

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

The objective of the study is to explore whether the claim that “ Environment is the fourth construction objective” is applicable throughout the process of design, planning, construction, operation and maintenance, and up to decommissioning, of construction projects.

As results of the study we can conclude following:

1. Construction industry accepts the following seven hypotheses.
 - a. Construction activities have adverse impacts on the environment.
 - b. Minimizing the materials used for construction projects minimize the environmental impacts.
 - c. Minimizing the amount of energy used for construction projects minimize the environmental impacts.
 - d. Minimizing the amount of water used for construction projects minimize the environmental impacts.
 - e. Minimizing rate of flow of waste into the environment minimize the environmental impacts.
 - f. Minimizing air, land and water pollution minimize the environmental impacts.
 - g. Making environment an objective of a construction project can minimize environmental impacts.

The construction industry accepts that it has to be concerned during planning, design, construction, operation and maintenance, and during decommissioning about the minimizing the environmental impacts due to projects. Hence we can conclude the owners and specialists in the construction industry accept that the Environment is the fourth construction objective.

2. Sample respondents are willing to adopt new construction practices in order to minimize the environmental impacts due to projects.
3. They are in view that implementation of the environment as a project objective should be in force now and also in favour of having the legislations in order to implement it.

5.2 Recommendations

Having accepted that the environment is the fourth construction objective, construction professionals have to change their present construction practices in order to minimize the environmental impacts due to construction projects. Therefore following recommendations are made:

1. UDA Act is concerned about the protection of environment to some extent in the process of planning and implementation of urban development. It should be further improved in environmental terms by incorporating new guidelines and regulations leading to minimization of environmental impacts due to projects.
2. EIA is a requirement of the Government for granting approval for prescribed projects. If the complete scope of EIA is addressed, it can be used as a tool for planning and implementation of projects minimizing environmental impacts due to a project. Hence, EIA should be implemented fully and used not only for approval of projects, but also as a guide for planning and implementation of projects minimizing the environmental impacts.
3. Architects and Engineers have to develop their designs based on the concepts of resource efficiency. Resource efficiency can be achieved through life cycle design, design for dessembly and specifying more renewable resources into the design.
4. Development of “best practice guidance” for construction professionals with new construction practices to minimizing environmental impacts, will help to carry out more environmentally responsible design and construction. Incorporation of best practices in the conditions of the bidding document would legally bind the constructor to carry out environmentally responsible construction.
5. Finished materials and products for the construction should be identified in terms of environmental performance. Materials and product units should be identified in terms of rate of depletion of virgin resource, embodied energy, extent of pollution generated from production during use and disposal, emissions to air water and soil, ability to reuse and recycle. This will help designers to select suitable materials with minimum impact for the purpose. These environmental performance qualities can be included into the technical specifications and used to evaluate environmental factor of the objectives.
6. Application of life cycle assessment when using materials and products in construction. This provides better answer to the selection of appropriate materials and equipments during operation and maintenance phase of the buildings.
7. Selecting constructors with reputation and standard certifications on application of environmental management systems in construction.

8. Development of new specifications for estimating requirement of water and electricity for the project based on energy efficient equipment and practices, and low water consumption equipments and practices.



APPENDIX A: FORM OF QUESTIONNAIRE

Objective: To analyze the hypothesis that the “Environment is the Fourth Construction Objective”

Questionnaire

Q.1. It is suggested that construction activities have an adverse impact on the environment.

Do you agree? (*Please indicate your answer with a “tick” against it*)

a)..... Yes b)..... No

(*If your answer is “yes” please go to Q3.*)

Q.2. Indicate whether you consider any of the following as adverse environmental impacts due to construction projects from construction, operation and maintenance, to final disposal.

(*If your answer is “Yes” indicate it with a “tick”. If your answer is “No” indicate it with a “X”*)

- a).....Depletion of resources
- b).....Loss of agricultural lands
- c).....Loss of wild life habitats
- d).....Loss of biodiversity
- e).....Generation of excessive noise and vibration
- f).....Air pollution from dust generated and emissions from chemicals
- g).....Contamination of ground water and streams from spillage of chemicals
- h).....Faster loss of land fill sites due to heavy waste depositing
- i).....Disruption of natural eco-system.
- j).....River bank erosion
- k).....Causes damages to neighboring countries due to pollution crossing geological boundaries.
- l).....Emissions contribute to global warming which causes incalculable damage to the world due to rising sea level.

