

CREAM OF BEAM Plus

A General Case Review of Green Buildings

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Abstract: BEAM Plus is Hong Kong's green building assessment system. In this study, the author analysed the assessment results of 12 projects which had achieved the highest rating, i.e. Platinum, including 11 Provisional Platinum projects and 1 Final Platinum project. The common success factors of these projects were found to be excellent indoor environmental quality, low water use as well as proper energy and pollution management. Nevertheless, there was room for improvement in microclimate study, analysis and minimisation of material embodied energy, extended use of renewable energy and extra water saving through grey water recycling, despite the fact that the average score of these projects was well above the minimum level for Platinum. The study demonstrates that BEAM Plus has driven the creation of more healthy, efficient and sustainable buildings in Hong Kong. With the continuous upgrading of the rating tool, the green building movement is expected to continue and thrive.

INTRODUCTION

First initiated in 1996, Building Environmental Assessment Method (BEAM) is a voluntary green building certification scheme tailor-made for the sub-tropical high-density urban environment of Hong Kong. The scheme has evolved throughout the years. In 2009, a major revamp of the scheme was made with the production of an enhanced rating tool known as "BEAM Plus" [1]. The enhancement was developed in response to global concern on climate change and to meet higher expectations in reduction of carbon emissions, site utilization and passive design. The rating tool provides building users with a single label that represents a wide range of building performance issues. A BEAM Plus-certified building is comparatively healthier, more comfortable, more energy efficient and with lower adverse environmental impact. The awards that buildings can obtain under the scheme are Platinum, Gold, Silver, Bronze and Unclassified. This paper reviews the key attributes of the first 12 Platinum-rated projects, including 11 Provisional Platinum projects and 1 Final Platinum project, which have been certified between scheme commencement and end of 2012.

BACKGROUND

Registration for BEAM Plus assessment commenced in August 2010. Up to now, over 300 projects have been registered for the scheme [2]. An analysis of the registered projects up to the end of 2012 revealed that nearly half (48%) of the projects were residential in nature. The next two major categories were Commercial (23%) and Government, Institution or Community (GIC) (16%). This indicates that a wide spectrum of buildings have participated in the certification. Details are shown in Figure 1.

As of the end of 2012, 26 projects had completed the design stage assessment (Provisional Assessment), while one had completed the post-construction stage assessment (Final Assessment). Profile of the assessed projects is given in Figure 2.

In total, the study examined 11 Provisional Platinum projects and 1 Final Platinum project. A breakdown of these projects by building category is shown in Figure 3. The majority (58%) were of GIC category. Nevertheless, each of the remaining main categories (i.e. residential, commercial or industrial) had one or two representative Platinum projects.

