

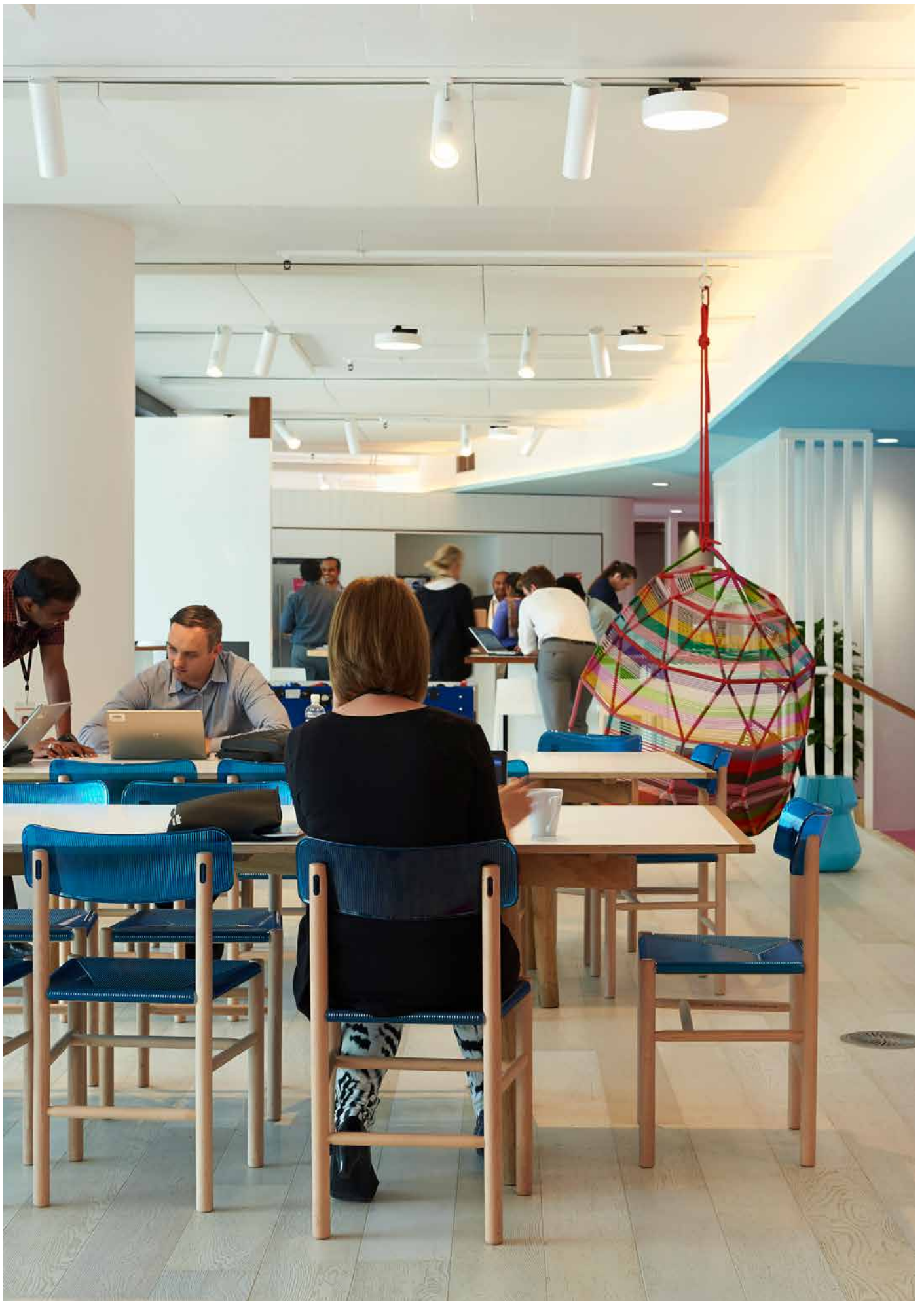
Cracking the Capacity Code

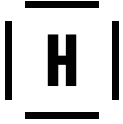
Rethinking Building Occupancy in a

New Era of Work

October, 2015







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DENSER OFFICE ENVIRONMENTS

New working practices are increasing the number of people per square metre in an office building. Organisations that have adopted flexible working are at risk of exceeding current building regulations and certifications.