Q.3. Do you think we should take action to minimize the environmental impacts of construction projects from construction, operation and maintenance to final disposal?

(*Please indicate your answer with a “tick” against it*)

a)..... Yes b).....No

(*If your answer is “yes” please go to Q.5.*)

Q.4. There are several institutions and legislations to protect the environment from adverse impacts of construction. In your opinion,

(Please indicate your answer with a "tick" against it)

- a). Is forest cover diminishing acceptable? Yes/.....No
- b). Is waterway and water pollution acceptable?Yes/No
- c). Is loss of wild life habitat and wild species acceptable?Yes/No
- d). Is loss of agricultural lands due to mining acceptable?Yes/No
- e). Is air pollution due to construction acceptable?Yes/.....No
- f). Is riverbank erosion due to sand mining acceptable?Yes/No
- g). Is loss of low lands due to filling is acceptable?Yes/.No

Q.5. When do you think the action should be taken?

Rank 1,2,3,4,5. 1-as most appropriate, 5- as least appropriate.

- a).....It is the time now to take action.
- b).....We can wait till development is achieved, for an action.
- c).....We can wait till public demand an action.
- d).....We can wait till international pressure for an action.
- e).....When new technologies are invented in future to counter the environmental damages.

Q.6. In order to minimize the environmental impacts, it is suggested to reduce amount of materials used for construction projects through careful planning and construction practices.



Do you agree? *(Please indicate your answer with a "tick" against it)*

- a).....Yes b).....No

(If your answer is "yes" go to Q.10.)

Q.7. Reducing use of clay bricks in construction projects, will reduce the quantity of clay to be extracted, processed and transported.

Do you agree with any of the following?

(If your answer is "Yes" indicate it with a "tick". If your answer is "No" indicate it with a "X")

- a).....It will reduce the transportation and hence reduce the consumption of fossil fuel and generation of gases contributing to global warming and air pollution.
- b).....It will reduce the creation of deeper pits which causes, lowering of water table in adjacent lands hence loosing irrigable lands.
- c).....It will reduce the formation of dust along gravel roads causing respiratory health problems to dwellers close to the roads and also pits will be converted to the ponds during rainy season and remain as mosquito breeding ponds.
- d).....It will reduce use of fire wood so that it will slower the rate of cutting of trees for fire wood and hence slower the damage to the eco-system.

e).....It will slower the depletion of clay as a natural resource.

(If you have a "yes" answer please go to Q.10.)

Q.8. Reducing use of sand in construction projects, will reduce the quantity of sand to be extracted and transported.

Do you agree with any of the following?

(If your answer is "Yes" indicate it with a "tick". If your answer is "No" indicate it with a "X")

- a)..... It will reduce the transportation. and hence reduce the consumption of fossil fuel and generation of gases contributing to global warming and air pollution
- b).....It will reduce the erosion of river banks
- c).....It will reduce the deepening of river bed disrupting the natural flow
- d).....It will reduce sudden high intensity floods in down stream.
- e).....It will slower the depletion of sand as a natural resource.

(If you have a "yes" answer please go to Q.10.)

Q.9. Reducing use of hard timber in construction projects will reduce rate of cutting down trees in forests.

Do you agree with any of the following?

(If your answer is "Yes" indicate it with a "tick". If your answer is "No" indicate it with a "X")

- a).....It will slower the rate of diminishing of jungles.
- b).....It will ensure the protection of wild life habitats and wildlife.
- c).....It will ensure the protection of eco-system.

(If you have a "yes" answer go to Q.10)

Q.10. The reduction of use of material in a construction project can be achieved by following way.

Do you agree with any of the following?

(If your answer is "Yes" indicate it with a "tick". If your answer is "No" indicate it with a "x")

- a).....Make the structures smaller by optimizing the use of space within the buildings, reducing presently accepted floor to floor height etc.
- b).....Remove the unessential elements from buildings such as soffit plaster, wall plaster, partition brick walls etc.
- c).....Reduce the waste during construction and maintain the structures properly so that replacing intervals of fixtures will be extended and also increases the durability of the structure.

