Report on the fifth business meeting of CIB Working Commission W115 "Construction Materials Stewardship" 2011

Wednesday, 19 October 2011, 11:30 – 1:30 PM (+2:00 Greenwich)

The fifth business meeting of the CIB W115 was held in conjunction with the World Sustainable Building Conference (SB11) in Helsinki.

The meeting was attended by participants from the United States, Germany, Canada, New Zealand, Portugal, Singapore and Switzerland.

Meeting Attendees

Surname	Name	Affiliation	Country	Email
Chini (Coordinator)	Abdol	University of Florida	United States	chini@ufl.edu
Schultmann (Coordinator)	Frank	Karlsruhe Institute of Technology (KIT)	Germany	frank.schultmann@kit.edu
Anggadjaja	Edward	Centre for Sustainable Buildings & Construction	Singapore	Edward_ANGGADJAJA@bca.gov.sg
Baird	George	Victoria University of Wellington	New Zealand	george.baird@vuW.ac.nz
Bakens	Wim	CIB	The Netherlands (CIB)	wim.bakens@cibworld.nl
Braganca	Luis	University of Minho	Portugal	Braganca@civil.uminho.pt
Dinis Silvestre	José	Technical University Lisbon	Portugal	silvestre@civil.ist.utl.pt
Gorgolewski	Mark	Ryerson University	Canada	mgoro@ryerson.ca
Kibert	Charles	University of Florida	United States	ckibert@ufl.edu
Kühlen	Anna	Karlsruhe Institute of Technology (KIT)	Germany	anna.kuehlen@kit.edu
Leong	Low Giau	Centre for Sustainable Buildings & Construction	Singapore	low_giau_leong@bca.gov.sg
Porteous	Bill	CIB secretariat		bill.porteous@cibworld.nl
Russell	Mark	University of New Mexico	United States	russ1307@unm.edu
Stengel	Julian	Karlsruhe Institute of Technology (KIT)	Germany	julian.stengel@kit.edu
Wallbaum	Holger	ETH Zürich	Switzerland	holger.wallbaum@ibb.baug.ethz.ch

Minutes of the Meeting

1. Abdol Chini and Frank Schultmann welcomed the participants and the participants introduced themselves.
   Regards from John Storey, the co-coordinator of the commission, who could not attend the meeting, were submitted.
   Abdol Chini presented background information and the history of the CIB working group W115.

2. **Reports of subgroups**, being currently in preparation, were presented by the respective person in charge.

   Subgroup 3:
   Develop systems to mitigate and ultimately avoid construction material waste
   Gillian Hobbs (see item 3)

   Subgroup 4:
   Develop ways of using material waste as raw materials for making construction materials
   Shiro Nakajima and Brad Guy are working on a publication about barriers for deconstruction and reuse of materials and the best strategies to overcome these barriers (see item 4).

   Within this context Holger Wallbaum will send a report from Switzerland to all participants of the meeting regarding life-cycle-impacts of recycled concrete aggregate.

   Subgroup 5:
   Develop methodologies for designing for close loop materials use and the effective recovery of materials and components from existing buildings
   Charles Kibert reported that a publication is planned for 2013 about the development of methodologies to design closed-loop-material-usage.

3. The report "**Construction waste reduction around the world, CIB Publication 364",** edited by Gillian Hobbs was published in October 2011. The report is a product of the commission and includes contributions from various members. It is available under the W115-website: http://www.iip.kit.edu/english/654.php.

4. The report **"Barriers for deconstruction and reuse/recycling of construction materials"** by Shiro Nakajima and Brad Guy is planned to be published in 2012. There is a survey available, which should be filled out by every member, as the report should include country-specific barriers for deconstruction and recycling activities and the best strategies to overcome these barriers. The completed survey should be sent to Shiro Nakajima by 15 December 2011.

5. **Country Reports/Updates**
   New Zealand
   George Baird gave a summary of the report prepared by John Storey (see appendix A) about the damage of the earthquake in Christchurch and the enormous volume of demolition waste generated. The report also highlights the NZ building certification system "Green star NZ" includes up to three points for recycling and reuse C&D waste. Furthermore a waste minimization plan has been established to help industry implement waste minimization measures.

   Abdol China and Frank Schultmann suggested contacting John Storey to evaluate possibilities to use Christchurch as a living research lab for the commission. In particular, some experimental work on demolishing damaged houses and developing strategies to reuse and recycle the salvaged materials and minimize use of landfill.

Germany
Anna Kuehlen presented characteristics and the regulatory framework of the German construction sector and national measures and initiatives for sustainable construction.