The potential of contemporary offices could be increased by rethinking the way capacity is understood and nominated. The number of people per square metre within the workplace is on the rise.

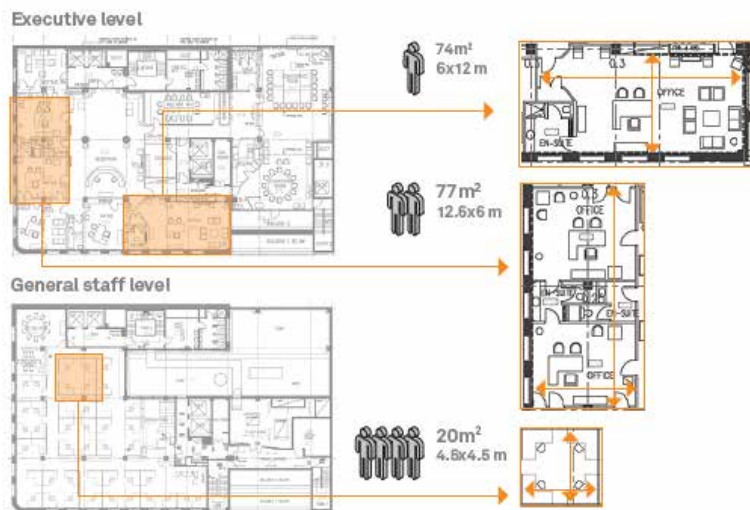
This is due to a combination of factors, including:

- the digitalisation of information making room for more people by reducing the amount of workspace and storage required

- the uptake of flexible working practices like Activity Based Working (ABW)
- evolving organisational cultures that are less reliant on space to denote hierarchy

Take the financial workplace as an example. Figure 01 shows the floorplates of offices for similar financial institutions in 1996 and 2013.

Figure 01
Typical floorplates
1996



General Manager
1:74m²*
_Ensuite with Shower
_Lounge
_16 Seats
_4 Windows
Manager
1:38m²*
_Shared ensuite
_2 Windows per office
General Staff
1:5m²*

2013



Senior Manager
1:16m²
Small meeting table
4seats
General Staff
1:3m²
Open plan breakout
collaboration area

*Based on highlighted area only, not inclusive of total NLA

The Changing Workplace

A clear standout of the workplace of 1996 is the private office, which was reserved for managers. Most general staff worked from cubicles. The hierarchical use of space had nuances amongst managers too. The office of the general manager equates to roughly two managers or 15 general staff.

This is in contrast with the 2013 office where space supports activities, rather than hierarchy. There is only one office which is 16m², less than half the size of the manager's office of the 1990s. It can also be seen that the allocated space for general staff has been reduced (from 1.5m² to 1.3m²). A new addition, however, are the variety of breakout and collaboration areas (in green) to support ABW.

While contemporary offices still have compactus rooms, their capacity, and footprint, is proportionally less than in the 1990s due to the digitalisation of information.

Digitalisation also allowed people to become more mobile within the office, and less reliant on an assigned desk.

In the more recent ABW example, the number of people in the office can no longer be counted by the number of chairs behind a desk, but must be based on a variety of parameters including ratios of people to workpoints, expected level of occupancy and real-time occupancy monitoring.

The driver of density

Increasing the number of people per square metre brings down the building's leasing and maintenance cost per person. As such, cost savings are a main driver of increased densities in workplace design.

However, density is only a measure of space efficiency and does not reflect the effectiveness of space use by its occupants.

What is more, a highly dense space may have a negative effect on workers' productivity as a result of overcrowded working conditions. Some studies isolate geography-based culture norms as an influencing factor in tolerating density.

The need for research

How is this increased density reflected in current codes and regulations governing office environments? This is an important question because it determines the safety, comfort and usability of the building. Issues range from ensuring the safe evacuation of its occupants in an emergency, to providing adequate amenities and a comfortable environment.

To this end, in 2014 Hassell partnered with Arup to explore this topic further. The following report shares our findings to date.



Workplace 1990s



Workplace - 2014

DENSITY AND DESIGN

Reviewing codes and regulations in Australia

The National Construction Code (NCC) states the minimum necessary requirements for the design and construction of buildings. We identified the clauses (or articles as they are referred to in the Code) that address the number of people in an office building.