Q.11. How do you think you can implement “minimizing the use of material” in a project during construction, operation and maintenance?

(Indicate your answer with a “tick” against it)

- a)..... Include this requirement in the project brief.
- b).....be concerned about this requirement during planning.
- c).....be concerned about this requirement during designing.
- d).....be concerned about this requirement during construction.
- e).....be concerned about this requirement during operation and maintenance.

Q.12. In order to minimize the environmental impacts, it is suggested to reduce the use of energy for construction projects from extraction, production of materials, transportation, construction, operation and maintenance up to final disposal.

Do you agree? *(Indicate your answer with a “tick” against it)*

- a)..... yes
- b).....No

(If your answer is “yes” please go to Q.15.)

Q.13. Fossil fuel is the major producer of energy. Reduced use of energy will reduce the use of the fossil fuel for energy generation.

Do you agree with any of the following?

(If your answer is “Yes” indicate it with a “tick”. If your answer is “No” indicate it with a “X”)

- a).....It will reduce the quantity of gaseous emissions contributing to global warming.
- b).....It will slow the depletion of natural stock of fossil fuel.
- c).....It will avoid installation of another diesel powered electrical generator.

(If you have a “yes” answer go to Q.15.)

Q.14. Reduced use of energy will avoid the necessity of generation of more energy. Hence It will avoid the necessity of another hydro power project.

Do you agree with any of the following?

(If your answer is “Yes” indicate it with a “tick”. If your answer is “No” indicate it with a “X”)

- a).....It will avoid the possible damage to natural flow of a river/stream
- b).....It will avoid the possible damage to water falls along that river/stream
- c).....It will avoid possible damage to areas with scenic beauty.
- d).....It will avoid another construction project.

(If you have a “yes” answer go to Q.15.)

Q.15. The reduction of use of energy in a construction project from construction, operation and maintenance up to final disposal can be achieved by following way

Do you agree ?

(If your answer is "Yes" indicate it with a "tick". If your answer is "No" indicate it with a "X")

- a).....Avoid use of high energy embodied materials.
- b).....Use natural lighting as much as possible.
- c).....Use natural breeze, ventilation to provide comfort.
- d).....Use energy efficient equipments such as pumps, motors etc.
- e).....Decide on the orientation and use vegetation to reduce ambient temperature.
- f).....Decide on location of building to reduce the energy consumption of transport of users.
- g).....Avoid wasteful use of electricity.

Q.16. How do you think you can implement the "minimizing the use of energy" in a construction project from construction, operation and maintenance up to final disposal?

(Indicate your answer with a "tick" against it)

- a)..... Include this requirement in the project brief.
- b)..... be concerned about this requirement during planning.
- c).....be concerned about it during designing.
- d).....be concerned about it during construction.
- e).....be concerned about it during operation and maintenance.
- f).....be concerned about it during decommissioning
- g)..... include these requirements in conditions, specifications and BOQ

Q.17. In order to minimize the environmental impacts, it is suggested to reduce the use of treated water for construction projects from construction, operation to final disposal.

Do you agree? *(Indicate your answer with a "tick" against it)*

- a)..... yes b)..... No

(If your answer is "yes" please go to Q.19.)

Q.18. Reducing use of water in construction projects from construction, operation to final disposal, will reduce following.

Do you agree with any of the following?

(If your answer is "Yes" indicate it with a "tick". If your answer is "No" indicate it with a "X")

- a).....Quantity of water to be treated at a treatment plant will be reduced and hence it will reduce the use of energy for water treatment at national level.

- b).....It will need smaller structures to store water and waste water disposal (sumps, soakage pits, septic tanks and manholes etc) thus reduce use of material.
- c).....It will need smaller capacity motors and pumps for pumping of water thus it will reduce the use of energy for operation.
- d).....It will reduce the quantity of effluent discharge to streams thus reduce the pollution of streams.
- e).....It will reduce the depletion of fresh water resources.

Q.19. The minimizing the use of treated water in a project during construction and operation can be achieved by following way.

Do you agree?

(If your answer is "Yes" indicate it with a "tick". If your answer is "No" indicate it with a "X")

- a).....avoid wasteful use of water during construction.
- b).....use low flow W/Cs, taps and showers.
- c).....use gray(washing) water for watering plants.
- d).....collect, stock and use rain water for washing and toilet flushing systems.