Switzerland
Holger Wallbaum reported about the Swiss building certification system "MinergieEco", which includes recycling and reuse of materials. The Swiss Database for Environmental Product Declaration (EPD) includes a large set of data respective to life cycle assessment of products. Information about the "International Journal of Life Cycle Assessment" was passed around.

Charles Kibert pointed out the importance of the inclusion of building equipment, such as lifts, HVAC systems, and cables, within LCA and access to data for calculation of their embedded energy.

CIB Report
Wim Bakens pointed out that CIB is losing members because some members see no benefit from their membership. To make CIB membership more valuable to its members, a series of new reports are required from each commission. Each working commission should provide the following reports:

1. ***research and development roadmap (see appendix B)***
2. ***impact report (see appendix C)***
3. ***best practice report***

Contributions for these reports are welcomed.

Furthermore the CIB inspire to establish student chapters within each working commission. This could be an opportunity for students to contact senior researchers and other students within their research area.
The members of W115 are asked to seek PhD students, who are willing to lead a student chapter group for 3 years. These students don't have to be member of CIB themselves, only their institution or their supervisors have to be CIB member.
The CIB contact person for student chapters is Bill Porteus.

6. The means and location for holding the sixth and seventh annual meeting of W115 in 2012 and 2013 were discussed.
   The "1st international conference on building sustainability assessment" (BSA 2012) in Porto, in Portugal (May, 23-25, 2012) was suggested by Luis Braganca. No registration fee for the conference would be required, if the participant is only attending the W 115 business meeting. Furthermore Luis is looking into providing the opportunity to join the meeting via video conference for people who are not able to attend the meeting in person.
   An E-mail will be sent by the coordinators to all commission members to solicit suggestions for the 2012 business meeting.

   For the 7th annual meeting of W115 in 2013 it was suggested to carry it out either in Asia or in conjunction with the CIB World Congress in Brisbane Australia.
   It was agreed that that it would be appropriate to carry out the meeting in Asia to increase awareness and interest in construction waste management, For instance, in China high volume of construction require enormous amount of materials and generate much waste. Edward Anggadjaja offered to check if the meeting could be linked to the Sustainable Building Congress in Singapore in 2013. He will provide further information to Frank Schultmann and Abdol Chini.

7. The expansion of the commission membership base by countries, such as India, Russia, Brazil, South Africa and South Korea, was emphaasized.

8. Liaisons with other CIB Task Groups and Working Commissions, being active in the area of sustainable buildings and construction.

   W116: Smart and Sustainable Built Environments
   Frank Schultmann reported about the acitvities of W116 “Smart and Sustainable Built Environments”. There will be a business meeting in conjunction with the SB11. W116 has already established a student chapter within the commission. Furthermore the working commission runs an owns a conference series, which takes place every 3 years. The next conference SASBE 2012 will be in Brazil, 28th -30th June 2012. Jay Yang the coordinator of W116 launched a journal “Smart and Sustainable Built Environment.” The first issue will be available in June 2012.

9. The W115 website is available under the link: www.cibw115.org, connected to the homepage of the Karlsruhe Institute of Technology (KIT). It is regulatory updated. For any issues regarding the website Frank Schultmann and Anna Kuehlen can be contacted. Documents and reports can be downloaded from the website.

10. Action items
    Mark Gorgolewski and Holger Wallbaum will form a new subgroup in LCA. Mark Russell expressed his desire to join the group. Mark and Holger will develop objectives for the new subgroup and share it with the members. Other interested members should contact them.

    Charles Kibert welcomes support for preparing a report on *development of methodologies for designing for close loop materials use and the effective recovery of materials and components from existing buildings.* The report will be published in 2013.

    Country representatives should complete the survey Shiro Nakajima sent in July 2011 (see appendix D) and return it to him by 15 December 2011. Based on the survey results Shiro and Brad will write a report about “Barriers for deconstruction and reuse/recycling of construction materials” to be published in spring 2012..

    Abdol Chini will send an e-mail providing information about the possible locations for the 2012 and 2013 business meetings and solicit suggestion from the members.

Appendixes:
A Country report NZ
B Roadmap
C Impact report
D Survey template

Karlsruhe, 10 November 2011
Frank Schultmann
Anna Kühlen

Country Report 2011New Zealand

This report covers the period from 2009 to 2011. The main focus of attention in Construction Materials Stewardship in New Zealand has been and will be for the foreseeable factors related to the Christchurch earthquake. However this report will also cover developments related to the Waste Minimisation Act, notably the progress of the Waste Minimisation Fund and Product Stewardship and the effects of the New Zealand Green Building Council's 'Green Star' and 'Homestar' assessment tools.