Table 01 shows the outcome of an automated search of the 2014 online version of the NCC using keywords related to the number of occupants in a building.

The results show the ambiguity of the terms related to building capacity, as well as the scarcity by which it is discussed. Only three out of 104 articles deal with, or are related to, the number of people in a building. Surprisingly, the word 'density' in relationship to building population was not found in the NCC—although the concept of people per square metre is.

A similar process was applied to other building regulations and certifications, including those developed by Property Council Australia (PCA) to ascertain the quality of the building, and Green Star by the Green Building Council of Australia to verify the merits of its sustainable design.

A total of eight design and services parameters within the Mechanical, Hydraulic, Fire Engineering, Vertical Transportation and Pedestrian Planning disciplines were identified to be determined by the number of people occupying the building, see Table 02.

Table 01
Number of articles in NCC per search word

Search Word	No. Of Articles	Comments
Capacity	24	Only Part D1 Provision for Escape, is relevant. Others refer to capacity as the ability to perform or satisfy a condition (e.g. load bearing)
Density	5	All articles refer to unrelated topics (e.g. illumination power density).
Occupancy	46	All, except one article, refer to occupancy as a classification criteria of buildings (e.g. sole-occupancy). Specification JV Annual Energy Consumption Criteria establishes the occupancy profile.
Persons	29	Only one article, F2.2 Calculation of Number of Occupants and Facilities. Other articles refer to types of persons (e.g. aged, or disabled).
Population	-	No articles found containing the word population.
Visitors	-	No articles found containing the word visitors.

Table 02
List of codes by discipline

DISCIPLINE / Code

MECHANICAL - Ventilation

AS 1668.2: Section 2.2.2 Occupancy, Minimum outdoor airflow rate of 7.5L/s. Tables A1 & B1(Exhaust air will increase proportionally with amenities fixtures).

MECHANICAL - Electrical

NCC - Specification JV Annual Energy Consumption Criteria: Occupancy profiles to be utilised for calculation of energy consumption.

MECHANICAL - Heating & Cooling

The population set the basis for the expected internal heat gains allowed for in the HVAC design.

HYDRAULICS - Sanitary Fixtures

NCC - F2.3 Facilities in Class 3 to 9: Amenities fixtures based on population, including anticipated male/female split.

FIRE ENGINEERING - Egress

NCC - D1.13 Number of persons accommodated: establishes maximum density (1:10m²)
NCC - D1.6 Dimensions of exits and paths of travel to exits: nominates exit width of minimum 1m plus 250mm for each 25 persons (or part) in excess of 100.

VERTICAL TRANSPORTATION - Lifts

PCA - Lift calculations depend entirely on the number and location of people within the building.

PEDESTRIAN PLANNING - Flow

PCA - Flow of people through lobby areas. Quantity of speed styles, etc based on population.

Are 'typewriting and document copying' representative of current workplaces?

According to NCC clause D1.13, the number of persons accommodated in an 'office, including one for typewriting and/or document copying' is one per 10 square metres.

The qualifier of 'including one for typewriting or document copying' does not reflect contemporary work environments. This description and the condition to satisfy have not changed since first introduced in the 1990 edition of the Building Code of Australia.

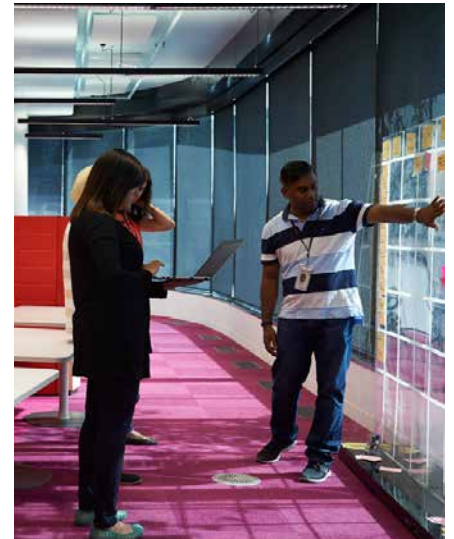
Given that clause D1.13 is a statutory requirement which deals with the critical issue of egress, this effectively sets the maximum occupancy density as 1:10m². This means, the maximum density in an office building in Australia has not increased in 25 years despite the intervening changes in technology and work practices. Contemporary workplace environments are being limited in their potential by outdated buildings codes and regulations.