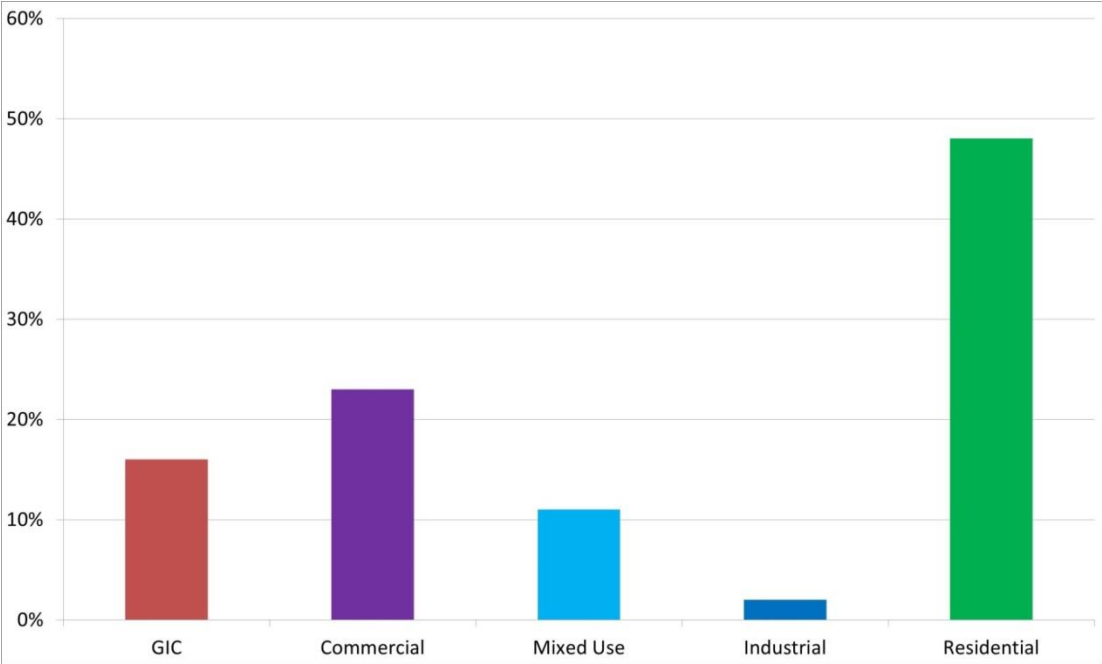


Figure 1: Registered projects (305 nos.)

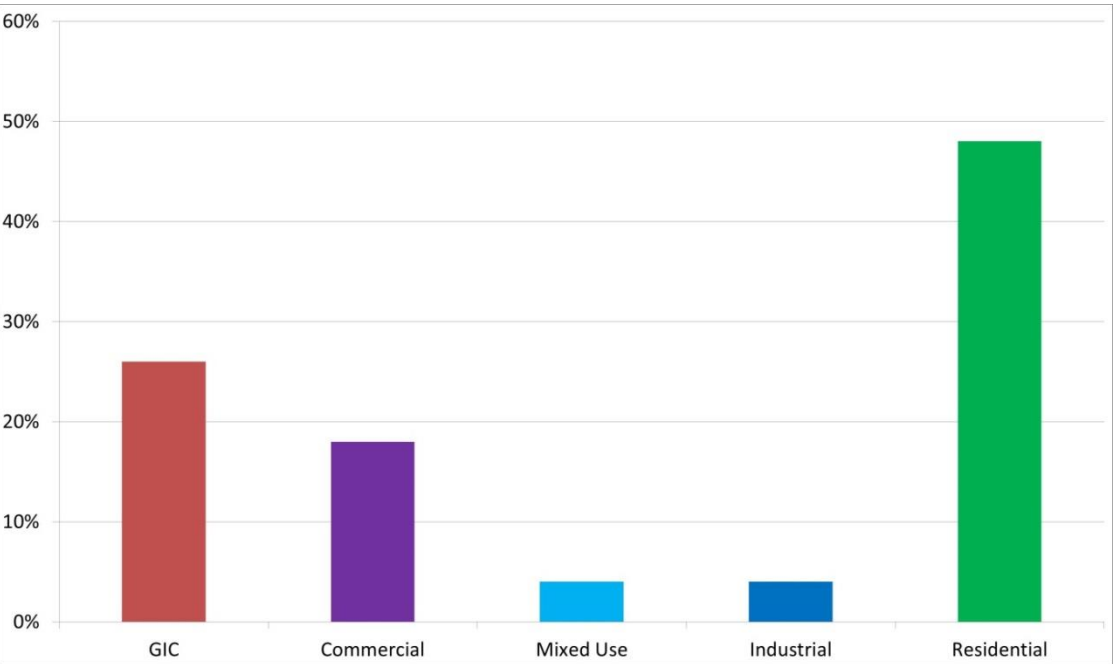


Figure 2: Assessed projects (27 nos.)