Christchurch

The series of earthquakes that hit Christchurch, New Zealand's second city, in 2010 and 2011, caused damage and after effects that were proportionately very similar to the damage and effects of the tsunami and earthquake that hit in Japan in 2011, without Japan's nuclear dimension. New Zealand normally generates about 2.5 million tonnes of solid waste a year. Roughly 50% of this is building C+D waste. It is estimated that the C+D waste from Christchurch is about 9 million tonnes. This is split roughly into 4 million tonnes of non-residential building waste, a similar amount of infrastructure waste, about 500,000 tonnes of silt and a still undetermined but substantial amount of residential waste.

During the period of the declared National Emergency, dangerous and condemned buildings were perforce demolished and the waste transported unsorted to a landfill at Burwood on the outskirts of Christchurch. This pre-existing closed landfill was reopened and rapidly expanded. At the height of the emergency it was dealing with 2000+ lorry movements a day, 6 days a week, 18 hours a day. This landfill now contains about 200,000 tonnes of commercial building waste plus some infrastructure and silt waste. It continues to receive demolition waste on a daily basis. The owners of the landfill have ordered significant amounts of recycling equipment from Europe and await its arrival before beginning a serious materials recovery and recycling programme. The plan is to recover 16 different streams of 'valuables' such as metals and native timber. The owners of the landfill have invested hundreds of million dollars in equipment at considerable financial risk and are currently seeking partners to spread the risk. It is likely that a new section of the Burwood landfill will be developed, lined and fitted with treatment facilities to take a million tonnes of the infrastructure waste, much of which is contaminated. Currently gate prices vary from $120 tonne for mixed waste to $15 per tonne for clean concrete waste.

The plan was for there to be 2 emergency landfills but so far no satisfactory additional sites have been able to be identified. Consequently there are still heaps of C+D waste and silt from the extensive liquefaction that took place all over the city.

A considerable proportion of the masonry waste is being used to rebuild Christchurch's port at Lyttleton, which was largely destroyed by the earthquakes. This port rebuild requires a major amount of reclamation. Roughly 2 million tonnes of clean masonry waste is being used for this purpose. The ability to use so much masonry waste is beneficial for Christchurch as recycling concrete for aggregate is not economically viable as there is an abundance of river gravel which needs to be removed from riverbeds to help control flooding of river valleys.

A very high proportion of New Zealand's demolition capacity is currently fully employed in Christchurch and is likely to remain so for a number of years. There are long waiting lists of owners who require their non-residential buildings to be demolished and thousands of residential buildings to follow. The downstream effects of this single centre concentration of resources are currently unclear.

Immediately following the major earthquake in February 2011, the amount of resource recovery undertaken was non-existent but once the Emergency was over demolition contractors started to pick out and remove the most valuable items such as metals and native hardwoods. Quite quickly there was a 25% recovery rate and this has now risen to 50%. This means that most of the material going to Burwood is now of low value. Much of the infrastructure waste is still in the ground and still has to be dug up and dealt with. It will all be removed over time. A significant proportion of this material is contaminated or hazardous in nature and presents special problems. The huge task of rebuilding Christchurch's infrastructure is currently underway, but will take years.

The Government has bought up 6000 houses which will eventually have to be demolished. Most of these houses are on unstable, liquefaction prone land. In addition to the houses bought up by Government many other houses will have to be demolished and rebuilt on the same site or undergo major repair work. Demolition work once underway is likely to lead to another wave of C+D waste. Many of the houses are relatively new which contain only small amounts of valuable materials and so afford very few opportunities for resource recovery. This is a problem that has been identified in many other parts of the world. Some of the materials in the houses have been contaminated by sewage, and household or garden chemicals.

Taken together the rebuilding programme in Christchurch is likely to absorb most of the skilled labour and huge quantities of materials for many years. There will almost certainly be a shortage of skilled personnel. Many skilled building workers left the industry or sought work overseas following the GFC of 2008 and the resultant downturn in work in the building sector. There is currently a major programme to train more building operatives. However there are no known courses in the country to train specialist demolition and deconstruction workers. Re-building work will start in earnest next year.

One of the most difficult problems is what to do with the 500,000+ tonnes of silt. So far no one has come up with any viable solutions for its use. Similarly there are large quantities of treated timber waste, much of it Copper Chrome Arsenic, but also material with a variety of other treatments that are currently simply being buried in hazardous waste sites for want of a better solution.