Q.20. How do you think you can implement the "minimizing the use of water" in a construction project from construction, operation to final disposal?

(Indicate your answer with a "tick" against it)

- a)..... include this requirement in the project brief.
- b).....be concerned about this requirement during planning.
- c).....be concerned about it during designing.
- d).....be concerned about it during construction.
- e).....be concerned about it during operation.
- f).....be concerned about it during decommissioning.
- g).....include these requirements in conditions specifications and BOQQ.

Q.21. In order to minimize the environmental impact due to construction projects from construction, operation and maintenance up to final disposal, it is suggested to minimize the rate of flow of waste into the environment.

Do you agree? *(Indicate your answer with a "tick" against it)*

- a).....Yes b).....No

(If your answer is "yes" please go to Q.25.)

Q.22. Waste material is normally transported to filling sites. Reducing the waste of materials will reduce the following environmental impacts

Do you agree with any of the following?

(If your answer is "Yes" indicate it with a "tick". If your answer is "No" indicate it with a "X")

- a).....less waste of materials will extend the life of existing filling sites and reduce the need for a new site thus reduce the rate of land degradation due to filling of waste.
- b).....Need of reduced number of trips of transportation will reduce the air pollution due to emissions from vehicles.
- c).....Reducing the waste of material contribute to attainment of "reduce the use of materials".

(If you have a "yes" answer go to Q.25)

Q.23. Efficient machines and equipment will consume less fuel and electricity compared to inefficient machines and equipment, for their functions and generate less waste (emissions) during extraction, process, transportation, construction, operation and final disposal. Hence reduced use of excess fuel and electricity will reduce the following environmental impacts.

Do you agree with any of the following?

(If your answer is "Yes" indicate it with a "tick". If your answer is "No" indicate it with a "x")

- a).....It will slow the depletion of energy resources.
- b).....It will reduce the generation of gases contributing to global warming and air pollution.
- c).....Reduced waste of energy contribute to attainment of "reduce the use of energy"

(If you have "yes" answer go to Q.25.)

Q.24. Minimizing the waste of treated water will reduce following environmental impacts.

Do you agree with any of the following?

(If your answer is "Yes" indicate it with a "tick". If your answer is "No" indicate it with a "X")

- a).....Minimizing the waste of water will reduce the quantity of water to be treated at a treatment plant thus conserve energy and materials used for purification of water at national level.
- b).....Reduce the depletion of fresh water resources.

Q.25. The waste can be minimized by following way in a construction project from construction, operation and maintenance up to final disposal.

Do you agree ?

(If your answer is "Yes" indicate it with a "tick". If your answer is "No" indicate it with a "X")

Materials

- a).....Site planning
- b).....Selecting the right construction method.
- c).....Procurement system to receive the materials just in time to the right location with the exact quantity.
- d).....Maintain minimum storage time, avoid transportation waste, inventory waste, waste due to motion and product defects.
- e).....Recycling the waste- glass, steel ,copper, alluminium, paper etc.
- f).....Reuse of waste materials- brick bats, plaster pieces, demolished concrete for filling under floors and approach roads, concrete left over from pumps to cast lintols, cover slabs etc.
- g).....Reuse of structural components such as form work, pre-cast elements, steel roof trusses etc.
- h).....Reuse of structures it self by refurbishing for other purposes. eg- office building into a apartment building.

Water

- a).....by avoiding wasteful use of water.

Energy

- a).....by avoiding wasteful use of electricity.
- b).....by using energy efficient machines and equipment .

Q.26. How do you think you can implement the “ minimizing the waste” in a project from construction, operation and maintenance up to final disposal?

(Indicate your answer with a "tick" against it)

- a)..... include this requirement in the project brief.
- b).....be concerned about this requirement during planning.
- c).....be concerned about it during designing.
- d).....be concerned about it during construction.
- e).....be concerned about it during operation.
- f).....be concerned about it during decommissioning.
- g).....include this requirement in conditions, specifications and BOQ

Q.27. In order to minimize the environmental impacts due to construction projects from construction, operation and maintenance, and final disposal, It is suggested to minimize air and water pollution and land degradation.

Do you agree? (indicate your answer with a tick against it)

a).....Yes b).....No

(if your answer is "yes" please go to Q.29.)