This problem is exacerbated in organisations that have adopted flexible working strategies (like ABW), where people to desk ratios and assumed occupancy are already within existing limits. In such cases, unexpected changes in these assumptions could render the

building non-compliant. Events like a higher than expected (assumed) number of visitors, which does not appear to be considered in the NCC (see Table 01), could also exceed the regulatory design capacity of the building.

It is worth mentioning that item 'c' of Clause D1.13 states that the number of persons accommodated in a building can also be determined by 'any other suitable means of assessing its capacity'.

This offers an alternative to the nominated maximum density of 1:10m² as previously discussed. However, it is open to ad-hoc solutions and does not address the problem.



Medibank Workplace, Melbourne, Australia
Photography by Earl Carter

WHAT CAN WE DO?

It would be clear and simple to remove the 'typewriting and document copy' qualifier from the office description and increase its density to whichever value seems appropriate.

'For every complex problem there is an answer that is clear, simple, and wrong.'

H.L. Mencken

However, using space planning densities alone to nominate capacity could be as ill-fitting as the outdated interpretation of the office.

Perhaps the solutions might not be to pursue higher space planning densities, but to rethink the way we calculate the number of people in a building.

This conclusion is drawn from a modelling prototype developed to test different population scenarios against the Hydraulic and Fire Engineering codes. We observed that the conditions to satisfy failed in a staggered fashion, see Table 03.

Lessons from these simulations could add to a revised framework that better reflects the dynamic nature of occupancy in contemporary office environments. It is recognised that instigating changes to such an established framework would be a complex and a long endeavour.

A clear, simple and right solution is needed. This could come from using the existing framework in a different way. For example, Table 04 is a filtered version of the original table in the NCC that nominates densities for different environments.

This table removes items usually not relevant to workplaces, like a dance floor, but leave those similar to cafe-like settings that are popular in contemporary office environments due to their ability to promote interactions between people.

The specified density of a cafe is 1:1m², 10 times higher than that specified for the 'office'.

Transurban, Melbourne, Australia
Photography by Dianna Snape



Cracking The Capacity Code

Similarly, ABW includes spaces that are comparable to libraries or reading rooms which also have a high density (1:2m²).

Reinterpreting the modern office as an amalgamation of different spaces where different activities happen could result in a multi-zone density that better reflects contemporary offices.

This, of course, would need to take into account possible changes to the fitout throughout its lifetime.

For example, a cafe-like environment might be refurbished to a gymnasium in the future - each of which has a different density.

The table below groups scenarios by columns (increase in population) and shows the impact on Fire Engineering and Hydraulics disciplines.

The occupancy rows indicate the population at average and peak for each scenario.

The rows in colour indicate whether the parameter is under, at or over capacity, based on an organisation of 100 people with an assumed occupancy of 90% peak and 70% average in a 1,000m² NLA office.

Table 04 shows an example of the type of uses found in NCC that can also be found in contemporary office environments.

Table 04
NCC and contemporary office uses

Type of use	m ² per person
Board Room	2
Cafe, dining room	1
Gymnasium	3
Kitchen	10
Library - reading spaces	2
Reading room	2
General Classroom	2
Theatre and public hall	1

Table 03
Impact on Fire Engineering and Hydraulics

	+0%	+10%	+30%	+45%	+70%	+75%	Legend
Occupancy	100	110	130	145	170	175	
Average	70	78	92	102	120	124	
Peak	90	100	118	132	154	158	
Fire Density							
Average							
Peak							
Washbasins							
Average							
Peak							
Closet pans							
Average							
Peak							
Urinal							
Average							
Peak							

The table above groups scenarios by columns (increase in population) and shows the impact on Fire Engineering and Hydraulics disciplines. The occupancy rows indicate the population at average and peak for each scenario. The rows in colour, indicate whether the parameter is under, at or over capacity. Based on an organisation of 100 people with an assumed occupancy of 90% peak and 70% average in a 1,000m² NLA office.