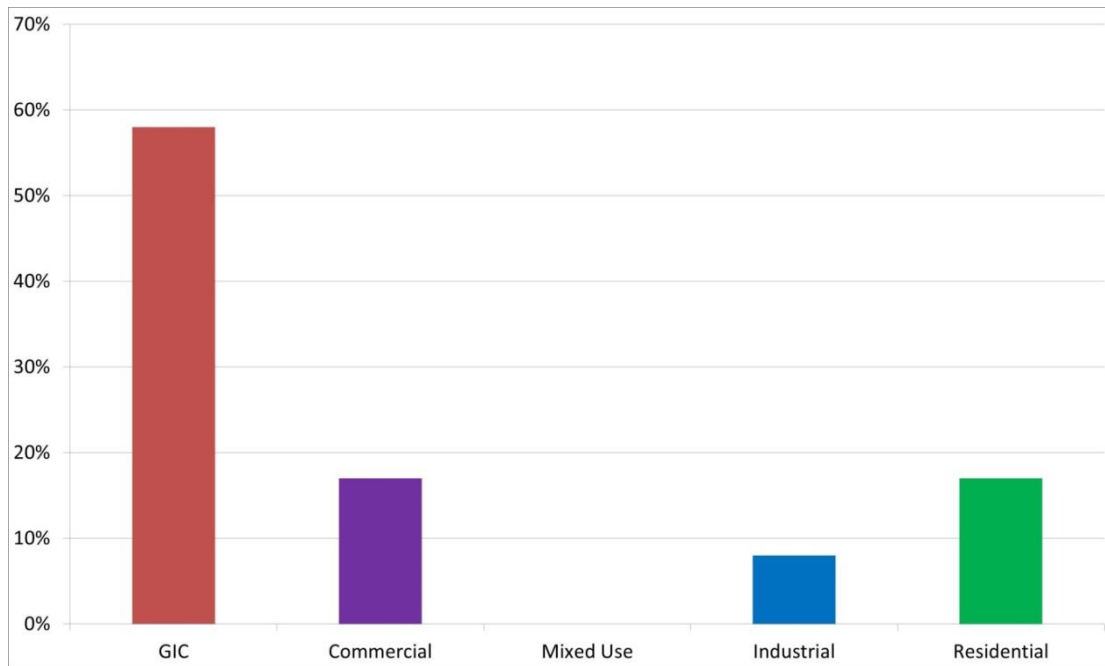


Figure 3: The Building Category of the Provisional and Final Platinum projects (12 nos.)

ANALYSIS OF THE PROJECTS

An analysis of the Assessment Reports [3] of the 11 Provisional and 1 Final Platinum projects was conducted. The observations are presented below.

Project Scores

For the purpose of this paper, commercial and industrial were combined into one group to avoid disclosing the identity of the projects. Below Figure 4 illustrates the individual score for each project by type and category.

While 75% is the minimum Overall Score required to achieve the Platinum rating, more than half (7 in total) achieved scores higher than 80%, reflecting a substantial effort to achieve a greener building and lower environmental impacts.