Q.28. Minimizing air and water pollution and land degradation can minimize following environmental impacts.

Do you agree any of the following?

(If your answer is "yes" indicate it with a "tick", if your answer is "No" indicate it with "x")

a)..... Minimized noise can protect workers from potential deafening and avoid the annoyance of the neighbors.

b).....Minimizing the dust generation can reduce the health risks-respiratory diseases, to workers and neighbors.

c).....Minimizing emissions from chemicals-adhesives, paints, thinners, ammonia based cleaners etc, to air can minimize indoor pollution.

d).....Eliminating contamination of storm water will protect the fresh water reserves without been contaminated.

e).....Protecting top soil at natural state and maintaining natural water table avoid the land degradation.

f).....Restoration of borrow pits will minimize land degradation.

g).....Pollution crosses the geological boundaries and make environmental impacts worst. So reduced intensity of pollution can minimize the intensity of impacts.

Q.29. It is suggested that following ways can minimize environmental pollution and land degradation due to construction projects from construction, operation and maintenance up to final disposal.

Do you agree with any of following?

(If your answer is "Yes" indicate it with a "tick". If your answer is "No" indicate it with a "X")

Noise and vibration

a).....Through using appropriate equipment and construction methods.

Air pollution

b).....Through appropriate measures to avoid dust generation.

c).....Controlling emissions through carefully managed use of chemicals.

d).....By using energy efficient machines and equipments

Ground water contamination

- a)..... By taking measures to avoid spilling of fuel, form work cleaning oil and chemicals onto the ground,
- b).....Maintaining of existing drainages and streams to function properly so that it will prevent the mosquito breeding pools.

Land degradation

- a).....By maintaining better top soil condition and improving the vegetation with indigenous plants.
- b).....Construction of storm water system such away that it facilitate the recharging of the water table.
- c).....Reinstatement of borrow pits.

Indoor Pollution

- a).....By avoiding use of adhesives, paints, paint thinner, ammonia based cleaners which releases volatile compounds to air.
- b).....By avoiding use of curtains, carpets, particle boards which release unhealthy particles and generates dust mites contributing "Asthma".
- c).....By maintaining healthy humidity levels within the building by providing proper ventilation.

Q.30. How do you think you can implement the ways of minimizing pollution and land degradation in a construction project?

(Indicate your answer with a "tick" against it)

- a).....include this requirement in the project brief.
- b).....be concerned about this requirement during planning.
- c).....be concerned about it during designing.
- d).....be concerned about it during construction.
- e).....be concerned about it during operation.
- f).....be concerned about it during decommissioning.
- g).....include these requirements in conditions, specifications and BOQQ.

Q.31. Do you believe that the concern for environment should be as important as the concern for time, cost and quality in a construction project?

(Indicate your answer with a "tick" against it)

a).....Yes b).....No

If your answer is "No", Please give reasons.

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APPENDIX B: DATA RECEIVED

Results are indicated in ***Bold Italic*** letters

Objective: To analyze the hypothesis that the “Environment is the Fourth Construction Objective”

Questionnaire with Results

Q.1. It is suggested that construction activities have an adverse impact on the environment.

Do you agree? (Please indicate your answer with a “tick” against it)

a)...**43**..... Yes b)...**01**..... No

(Note: the respondent who has marked “No” to Q.1. has not answered to Q.2. also)

Q.3. Do you think we should take action to minimize the environmental impacts of construction projects from construction, operation and maintenance to final disposal?

(Please indicate your answer with a “tick” against it)

a)...**43**..... Yes b).....**01**.....No

(If your answer is “yes” please go to Q.5.)

Q.4. There are several institutions and legislations to protect the environment from adverse impacts of construction. In your opinion,

(Please indicate your answer with a “tick” against it)

- g) Is forest cover diminishing acceptable? **04.... Yes/...15....No**
- h) Is water way and water pollution acceptable ? **03....Yes/...16....No**
- i) Is loss of wild life habitat and wild species acceptable? **03....Yes/ ...15...No**
- j) Is loss of agricultural lands due to mining acceptable? **05....Yes/ ...14...No**
- k) Is air pollution due to construction acceptable? **06.... Yes/ ...13... No**
- l) Is river bank erosion due to sand mining acceptable? **05.....Yes/ ...14....No**
- g) Is loss of low lands due to filling is acceptable? **04....Yes/. ...15...No**

	a		b		c		d		e		f		g	
Yes	04	21%	03	15%	03	17%	05	26%	06	31%	05	26%	04	21%
No	15	79%	16	85%	15	83%	14	74%	13	69%	14	74%	15	79%

Q.5. When do you think the action should be taken?