REBRI (Resource Efficiency in the Building related Industries)

The REBRI website has been taken over by MfE (Ministry for the Environment) and redeveloped with new material that makes it more commercially useful and usable some eighteen months ago. Management of this website now lies with BRANZ (Building Research Association of New Zealand). Take up and presumably use of the information has increased following the changes.

Green Star NZ MAN-5 Waste Management Credit

The NZGBC (Green Building Council) operates a Green Star building assessment tool which is equivalent to BREEAM and LEED. Green Star awards one point, two or three points where 30%+, 50%+ and 70%+ respectively of construction and demolition waste by weight is reused or recycled in a particular project. Green Star accreditation is voluntary but is becoming the norm in large commercial buildings and in an increasing number of other buildings. Many large commercial buildings target the 70%+ category and achieved rates in excess of 90% are not abnormal. Most of the large construction companies and many sub-contractors and tradespeople are enthusiastic about this measure and now conventionally apply reuse and recycling programmes on their contracts even when Green Star accreditation is not being sought. Information from the REBRI website has proved useful in helping contractors to source markets. Many contractors are now much more aware of construction waste and strive to reduce waste generation as well as maximising reuse or recycling

Waste Minimisation Fund

As part of the Waste Minimisation Act, previously chronicled in this report series, a Waste Minimisation Fund was established. The primary purpose of the fund is to help industry implement waste minimisation measures. This fund has now been in operation for a little over a year. So far only two building related projects have been funded, one for the collection and use of liquid concrete waste from concrete batching plants for use as a feedstock to make concrete blocks and the other to establish the use of reject post consumer bottle glass as concrete aggregate. A number of other building related waste reduction related initiatives are in the pipeline but cannot yet be made public.

Product Stewardship

Another part of the Waste Minimisation Act encouraged the establishment of voluntary Product Stewardship schemes. Again it is early days and so far there are only two building sector related product stewardship schemes in existence one by a concrete company deals with waste oil recycling and another by a paint company dealing with paint and container recycling.

See the MfE website for further information on The Waste Minimisation (Solids) Act, Waste Minimisation Fund and Product Stewardship initiatives. www.mfe.govt.nz

There is nothing of note to report in other CMS sectors at this stage.

I should like to acknowledge the great help provide by Mr David Wilson of the Ministry for the environment in the preparation of this report.

John Storey

12/10/2011

Towards CIB R&D Roadmaps

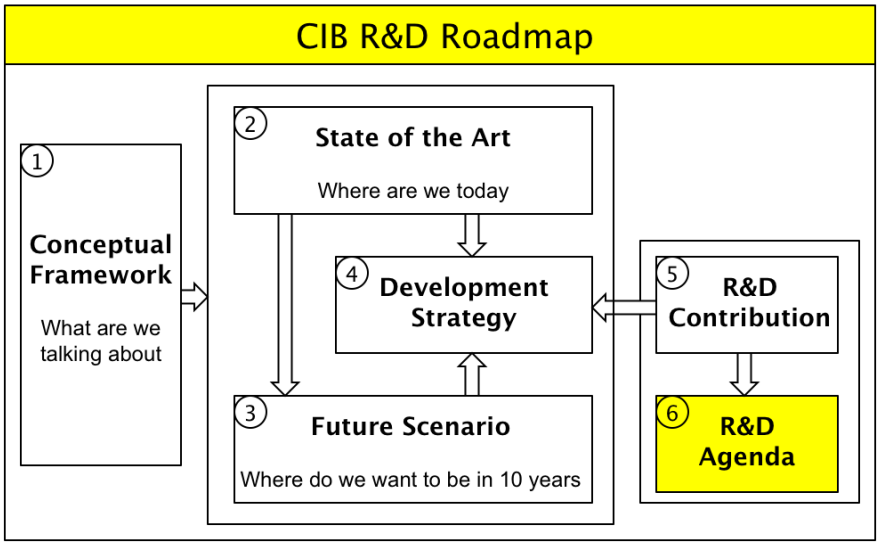
New CIB Commissions are requested and existing ones are encouraged to develop R&D (Research & Development) Roadmaps relevant to their scopes.

As at the middle of 2011 5 CIB Commissions are engaged in Roadmap development projects. The outcomes of those pilot projects will provide further guidance to facilitate a broader implementation of the Roadmap concept within CIB.

It is envisaged that eventually all CIB Commissions will develop an R&D Roadmap and keep it up to date.

