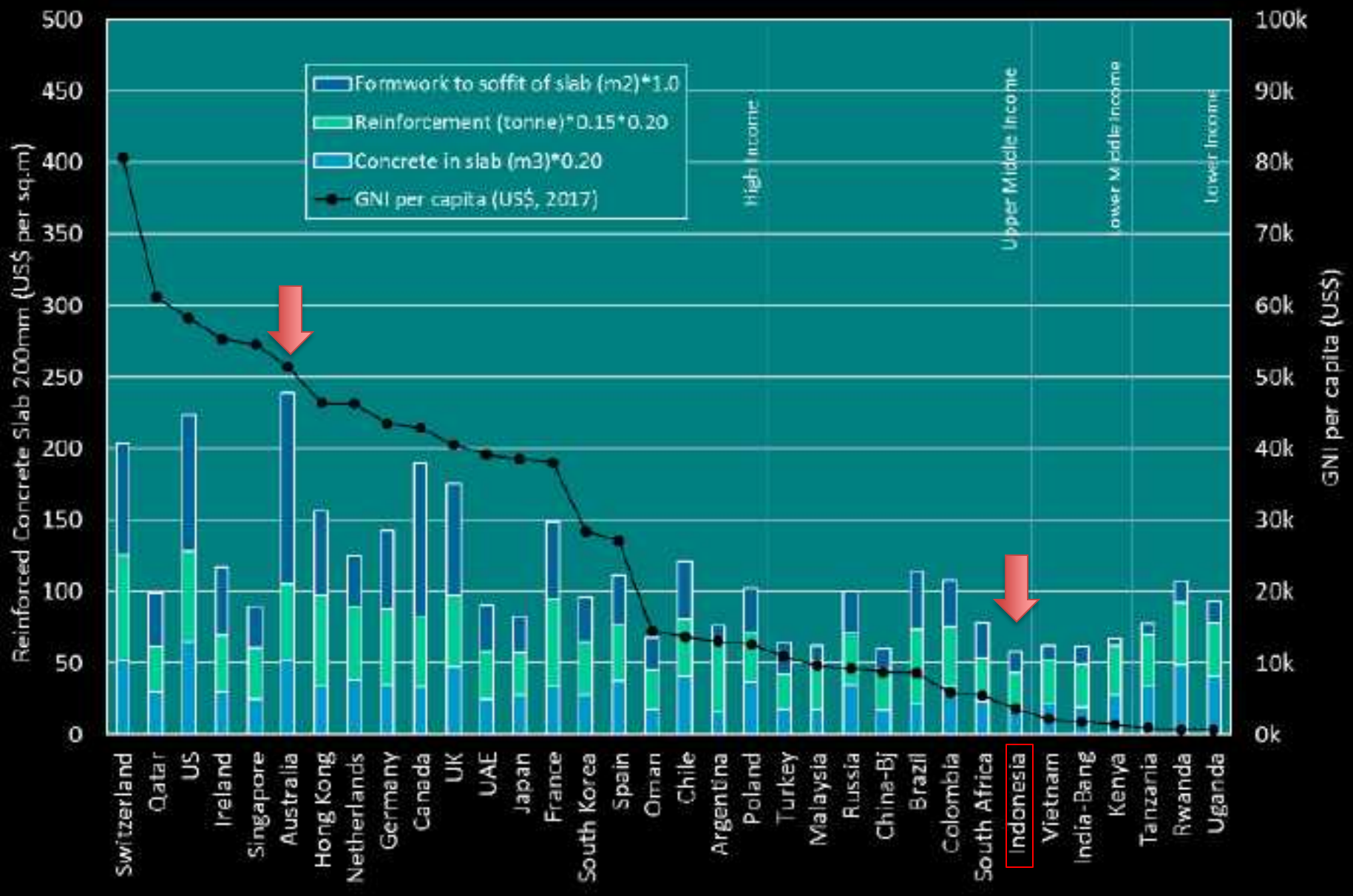
	Australia	Malaysia	Indonesia	India
bricks (1000) 	 3.9	 2.1	 0.7	 1.0
timber (100 metres of 100x50mm) 	 1.4	 7.0	 6.7	 2.8

reinforced concrete slab (USD)

Cost comparison for concrete slab

- steel = 150kg per m^3
- concrete = 200mm G30
- formwork = timber

reinforced concrete slab (USD)



reinforced concrete slab (USD)

- formwork cost is significant in high income countries due to high labour cost
- formwork cost is small in lower income countries due to lower labour cost
- countries with migrant workers exhibit lower formwork cost

- high labour cost countries will utilise more technology to save on labour – should lower- or middle-income countries adopt more labour-saving technology?