Rank 1,2,3,4,5. 1-as most appropriate, 5- as least appropriate.

- a).....It is the time now to take action.
 b).....We can wait till development is achieved, for an action.
 c).....We can wait till public demand an action.
 d).....We can wait till international pressure for an action.
 e).....When new technologies are invented in future to counter the environmental damages.

	1	2	3	4	5	Rank
a	43	01	00	00	00	1
b	00	11	07	06	11	2
c	00	07	09	03	12	3
d	00	00	03	13	18	4
e	01	04	02	02	22	5

Q.6. In order to minimize the environmental impacts, it is suggested to reduce amount of materials used for construction projects through careful planning and construction practices.

Do you agree? (Please indicate your answer with a "tick" against it)

- a)...43.....Yes b)...01.....No

(If your answer is "yes" go to Q.10.)

Q.10. The reduction of use of material in a construction project can be achieved by following way.

Do you agree with any of the following?

(If your answer is "Yes" indicate it with a "tick". If your answer is "No" indicate it with a "x")

- a).....Make the structures smaller by optimizing the use of space within the buildings, reducing presently accepted floor to floor height etc.
 b).....Remove the unessential elements from buildings such as soffit plaster, wall plaster, partition brick walls etc.
 c).....Reduce the waste during construction and maintain the structures properly so that replacing intervals of fixtures will be extended and also increases the durability of the structure.

	a		b		c	
<i>Yes</i>	<i>16</i>	<i>39%</i>	<i>15</i>	<i>38%</i>	<i>37</i>	<i>86%</i>
<i>No</i>	<i>25</i>	<i>61%</i>	<i>24</i>	<i>62%</i>	<i>06</i>	<i>14%</i>

Q.11. How do you think you can implement “minimizing the use of material” in a project during construction, operation and maintenance?

(Indicate your answer with a “tick” against it)

- a)...**28 (64%)**.....include this requirement in the project brief.
- b). ...**43 (97%)**.....be concern about this requirement during planning.
- c)...**42 (95%)**..... be concerned about this requirement during designing.
- d)...**31 (70%)**.....concerned about this requirement during construction.
- e)...**28 (64%)**.....be concerned about this requirement during operation and maintenance

Q.12. In order to minimize the environmental impacts, it is suggested to reduce the use of energy for construction projects from extraction, production of materials, transportation, construction, operation and maintenance up to final disposal.

Do you agree? *(Indicate your answer with a “tick” against it)*

- a)...**43**.... yes b).....**01**.....No
- (If your answer is “yes” please go to Q.15.)*

Q.15. The reduction of use of energy in a construction project from construction, operation and maintenance up to final disposal can be achieved by following way

Do you agree ?

(If your answer is “Yes” indicate it with a “tick”. If your answer is “No” indicate it with a “X”)

- a).....Avoid use of high energy embodied materials.
- b).....Use natural lighting as much as possible.
- c).....Use natural breeze, ventilation to provide comfort.
- d).....Use energy efficient equipments such as pumps, motors etc.
- e).....Decide on the orientation and use vegetation to reduce ambient temperature.
- f).....Decide on location of building to reduce the energy consumption of transport of users.
- g).....Avoid wasteful use of electricity.

	a		b		c		d		e		f		g	
Yes	27	75%	43	100%	43	100%	38	98%	31	81%	25	67%	38	95%
No	9	25%	0	0%	0	0%	1	2%	7	19%	12	33%	2	5%

Q.16. How do you think you can implement the “minimizing the use of energy” in a construction project from construction, operation and maintenance up to final disposal?

(Indicate your answer with a “tick” against it)

- a)...**26 (59%)**.....Include this requirement in the project brief.
- b)...**43 (97%)**.....be concerned about this requirement during planning.
- c)...**42 (95%)**.....be concerned about it during designing.
- d)...**32 (72%)**.....be concerned about it during construction.
- e)...**30 (68%)**.....be concerned about it during operation and maintenance.
- f)...**21 (47%)**.....be concerned about it during decommissioning
- g)...**31 (70%)**.....include these requirements in conditions, specifications and BOQQ.