Structure and Content

The illustration below shows the structure and the main components of such a Roadmap. It demonstrates that such a Roadmap includes, but is not restricted to an R&D Agenda (or alternatively a strategy for such agenda).



As the illustration indicates, creating an R&D Roadmap requires the following questions to be answered:

1 Conceptual framework: What are we talking about? What are the issues, how do those interrelate, what influences all of this, who are the stakeholders, what are the relevant areas of expertise, what are the characteristics of relevant systems, processes and technologies, …

2 State of the Art: Where are we today? State of technology, best practices, international variations, perceived problems. Challenges, needs for improvement, who are the world's leading centres of expertise, …

3 Future Scenario: Where do we want to be in say ten years? Stakeholders opinions on required / envisaged future systems, processes and technologies, preferred future practices and skills ,…

4 Development strategy: What is needed in terms of knowledge, information, tools, concepts and applications to enable the respective systems, processes and technologies to develop from where we are today to where we want to be in ten years?
5 R&D Contribution: How can R&D contribute to such Development Strategy, what are the requirements for R&D to make that contribution?
6 R&D Agenda: What is to be the agenda for research worldwide? Areas of science and technology development, required sequences of development, priorities for research, international cooperation within the research community, cooperation between research and practice, …

Authority

The authority of a CIB R&D Roadmap is derived from a worldwide consultation of (and, if possible, consensus amongst) stakeholders and experts, including, but not restricted to, the membership of the respective CIB Commission.

Use

It is envisaged that the CIB R&D Roadmaps will provide authoritative guidance for national and international R&D programming and funding agencies.

It will be beneficial for research institutes amongst the CIB Membership to use the CIB series of R&D Roadmaps in their communication with R&D programming and funding agencies and show the potential added value for funded projects from being part of such a Roadmap approach, and thus be able to profit from an alignment and exchange with other such R&D projects worldwide.

Publication and Presentation

A typical CIB R&D Roadmap may consist of a report of about 20 pages, although such a report may cite other publications for reference.
For example there may be a separate elaborated State of the Art report that includes a presentation of best practices in the world, a summary of which is then included in the R&D Roadmap. Or a separate publication of alternative future scenarios, based on a detailed survey of stakeholder opinions, with a summary being part of the R&D Roadmap.

It is envisaged that a series of such CIB Commission-based R&D Roadmaps will be developed to become a series of high status and high quality CIB publications.

Consequently it is envisaged that there will be a presentation of over 50 new and updated CIB Roadmaps at each triennial CIB World Building Congress.

Wim Bakens
CIB General Secretariat
19.8.2011

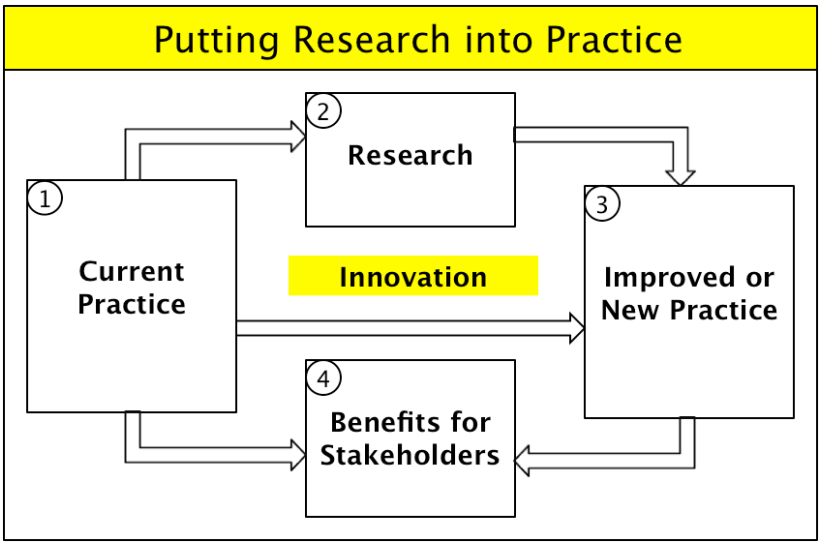
Towards CIB Impact Reports (draft as at 25082011)

New CIB commissions are requested and existing ones are encouraged to develop reports that describe examples of improvements of existing practices or the adoption of new practices that have resulted from research being put into practice..

The intention of these reports is to demonstrate how the results of research have been successfully applied to achieve a practical innovative outcome that generates benefits to stakeholders. For that reason they will be called *impact reports.*

Structure and Content

The illustration below shows the relationship between improvement of current practice by application of research results, the consequent improved or even new practice, and the ensuing additional benefits for stakeholders. The illustration also emphasizes the pervasive role of innovation in these events.