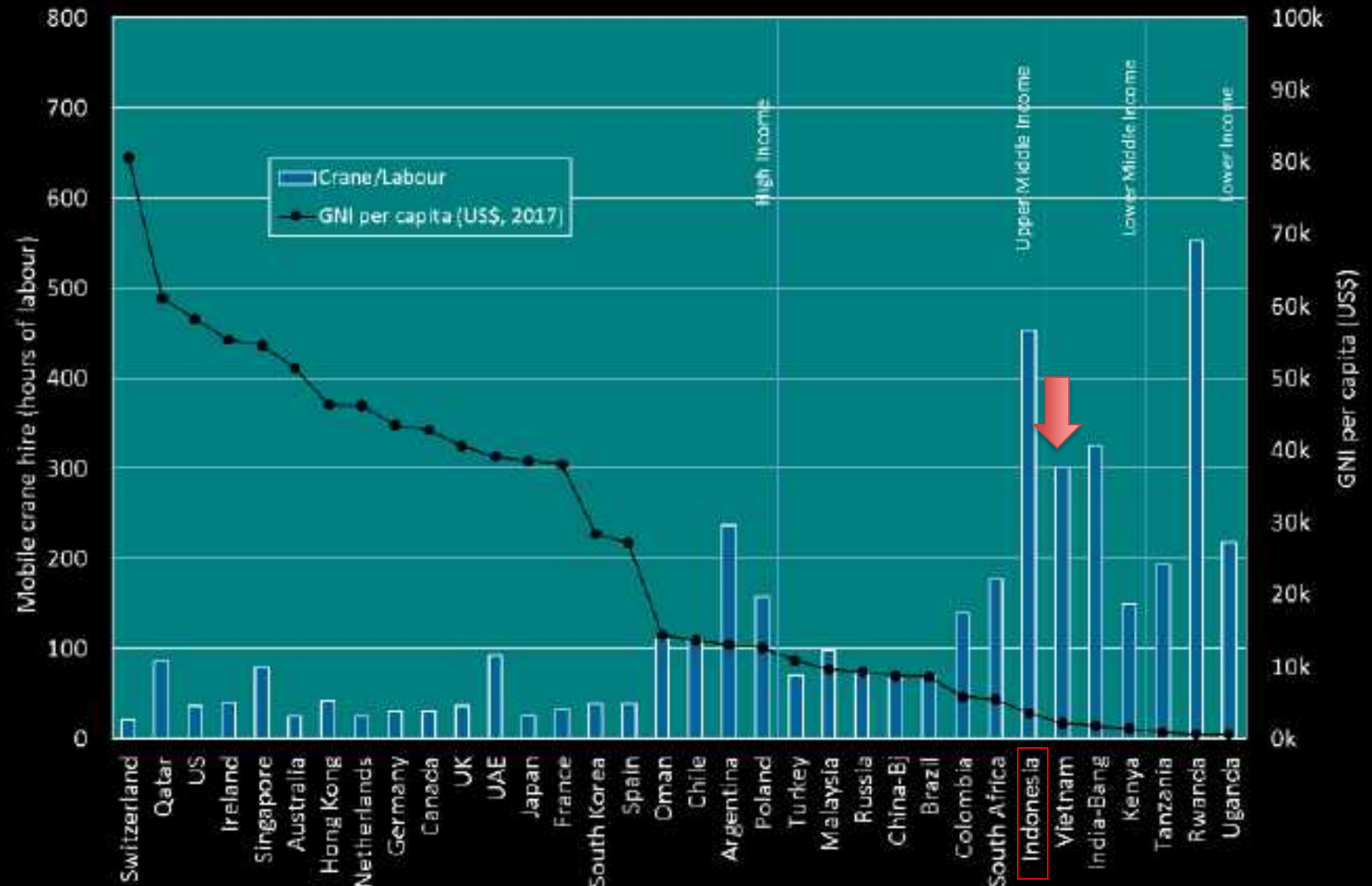
reinforced concrete slab (USD)