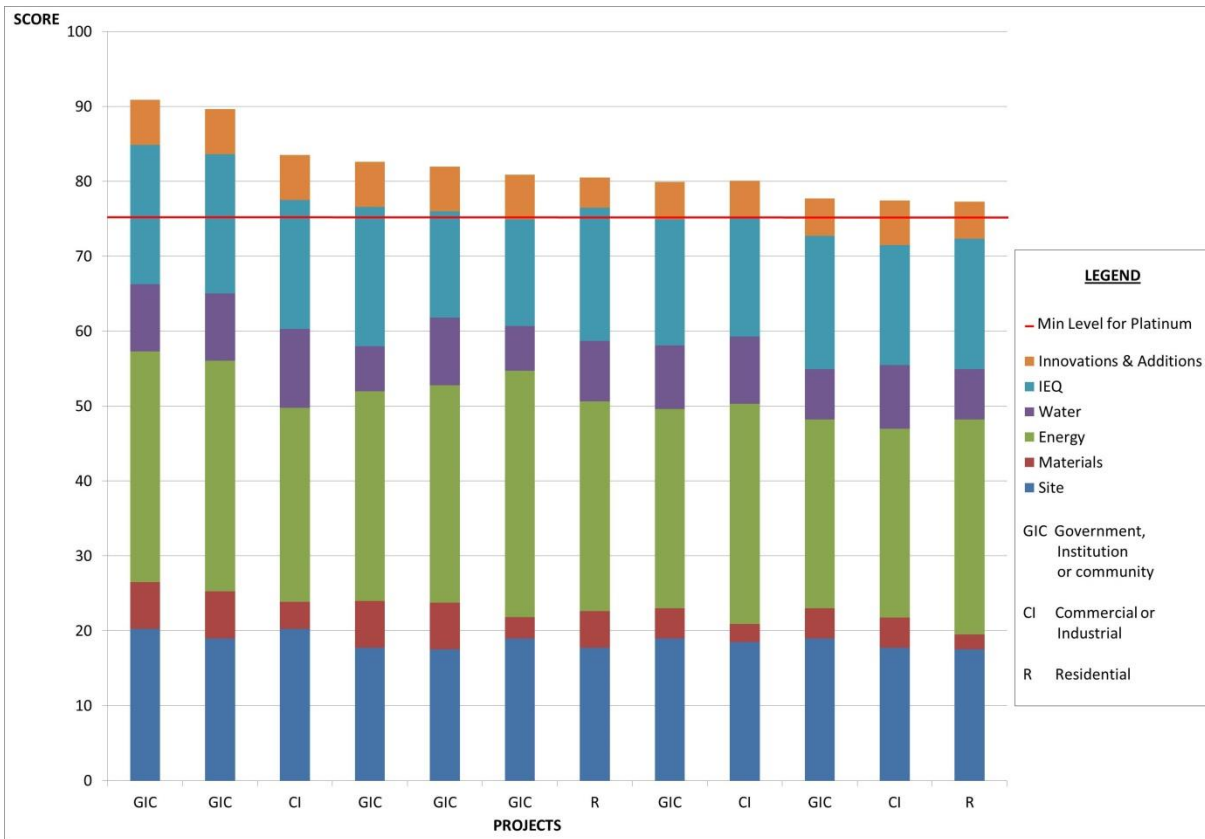


Figure 4: Individual scores achieved by the 11 Provisional and 1 Final Platinum projects and their breakdown

The 6 highest score projects were dominated by GIC (5 out of 6), with both the highest score and second highest score attained by them. The third highest score was attained by a private sector project, demonstrating that private sector is also enthusiastically pursuing green building.

An analysis of the 5 private sector projects revealed that whilst 2 were well-established enterprises, the remaining 3 were not in the top range in terms of company size in their respective sectors. This reflects that environmental policy, rather than organisation size, of the project proponent matters.

Category Scores

BEAM Plus assessment is divided into six categories, namely Site Aspects, Materials Aspects, Energy Use, Water Use, Indoor Environmental Quality (IEQ) and Innovations and Additions. The average score of the 12 projects in each category and in the overall total is illustrated in Figure 5 below:

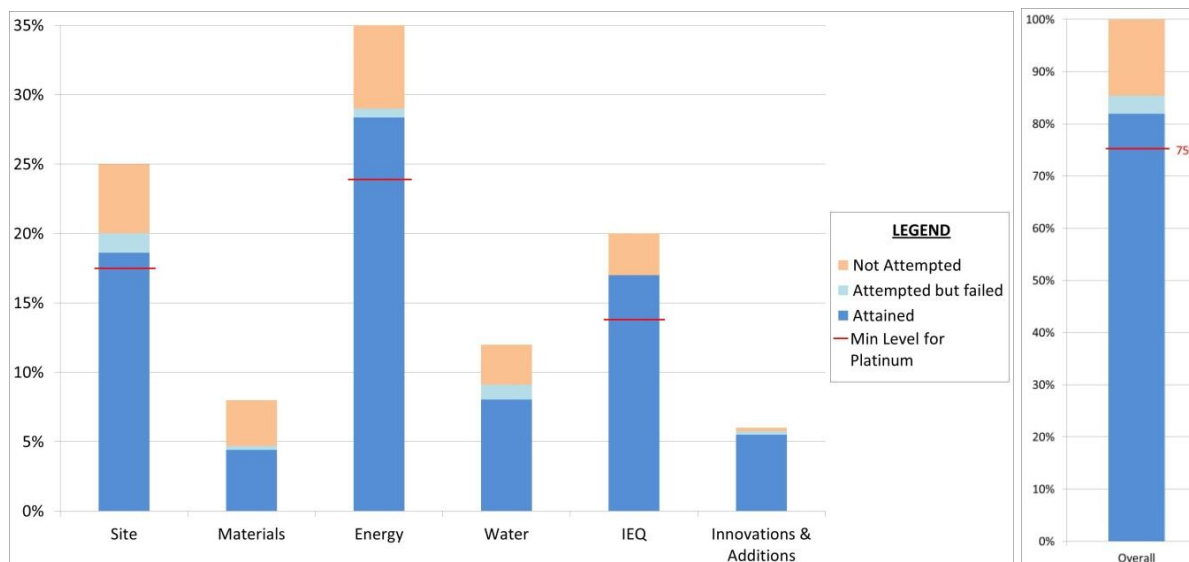


Figure 5: Average category scores and overall score achieved by 11 Provisional and 1 Final Platinum projects