As the illustration indicates, reporting on separate examples of research being put into practice requires the following questions to be answered:

1 Current practice: What deficiencies exist in current practice? What technique, design or process needed to be refined?
2 Research: Who carried it out? What were the outcomes? How were the research outcomes made available to practice stakeholders?
3 Improved or new practice: What is this? How did the transfer form the old practice take place?
4 Benefits for stakeholders: What are the benefits? How are they measured? Are the benefits purely financial, or to efficiency or safety? Is the formerly impossible now made possible?

Scope and intent

The impact reports can include new or improved practices in any aspect of regulatory control, planning, financing, design, engineering, construction, use, maintenance, insurance, management and deconstruction of buildings and the built environment.

The impact reports are not intended to be “best practice” reports but are intended to report on new or better practices that have been successfully adopted as the result of research outcomes being applied to practice.

Production

It is envisaged that members of Commissions will produce impact reports based upon the research carried out or on putting research outcomes into practice by their organization.

Impact reports may use content of earlier published research or technology fact sheets, journal articles and conference papers.

It is envisaged that each impact report will be about 3-5 pages long.

Impact reports will be submitted to the respective Commission.

Commissions will be responsible for assessing the quality and relevance of submitted impact reports and will select reports for publication.

Publication and Presentation

It is anticipated that every CIB Commission will present at least 10 new impact reports at each triennial CIB World Building Congress.

It is envisaged that the impact reports of each Commission will be published in a CIB publication.

In addition Commissions are encouraged to consider producing a webinar incorporating the reports, because a recording of such a webinar is assumed to be an attractive format for use by industry people especially.

Development of a searchable online database containing all CIB impact reports is also being considered.

Template for the CIB W115 Annual Report 2011

Guidance

Barrier for Deconstruction (Chapter 1)

1. Please choose the major three construction types in your country. If it is difficult to choose three please choose one or two construction types.
2. Please report on the methods commonly used to remove buildings in your country for the major construction types you chose.
3. Please report on the barriers for deconstruction to make better use of the C&D waste and report on the strategies to overcome the barriers in your country.
4. When reporting on the strategies to overcome the barriers, please make comments on the technical, political and other related strategies.
5. Please use text, tables and figures anything as you like to write the report.

Barrier for Reuse and Recycle (Chapter 2)

6. Please choose the top five C&D wastes in your country such as wood, concrete, steel, dry gypsum etc. If it is difficult to choose five C&D wastes please choose the top one or two or three materials.
7. Please choose additional C&D waste of universal concern such as asbestos, plastics etc.
8. Please report on the recycle ratio in your country of the C&D waste. Report on all the C&D waste you chose in [6] and [7].
9. Please report on the products produced in your country from the C&D waste if any. Report on the C&D waste you chose in [6] and [7].
10. Please report on the barriers for reuse and recycle and the related strategies to overcome the barriers in your country for the C&D waste you chose.
11. When reporting on the strategies to overcome the barriers, please make comments on the technical, political and other related strategies.
12. Please use text, tables and figures anything as you like to write the report.

1. BARRIERS FOR DECONSTRUCTION

1.1 Major Construction Type 1 ( )

1.1.1. Commonly used method to remove buildings (deconstruction / dismantle)

<Text, Tables and Figures>

1.1.2. Barrier for deconstruction-1

<Text, Tables and Figures>

1.1.2. Strategies-1

(1) Technical strategies to overcome the barriers

<Text, Tables and Figures>

(2) Political strategies to overcome the barriers

<Text, Tables and Figures>

(3) Other strategy to overcome the barriers (ex. Ecological Incentive)

<Text, Tables and Figures>

[If the barriers to comment are more than 1 please add section by using the following format]

1.1.3. Barrier for deconstruction-2

1.1.3. Strategies-2

(1) Technical strategies to overcome the barriers

(2) Political strategies to overcome the barriers

(3) Other strategies to overcome the barriers

1.2 Major Construction Type 2 ( )

1.2.1. Commonly used method to remove buildings (deconstruction / dismantle)

<Text, Tables and Figures>

1.2.2. Barrier for deconstruction-1

<Text, Tables and Figures>

1.2.2. Strategies-1

(1) Technical strategies to overcome the barriers

<Text, Tables and Figures>

(2) Political strategies to overcome the barriers

<Text, Tables and Figures>

(3) Other strategy to overcome the barriers (ex. Ecological Incentive)

<Text, Tables and Figures>

[If the barriers to comment are more than 1 please add section by using the following format]