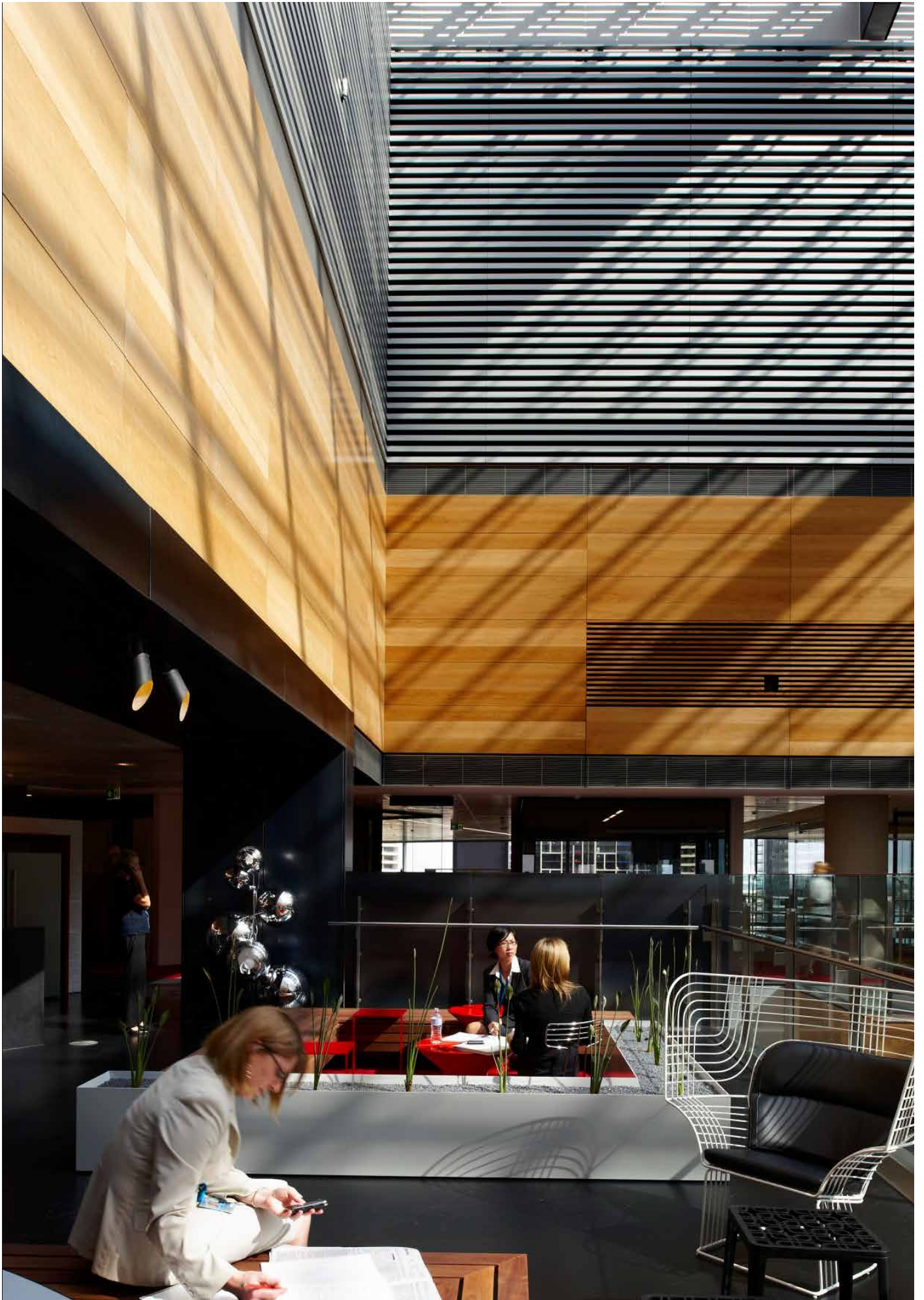
CONCLUSIONS

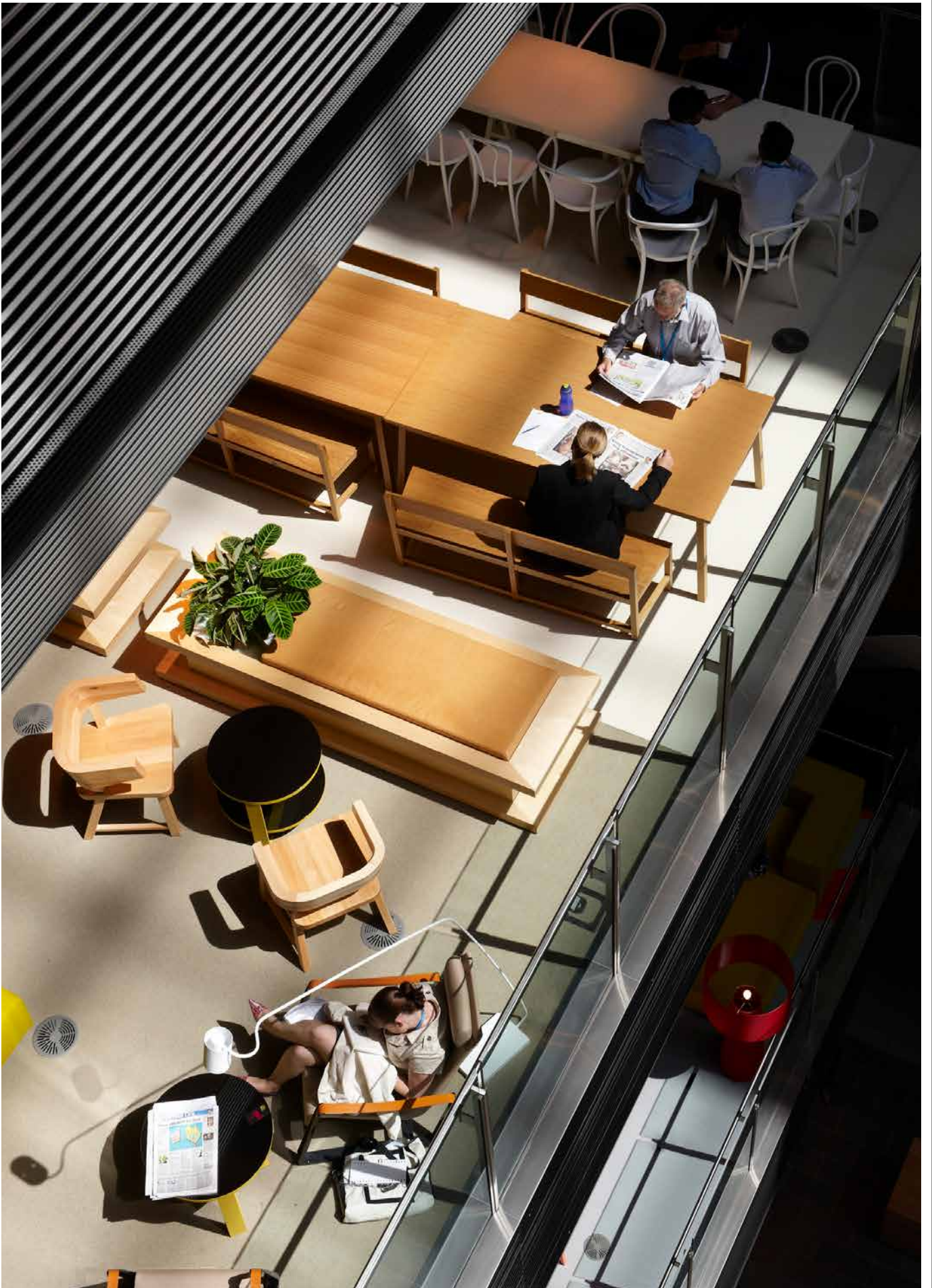
The NCC definition of an office and its nominated density have not changed since first introduced in 1990. This is a problem because it fails to acknowledge the intervening changes in technology and work practices which, amongst other changes, have created denser environments.

As such, contemporary office buildings, especially those that have adopted flexible working practices, are not only being limited in their potential, but are at a high risk of exceeding their design capacity.

Our research suggests that efforts should not focus on nominating a higher density, but on developing a framework that better reflects the nature of occupancy in contemporary work environments. However, the prevalence and importance of space efficiency as a strategy to reduce property costs require a faster solution. An interim approach might be to develop an ABW-like, multi-zone density method in which building capacity is nominated based on matching activities with relevant uses already specified in the NCC.

In any case, the solution must maintain - if not improve- the safety, usability and comfort of office buildings. The process to reach that solution must be inclusive of all stakeholders including designers, engineers, developers, tenants and ultimately the occupiers.





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