Each of these categories has a certain weighting in the assessment. The weighting is represented by the height of each bar in Figure 5, i.e. the maximum number of percentage scores that each category can contribute. The dark blue part within each bar represents how many scores these 12 projects could achieve on average, while the light blue part represents the scores which were attempted but not successfully achieved. The red line represents the minimum level to achieve Platinum rating. The minimum levels are required for 3 categories, namely Site Aspects, Energy Use and IEQ.

Analysis shows us that the 12 projects did considerably better than the minimum levels in Energy Use and IEQ but barely exceeded that level in Site Aspects. The percentage achievements within all categories were generally high (all above 70% minimum) with the exceptions of Water Use (67%) and Materials Aspects (55%). However, since the latter had no threshold values and their weighting was comparatively lower than the other four, the effect on the overall total score was minimal.

These 12 projects achieved an average score of 82%, which was well above the required Overall Score (75%) for Platinum rating.

For Credits which were attempted but not successfully achieved (i.e. the light blue part within each bar), the chart shows that the largest number occurred under Site Aspects and Water Use categories, with fewer cases occurring in Energy Use, and relatively few cases occurring in Materials Aspects and Innovations and Additions. Interestingly, the IEQ category was the only category that had no refused credits in this study.

In this study, on average the projects targeted an overall score of 85%, and actually achieved 82%. It is a timely reminder that project applicants should always target at more credits than the minimum required.

High Score Areas

An analysis of the higher scoring results was conducted. The result is as follows (Table 1):

Item	% of Platinum projects achieved full scores
1. Site Aspects	
1.1 Controlling noise from building equipment	100
1.2 Pollution management during construction	92
1.3 Maintaining neighbourhood daylight access	83
1.4 Site greenery (planting area > 30% of the site)	75
2. Materials Aspects	
2.1 Regionally manufactured materials	92
2.2 Avoiding ozone depleting substances	83
2.3 Sustainable source/recycled timber	83
3. Energy Use	
3.1 Adequate meters for monitoring energy use	100
3.2 Testing and commissioning (T&C) requirements (excluding bonus credit ^{*1})	92
3.3 Operation and maintenance (O&M) requirements	83
3.4 Reduction of CO ₂ emissions and peak electricity demand	75
4. Water Use	
4.1 Low sewage discharge	100
4.2 Low annual water use	92
5. Indoor Environmental Quality	
5.1 Adequate security measures	100
5.2 Adequate measures to reduce potential for transmission of harmful bacteria, virus & odour through drainage system	100
5.3 Adequate measures to reduce risk of Legionnaires' Disease in building services	100
5.4 Good indoor air quality	100
5.5 Good lighting quality	100
5.6 Enhanced provisions for persons with a disability	92

*1 42% projects could not achieve the **bonus** credit of engaging an independent commissioning authority for their projects though the other documentation and planning requirements were met.

Bonus credits would not count towards the total number of credits available but are intended to be extra rewards.

Table 1: Common high score areas among the 11 Provisional and 1 Final Platinum projects

From Table 1, all the projects had:

- minimized adverse environmental impacts during construction and operation.
- provided extra greenery on site to mitigate urban heat island effect.
- used environmentally friendly and regionally produced materials.
- took adequate measures to ensure proper T&C and O&M.
- achieved lower-than-average energy and water use.
- provided security measures to prevent crimes and protect occupants.
- provided quality and healthy indoor environment.
- enhanced facility provisions for persons with disability.