Low labour
cost country

reinforced concrete slab (USD)

Higher labour cost country

mobile crane-to-labour cost ratio



mobile crane-to-labour cost ratio

- technology is expensive in developing countries

- implications for industry
- invest in up-skilling
- raise worker income levels
- create more value add

longitudinal study: Melbourne, Australia

Reinforced concrete
beam and slab

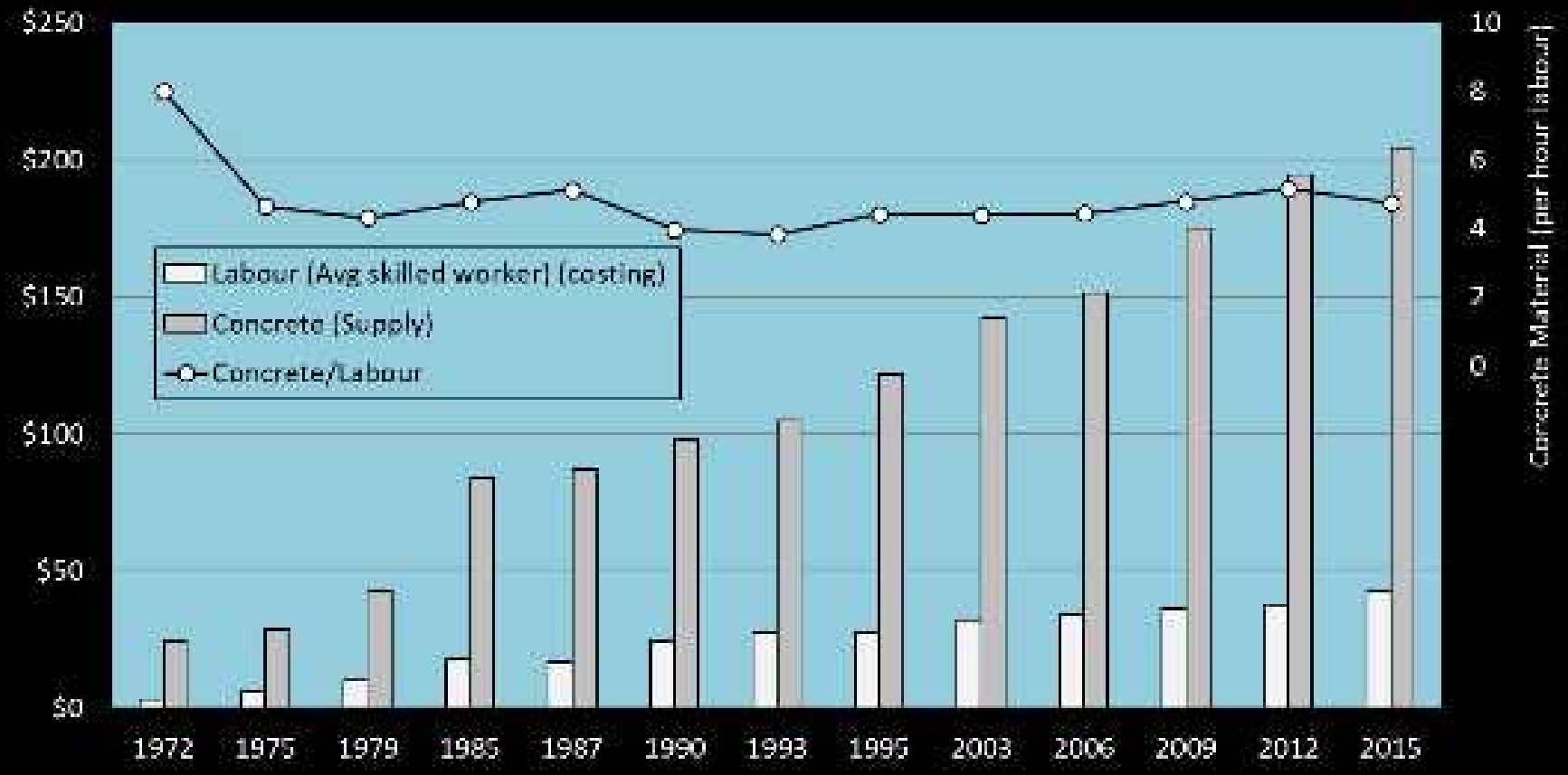
Reinforced concrete slab
with metal formwork