Q.17. In order to minimize the environmental impacts, it is suggested to reduce the use of treated water for construction projects from construction, operation to final disposal.

Do you agree? *(Indicate your answer with a “tick” against it)*

- a).....**43**..... yes b).....**01**..... No

(If your answer is “yes” please go to Q.19.)

Q.19. The minimizing the use of treated water in a project during construction and operation can be achieved by following way

Do you agree?

(If your answer is “Yes” indicate it with a “tick”. If your answer is “No” indicate it with a “X”)

- a).....avoid wasteful use of water during construction
- b).....use low flow W/Cs, taps and showers
- c).....use gray(washing) water for watering plants
- d).....collect, stock and use rain water for washing and toilet flushing systems.

	a		b		c		d	
Yes	41	98%	26	65%	30	76%	20	55%
No	1	2%	14	35%	9	24%	17	45%

Q.20. How do you think you can implement the “minimizing the use of water” in a construction project from construction, operation to final disposal?

(Indicate your answer with a “tick” against it)

- a)...**26 (59%)**.... include this requirement in the project brief.
- b)...**36 (81%)**.....be concerned about this requirement during planning.
- c)...**35 (81%)**....be concerned about it during designing.
- d)...**41 (93%)**....be concerned about it during construction.
- e)...**32 (72%)**....be concerned about it during operation.
- f)...**23 (52%)**.....be concerned about it during decommissioning.
- g)...**23 (52%)**....include these requirements in conditions specifications and

BOQQ.

Q.21. In order to minimize the environmental impact due to construction projects from construction, operation and maintenance up to final disposal ,It is suggested to minimize the rate of flow of waste into the environment.

Do you agree? *(Indicate your answer with a “tick” against it)*

- a).....**43**.....Yes b).....**01**.....No

(If your answer is “yes” please go to Q.25.)

Q.25. The waste can be minimized by following way in a construction project from construction, operation and maintenance up to final disposal.

Do you agree ?

(If your answer is “Yes” indicate it with a “tick”. If your answer is “No” indicate it with a “X”)

Materials

- a).....Site planning
- b).....Selecting the right construction method.
- c).....Procurement system to receive the materials just in time to the right location with the exact quantity.
- d).....Maintain minimum storage time, avoid transportation waste, inventory waste, waste due to motion and product defects.
- e).....Recycling the waste- glass, steel ,copper, alluminium, paper etc.
- f).....Reuse of waste materials- brick bats, plaster pieces, demolished concrete for filling under floors and approach roads, concrete left over from pumps to cast lintols, cover slabs etc.
- g).....Reuse of structural components such as form work, pre-cast elements, steel roof trusses etc.

- h).....Reuse of structures it self by refurbishing for other purposes.
eg- office building into a apartment building.

Water

- a).....by avoiding wasteful use of water.

Energy

- a).....by avoiding wasteful use of electricity
b).....by using energy efficient machines and equipment .

Materials

	a		b		c		d	
Yes	41	98%	39	100%	34	92%	30	79%
No	1	2%	0	0%	3	8%	8	21%

	e		f		g		h	
Yes	35	93%	35	84%	39	96%	28	72%
No	3	7%	7	16%	2	4%	11	28%

Water

	a	
Yes	40	94%
No	3	6%

Energy

	a		b	
Yes	40	96%	40	98%
No	2	4%	1	2%



- Q.26.** How do you think you can implement the “ minimizing the waste” in a project from construction, operation and maintenance up to final disposal?

(Indicate your answer with a “tick” against it)

- a)...**18 (41%)**.... include this requirement in the project brief.
b)...**39 (88%)**.....be concerned about this requirement during planning.
c)...**35 (79%)**.....be concerned about it during designing.
d)...**36 (81%)**.....be concerned about it during construction.
e)...**26 (59%)**.....be concerned about it during operation.
f)...**18 (41%)**.....be concerned about it during decommissioning.
g)...**16 (36%)**.....include this requirement in conditions, specifications and BOQ

- Q.27.** In order to minimize the environmental impacts due to construction projects from construction, operation and maintenance, and final disposal, It is suggested to minimize air and water pollution and land degradation.