Further detailed statistics about these Platinum buildings are provided below:

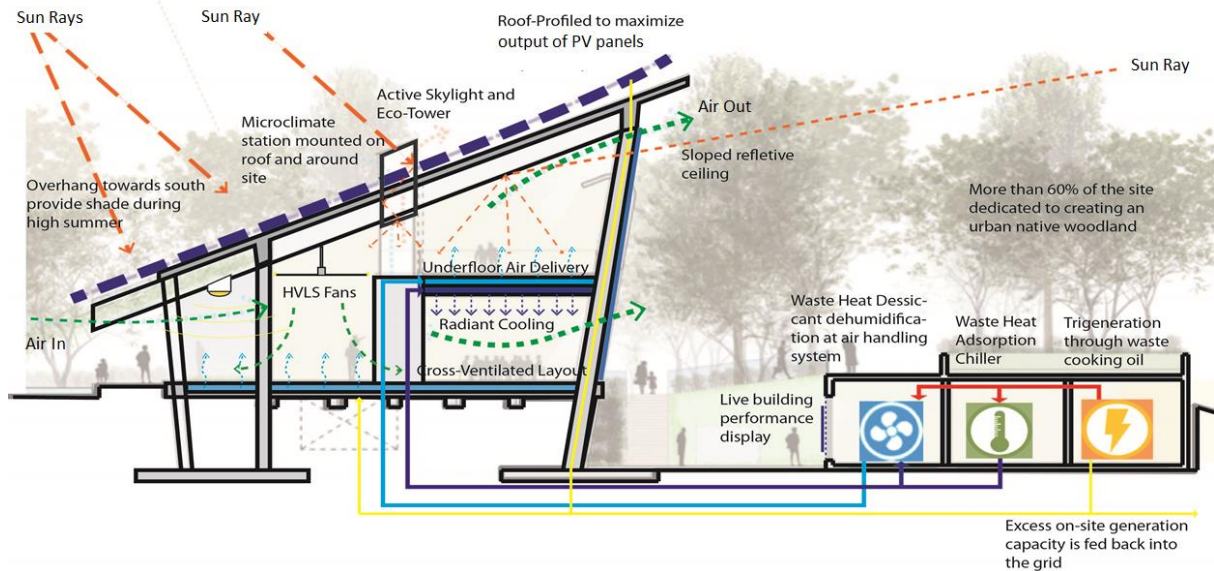
- Greenery as a percentage of site area ranged from about 11% to 48%. The average value was 36% (excluding two projects without data).
- 8 of the projects adopted roof gardens that ranged from about 40% to 100% of the roof area.
- 8 of the projects achieved credits in using recycled materials in external works. The average percentage of recycled content was 39%.
- 7 of the projects achieved credits in construction waste recycling. The average percentage of construction waste recycled was 52%.
- On average, the estimated energy consumption of the projects was 33% below the baseline value. For peak electricity demand, it was 29% below the baseline value.
- Daylight and/or occupancy sensors were commonly adopted in the projects to reduce lighting energy use. Other energy-saving measures included LED external lighting (4 projects), task lighting (2 projects), demand-controlled ventilation (6 projects), hybrid/natural ventilation (5 projects), free cooling (2 projects), heat recovery (2 projects), variable refrigerant flow (3 projects), low-e glass (6 projects), shading devices (5 projects) and passive design with emphasis on proper building orientation (8 projects).
- Renewable energy was adopted in 7 projects. Full credits were only achieved in low-rise buildings. For high-rise buildings, the credits achieved were less than 50%.
- Low-flow water fixtures and dual-flush water closets were commonly adopted to reduce water use and sewage discharge. The average annual water saving was 40% compared with the baseline value.
- Other water-saving measures included drip pipe irrigation (2 projects) and adopting of native species in landscaping (3 projects). Besides, a large number of projects (9) adopted rainwater harvesting. The installation led to an average reduction of about 18% in the consumption of fresh water.

Innovations

Innovative features (see Figure 6) specific to individual projects included:

- Openings within the body of the building to enhance urban ventilation
- Trigeneration or flexibility for future trigeneration
- Use of bio-diesel in power generation
- Feedback of excess electricity generated on site to the public grid
- Innovative cooling devices such as radiant cooling and peltier bed coolers
- Intelligent variable speed fan coil units
- Solar energy reclaimed for hot water heating
- Education signage inside buildings
- Building Information Modelling (BIM) to optimise material use
- On-line project collaboration platform to save paper consumption

It should be pointed out that with the passage of time, some of the above features (e.g. BIM and on-line collaboration platform) have been increasingly adopted in the building industry. It is likely that in the future, they would no longer be regarded as innovative.