longitudinal study: Melbourne, Australia

Post-tensioned concrete slab with metal formwork

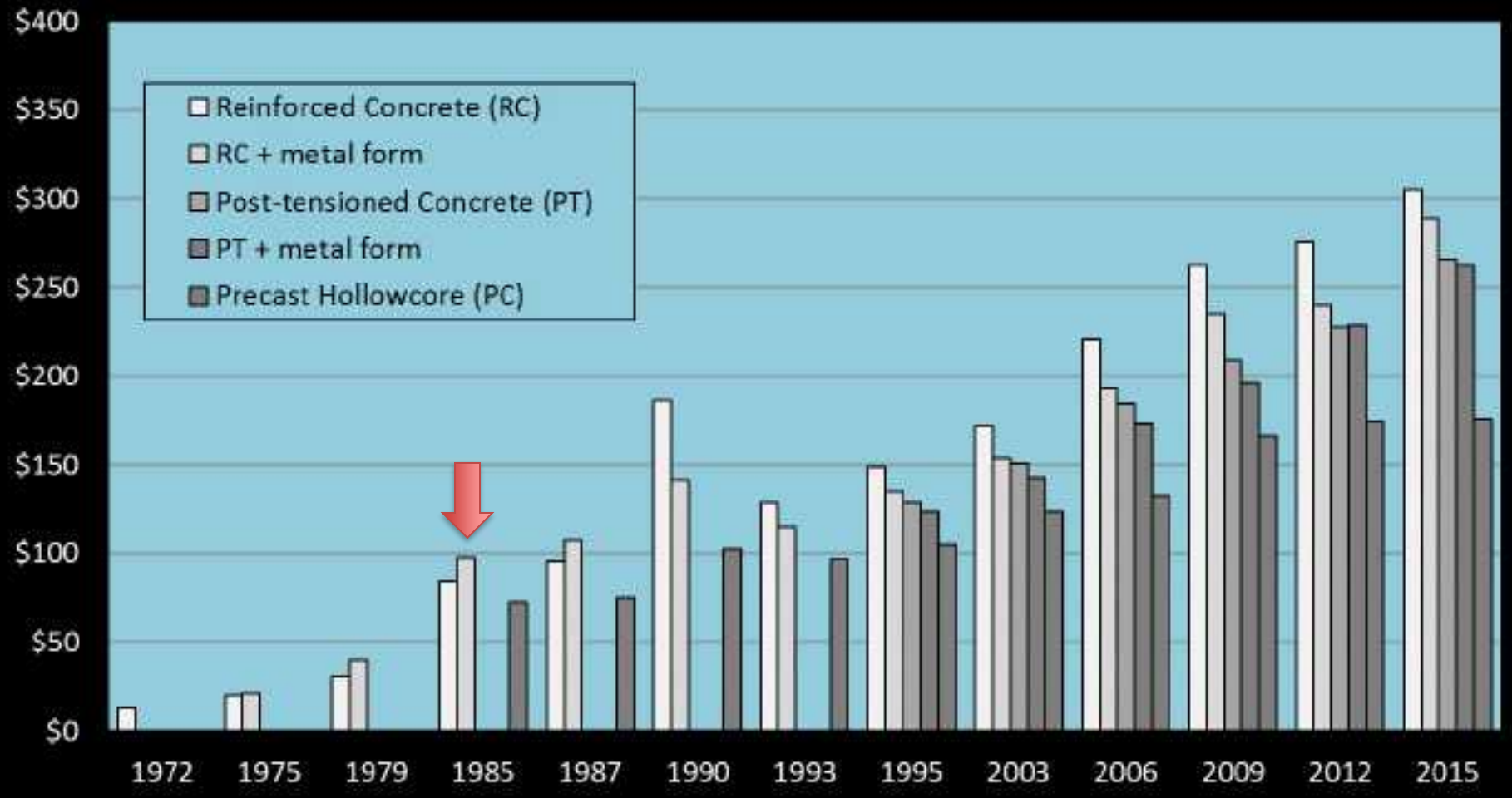
Precast concrete hollowcore planks, inverted-T beams, precast columns