1.2.3. Barrier for deconstruction-2

1.2.3. Strategies-2

(1) Technical strategies to overcome the barriers

(2) Political strategies to overcome the barriers

(3) Other strategies to overcome the barriers

1.3 Major Construction Type 3 ( )

1.3.1. Commonly used method to remove buildings (deconstruction / dismantle)

<Text, Tables and Figures>

1.3.2. Barrier for deconstruction-1

<Text, Tables and Figures>

1.3.2. Strategies-1

(1) Technical strategies to overcome the barriers

<Text, Tables and Figures>

(2) Political strategies to overcome the barriers

<Text, Tables and Figures>

(3) Other strategy to overcome the barriers (ex. Ecological Incentive)

<Text, Tables and Figures>

[If the barriers to comment are more than 1 please add section by using the following format]

1.3.3. Barrier for deconstruction-2

1.3.3. Strategies-2

(1) Technical strategies to overcome the barriers

(2) Political strategies to overcome the barriers

(3) Other strategies to overcome the barriers

1.4 Additional Construction Type ( )

Construction type ( )

1.4.1. Commonly used method to remove buildings (deconstruction / dismantle)

<Text, Tables and Figures>

1.4.2. Barrier for deconstruction-1

<Text, Tables and Figures>

1.4.2. Strategies-1

(1) Technical strategies to overcome the barriers

<Text, Tables and Figures>

(2) Political strategies to overcome the barriers

<Text, Tables and Figures>

(3) Other strategy to overcome the barriers (ex. Ecological Incentive)

<Text, Tables and Figures>

[If the barriers to comment are more than 1 please add section by using the following format]

1.4.3. Barrier for deconstruction-2

1.4.3. Strategies-2

(1) Technical strategies to overcome the barriers

(2) Political strategies to overcome the barriers

(3) Other strategies to overcome the barriers

2. BARRIERS FOR REUSE AND RECYCLE

2.1 No.1 C&D waste ( )

2.1.1 Recycle ratio

Reused	( ) %	
Recycled for raw materials of products	( ) %	----- Answer 2.1.2 if possible.
Recycled for energy source	( ) %	
Land filled or burned	( ) %	
Other	( ) %	
Total	(100) %	

2.1.2 Products produced from No.1 C&D waste

<List the products produced from No.1 C&D waste.>

2.1.3.1 Barrier-1

<Text, Tables and Figures>

2.1.3.2 Strategy-1

(1) Technical strategies to overcome the barriers

<Text, Tables and Figures>

(2) Political strategies to overcome the barriers

<Text, Tables and Figures>

(3) Other strategy to overcome the barriers (ex. Ecological Incentive)

<Text, Tables and Figures>

[If the barriers to comment are more than 1 please add section by using the following format]

2.1.4.1 Barrier-2

2.1.4.2 Strategy-2

(1) Technical strategies to overcome the barriers

(2) Political strategies to overcome the barriers

(3) Other strategies to overcome the barriers

2.2 No.2 C&D waste ( )

2.2.1 Recycle ratio

Reused	( ) %	
Recycled for raw materials of products	( ) %	----- Answer 2.2.2 if possible.
Land filled	( ) %	
Other	( ) %	
Total	(100) %	

2.2.2 Products produced from No.2 C&D waste

<List the products produced from No.2 C&D waste.>

2.2.3.1 Barrier-1

<Text, Tables and Figures>

2.2.3.2 Strategy-1

(1) Technical strategies to overcome the barriers

<Text, Tables and Figures>

(2) Political strategies to overcome the barriers

<Text, Tables and Figures>

(3) Other strategy to overcome the barriers (ex. Ecological Incentive)

<Text, Tables and Figures>

[If the barriers to comment are more than 1 please add section by using the following format]

2.2.4.1 Barrier-2

2.2.4.2 Strategy-2

(1) Technical strategies to overcome the barriers

(2) Political strategies to overcome the barriers

(3) Other strategies to overcome the barriers

2.3 No.3 C&D waste ( )

2.3.1 Recycle ratio

Reused	( ) %	
Recycled for raw materials of products	( ) %	----- Answer 2.3.2 if possible.
Land filled	( ) %	
Other	( ) %	
Total	(100) %	

2.3.2 Products produced from No.3 C&D waste

<List the products produced from No.3 C&D waste.>

2.3.3.1 Barrier-1

<Text, Tables and Figures>

2.3.3.2 Strategy-1

(1) Technical strategies to overcome the barriers

<Text, Tables and Figures>

(2) Political strategies to overcome the barriers

<Text, Tables and Figures>

(3) Other strategy to overcome the barriers (ex. Ecological Incentive)