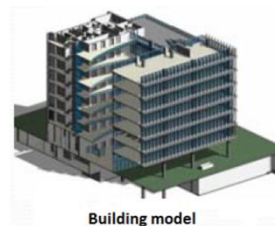
Courtesy of CIC / Arup / RLPKH



Peltier Bed Headboard



Courtesy of Holiday Inn Express HK Soho



Building model



Clash analysis



Simulation of daylight



Courtesy of HKSP & its consultant team

Figure 6: Innovations adopted in some of the 12 projects

Performance Enhancements

Besides innovations, BEAM Plus allows project designers to achieve bonus credits by demonstrating significant performance enhancements that greatly exceed the requirements of the existing credits. The specific performance enhancement features that had been applied in some of the projects included:

- Operable louvre façade to facilitate natural ventilation and to IAQ management during renovation/construction
- Extensive use (99%) of regionally manufactured building materials
- Use of rainwater harvesting to achieve large extent of water saving (55%)
- Extensive generation of energy from renewable sources (>100% of demand) and large extent of energy reduction (52%)
- Achieving excellent class in IAQ certification
- Extensive recycling (90%) of demolition waste
- Extensive use (70%) of paving materials made from recycled contents
- Extensive use (over 80%) of sustainable source or recycled timber

BEAM Professionals

Although not a bonus credit, there is one credit obtainable under the Innovations and Additions category by employing at least one BEAM Professional as key member of the project team. BEAM Professionals are architects, engineers, surveyors or other building professionals who have attended the specified training and examination on BEAM Plus conducted by BEAM Society Limited (BSL). Upon passing the examination, they are accredited by the Hong Kong Green Building Council (HKGBC). All the Platinum projects examined in this study were able to achieve this credit.

The Pinch Points

An analysis also revealed pinch points, situations where credits were less commonly achieved. These are summarized in Table 2 below:

Item	% of Platinum projects achieved full scores
1. Site Aspects	
1.1 Contaminated land assessment and rehabilitation (bonus credit)	None
1.2 Conserving and enhancing ecological value of the site (bonus credit)	58
1.3 Demonstrating exterior lighting does not create light pollution	58
1.4 Microclimate around buildings (AVA and CFD studies are required)	8 (On average, only 2 credits were attained out of 4)
2. Materials Aspects	
2.1 Rapidly renewable materials (at least 2.5%)	None
2.2 Prefabrication (at least 20%)	25
2.3 Modular and standardised design (at least 50%)	42
2.4 Construction waste recycling (at least 60%)	33
3. Energy Use	
3.1 Life cycle assessment of embodied energy in structural materials and its minimization (1 normal and 1 bonus credits)	17
3.2 Renewable energy systems (supplying 2.5% of building energy or	17

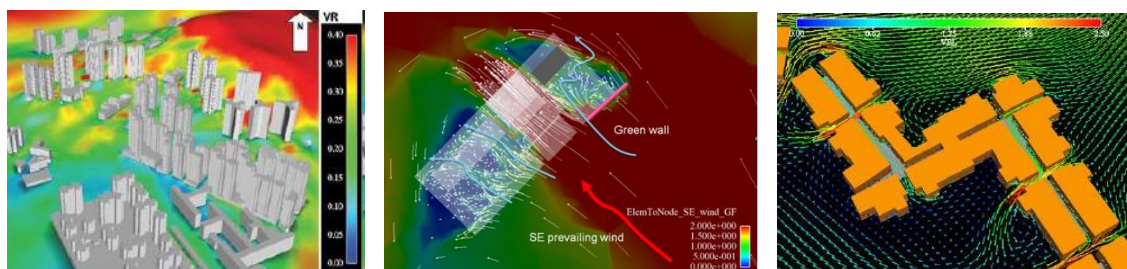
	covering the whole of building footprint)	
4. Water Use		
4.1	Leakage monitoring for water distribution pipework	8
4.2	Extra water saving through grey water recycling <u>and</u> rain water harvesting (2 normal and 1 bonus credits)	None ^{*1}
5. Indoor Environmental Quality		
5.1	At least 80% of floor area is adequately lit with an average daylight factor of 1%	25

*1 Many of the projects achieved part of the credits by rainwater harvesting. None of them adopted grey water recycling. Therefore, full credits were not attained.