longitudinal study: Melbourne, Australia



Increase in wages and concrete supply rate compared to five flooring systems in Melbourne (note that x-axis is not to scale)

longitudinal study: Melbourne, Australia



Increase in wages and concrete supply rate compared to five flooring systems in Melbourne (note that x-axis is not to scale)

longitudinal study: Melbourne, Australia

- transition from labour-intensive to labour-saving methods
- where are these transition points

longitudinal study: Melbourne, Australia

Year	1970 1974	1975 1979	1980 1984	1985 1989	1990 1994	1995 1999	2000 2004	2005 2009	2010 2014	2015 2016
Structural steel/concrete Ratio (average for 5-year period)	6.8	8.8	-	11.5	13.5	12.0	8.6	13.9	13.3	10.2
Tall Buildings | Materials										
a. composite	3	13	7	5	10	5	1	5	5	3
b. concrete	5	14	27	24	39	34	54	68	71	29
c. concrete/steel	1	1	0	0	0	0	0	0	3	0
d. masonry	0	0	0	0	0	0	0	0	0	0
e. steel	11	15	1	2	2	0	0	0	0	0
f. steel/concrete	0	0	0	0	0	1	0	0	0	0
Total	20	43	35	31	51	40	55	73	79	32
Percentage STEEL	70%	65%	23%	23%	24%	13%	2%	7%	6%	9%
Percentage CONCRETE	25%	33%	77%	77%	76%	85%	98%	93%	90%	91%
Percentage Hybrid	5%	2%	0%	0%	0%	3%	0%	0%	4%	0%

Number and percentage of structural materials for completed tall buildings in Australia from 1970 until 2016 (Source: CTBUH)

cross-laminated timber

cross-laminated timber

cross-laminated timber

industry challenges and opportunities

labour

- invest in training and up-skilling
- improve overall output per worker and labour productivity

materials

- use locally available materials – increase value add to economy
- grow local supply chains but maintain resource efficiency
- encourage sustainable practices

technology

- invest in technologies that enhances quality and productivity
- adopt digital tools?

industry challenges and opportunities (continued)

firms

- invest training of professionals and managers
- shift to high knowledge content, modern methods of construction
- build capacity in all areas of operations
- invest in occupational health and safety
- invest in quality assurance programmes

national

- one of the largest economic sectors
- develop national strategy for industry development
- domestic benchmarking for best practices

Construction Industry Institute Indonesia

Address the global challenge of construction, to foster collaboration between industry and academia, and to advance knowledge in construction management. The centre will focus on research into construction best practices, benchmarking of performance and bring the knowledge and expertise of global experts to Indonesia.

The aims for the ICRC are:

- Advancing scientific knowledge
- Fostering innovation and entrepreneurship
- Building capacity and collaboration
- Informing policy and decision-making

Construction Industry Institute Indonesia

Activities:

- Publication of research reports, market intelligence, and networking
- Research activities will be funded through sponsored research either directly by member firms or through various international or national research grants.
- Develop and deliver workshops on identified industry topics to industry professionals and provide tailored training program for construction companies
- Annual meeting

Construction Industry Institute Indonesia

Operation Model:

- Emulate the Construction Industry Institute at the University of Texas at Austin where leading owner companies, engineering-contractor firms, and service providers – from both the public and private sectors – collaborate through the CII to improve industry outcomes.
- Industry members pay a nominal annual fee to receive research and market reports, attend annual meetings to direct the research activities to address local and international challenges, and to avail themselves to the training materials developed.
- ITB to play a leading role in this research endeavour with the support of its international partners.
- International research partners bring expertise and global perspectives to inform on Indonesia’s role as the largest economy in Southeast Asia and its ambition to be a major player in the global economy.

Further questions to:

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