<Text, Tables and Figures>

[If the barriers to comment are more than 1 please add section by using the following format]

2.3.4.1 Barrier-2

2.3.4.2 Strategy-2

(1) Technical strategies to overcome the barriers

(2) Political strategies to overcome the barriers

(3) Other strategies to overcome the barriers

2.4 No.4 C&D waste ( )

2.4.1 Recycle ratio

Reused	( ) %	
Recycled for raw materials of products	( ) %	----- Answer 2.4.2 if possible.
Recycled for energy source	( ) %	
Land filled or burned	( ) %	
Other	( ) %	
Total	(100) %	

2.4.2 Products produced from No.4 C&D waste

<List the products produced from No.4 C&D waste.>

2.4.3.1 Barrier-1

<Text, Tables and Figures>

2.4.3.2 Strategy-1

(1) Technical strategies to overcome the barriers

<Text, Tables and Figures>

(2) Political strategies to overcome the barriers

<Text, Tables and Figures>

(3) Other strategy to overcome the barriers (ex. Ecological Incentive)

<Text, Tables and Figures>

[If the barriers to comment are more than 1 please add section by using the following format]

2.4.4.1 Barrier-2

2.4.4.2 Strategy-2

(1) Technical strategies to overcome the barriers

(2) Political strategies to overcome the barriers

(3) Other strategies to overcome the barriers

2.5 No.5 C&D waste ( )

2.5.1 Recycle ratio

Reused	( ) %	
Recycled for raw materials of products	( ) %	----- Answer 2.5.2 if possible.
Land filled	( ) %	
Other	( ) %	
Total	(100) %	

2.5.2 Products produced from No.5 C&D waste

<List the products produced from No.5 C&D waste.>

2.5.3.1 Barrier-1

<Text, Tables and Figures>

2.5.3.2 Strategy-1

(1) Technical strategies to overcome the barriers

<Text, Tables and Figures>

(2) Political strategies to overcome the barriers

<Text, Tables and Figures>

(3) Other strategy to overcome the barriers (ex. Ecological Incentive)

<Text, Tables and Figures>

[If the barriers to comment are more than 1 please add section by using the following format]

2.5.4.1 Barrier-2

2.5.4.2 Strategy-2

(1) Technical strategies to overcome the barriers

(2) Political strategies to overcome the barriers

(3) Other strategies to overcome the barriers

2.6 C&D waste for universal concern ( )

2.6.1 Recycle ratio

Reused	( ) %	
Recycled for raw materials of products	( ) %	----- Answer 2.6.2 if possible.
Land filled	( ) %	
Other	( ) %	
Total	(100) %	

2.6.2 Products produced from C&D waste for universal concern

<List the products produced from the additional C&D waste.>

2.6.3.1 Barrier-1

<Text, Tables and Figures>

2.6.3.2 Strategy-1

(1) Technical strategies to overcome the barriers

<Text, Tables and Figures>

(2) Political strategies to overcome the barriers

<Text, Tables and Figures>

(3) Other strategy to overcome the barriers (ex. Ecological Incentive)

<Text, Tables and Figures>

[If the barriers to comment are more than 1 please add section by using the following format]

2.6.4.1 Barrier-2

2.6.4.2 Strategy-2

(1) Technical strategies to overcome the barriers

(2) Political strategies to overcome the barriers

(3) Other strategies to overcome the barriers

2.7 C&D waste for universal concern ( )

Material Type ( )

2.7.1 Recycle ratio

Reused	(	) %	
Recycled for raw materials of products	(	) %	----- Answer 2.7.2 if possible.
Recycled for energy source	(	) %	
Land filled or burned	(	) %	
Other	(	) %	
Total	(	100) %	

2.7.2 Products produced from C&D waste for universal concern

<List the products produced from the additional C&D waste.>

2.7.3.1 Barrier-1

<Text, Tables and Figures>

2.7.3.2 Strategy-1

(1) Technical strategies to overcome the barriers

<Text, Tables and Figures>

(2) Political strategies to overcome the barriers

<Text, Tables and Figures>

(3) Other strategy to overcome the barriers (ex. Ecological Incentive)

<Text, Tables and Figures>

[If the barriers to comment are more than 1 please add section by using the following format]

2.7.4.1 Barrier-2

2.7.4.2 Strategy-2

(1) Technical strategies to overcome the barriers

(2) Political strategies to overcome the barriers

(3) Other strategies to overcome the barriers