Table 2: Credits not commonly achieved among the 11 Provisional and 1 Final Platinum projects

It can be seen that some of these are **bonus** credits. Examples include contaminated land assessment and rehabilitation, conservation and enhancement of ecological value of site, minimization of embodied energy in structural materials, as well as extra water saving through water recycling. These credits typically require substantial efforts to pursue such as the engagement of specialist consultants and contractors. As such, the scores achieved in these areas were typically lower.

Another reason for low scores was contested credits. Contested credits are credit submissions that failed technical scrutiny. Common reasons for review included insufficient supporting materials, calculation errors, inconsistent information and lack of justification. One notable criterion was water leakage monitoring for water distribution pipework. Applicants attempted this credit but failed owing to insufficient coverage of the leakage monitoring system, e.g. sensors were only installed in pump rooms but not in other distribution locations. Another notable issue was the microclimate study. In line with the growing use of computational fluid dynamics (CFD), a microclimate study was conducted commonly for all the Provisional and Final Platinum projects to assess the impacts of the buildings on adjacent environment such as wind amplification and air ventilation (Figure 7). However, on average, only half of the credits for this item were achieved. This reflected that although some work was done, it was less than expected and not thorough. For example, the number of wind directions simulated was insufficient. In other cases, the number of design options studied was not adequate to demonstrate the optimal solution was selected.



Courtesy of HKHA / CIC / Arup

Figure 7: Examples of microclimate studies

The low achievement rates of some other credits (including the use of rapidly renewable materials, prefabrication, modular and standardized design, ensuring adequate daylight for 80% of the floor area) were most probably a result of self-imposed constraints whilst developing the building form. This is no surprise because BEAM Plus rating tool is performance-based. Designers have the liberty to decide which credits are more suitable to pursue without compromising their ability to achieve a good final rating.

Last but not least, the maturity of technologies also has a bearing on why some of the credits were not commonly achieved. It is likely that as tools and technologies (e.g. software for material life cycle assessment, carbon labelling for construction materials, renewable energy systems, etc.) continue to advance and become more available, credits that are currently challenging may become more achievable in the future. The BEAM Plus rating tool is subject to review on a regular basis. The criteria will be fine-tuned and upgraded on a regular basis to ensure its relevancy and reflect the latest leadership practices for high performance buildings.

CONCLUSION

An analysis of BEAM Plus project statistics revealed that there were a large variety of buildings achieving Platinum grade, including GIC, commercial, residential and industrial projects. Of these, GIC occupied the largest proportion (58%). More than half of the projects obtained percentage score higher than 80% though the minimum score for Platinum was 75%.

Common success factors of the projects included excellent indoor environmental quality, low water use, good energy management provisions, careful pollution management and extended use of regionally produced materials. A large number of innovative and performance enhancement techniques were adopted by the projects, though there was still room for improvement in microclimate study, analysis and minimization of material embodied energy, extended use of renewable energy and adoption of grey water recycling.

This study demonstrates that BEAM Plus has driven the creation of more healthy, efficient and sustainable buildings in Hong Kong. The BEAM Plus rating tool has set out ambitious best practice targets for the industry, that project proponents have both embraced, and achieved. With the continuous upgrading of the rating tool and implementation of innovative initiatives, the green building movement is expected to continue and thrive.

REFERENCES

- [1] BEAM Plus Manuals, available on website of HKGBC (<http://www.hkgbc.org.hk/eng/beamplus-main.aspx>)
- [2] BEAM Plus Project Directory on website of HKGBC (<http://www.hkgbc.org.hk/eng/BeamPlusDirectory.aspx>)
- [3] Assessment Reports and Project Information of BEAM Plus Projects in the internal database of BSL

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