Do you agree? (indicate your answer with a tick against it)

a).....43.....Yes b)01.....No

(if your answer is "yes" please go to Q.29.)

Q.29. It is suggested that following ways can minimize environmental pollution and land degradation due to construction projects from construction, operation and maintenance up to final disposal.

Do you agree with any of following?

(If your answer is "Yes" indicate it with a "tick". If your answer is "No" indicate it with a "X")

Noise and vibration

a).....Through using appropriate equipment and construction methods.

Air pollution

b).....Through appropriate measures to avoid dust generation.

c).....Controlling emissions through carefully managed use of chemicals.

d).....By using energy efficient machines and equipments

Ground water contamination

a).....By taking measures to avoid spilling of fuel, form work cleaning oil and chemicals onto the ground,

b).....Maintaining of existing drainages and streams to function properly so that it will prevent the mosquito breeding pools.

Land degradation

a).....By maintaining better top soil condition and improving the vegetation with indigenous plants.

b).....Construction of storm water system such away that it facilitate the recharging of the water table.

c).....Restoration of borrow pits.

Indoor Pollution

a).....By avoiding use of adhesives, paints, paint thinner, ammonia based cleaners which releases volatile compounds to air.

b).....By avoiding use of curtains, carpets, particle boards which release unhealthy particles and generates dust mites contributing "Asthma".

c).....By marinating healthy humidity levels within the building by providing proper ventilation.

Noise

	a	
Yes	42	98%
No	1	2%

Ground water Contamination

	a		b	
Yes	41	96%	38	93%
No	2	4%	3	7%

Air Pollution

	a		b		c	
Yes	42	98%	32	80%	37	98%
No	1	2%	8	20%	1	2%

Land degradation

	a		b		c	
Yes	40	100%	37	92%	30	86%
No	0	0%	3	8%	5	14%

Indoor pollution

	a		b		c	
Yes	21	68%	20	64%	39	98%
No	10	32%	11	36%	1	2%

Q.30. How do you think you can implement the ways of minimizing pollution and land degradation in a construction project?

(Indicate your answer with a "tick" against it)

- ...**25 (57%)** ... include this requirement in the project brief.
- ...**41 (93%)**.....be concerned about this requirement during planning.
- ...**37 (84%)**.....be concerned about it during designing.
- ...**35 (79%)**.....be concerned about it during construction.
- ...**29 (66%)**.....be concerned about it during operation.
- ...**22 (50%)**.....be concerned about it during decommissioning.
- ...**25(56%)**.....include these requirements in conditions, specifications and BOQQ.

Q.31. Do you believe that the concern for environment should be as important as the concern for time, cost and quality in a construction project?

(Indicate your answer with a "tick" against it)

a)....**41**.....Yes b).....**03**.....No

If your answer is "No", Please give reasons.

.....
.....
.....
.....

Reasons given:

1. Time, cost, quality, return on investment are more important. Concern for environment is important, but not as important as above, you have only to be "SOFT" to the environment.
2. The environment concern has to be taken into consideration from the very beginning of the project which is planning, design stages etc. The quality aspect of the project management will look-after the implementation of environmental management of the project during the construction stage.
3. This depends on the type of the project. For example, a large dam project may cause severe environmental damages compared to series of small dams etc. Some projects generate harmful effects in a temporary basis only. Hence general statement cannot be made.



REFERENCES

1. Ofori, G. (1992) The Environment: the forth construction project objective?. *Construction Management and Economics*, **10**, 369-395.
2. Hill, R.C. and Bowen, P.A. (1997) Sustainable Construction, Principals and a frame work for attainment. *Construction Management and Economics*, **15**, 223-239.
3. Pasquire, C. (1999) The implication of environmental issues on UK construction management. *Engineering Construction and Architectural Management*, **6/3**, 276-286.
4. Chen, J. J. and Chambers, D. (1999) Sustainability and impact of Chinese Policy initiatives up on construction. *Construction Management and Economics*, **17**, 679-687.
5. Wright, T. (1999) Sustainable Specifying: A plan for greening of national building specification. *The building Economist*, March, 4-11.
6. Ofori, G. (undated) Competitive advantage through environment responsibility. School of Building & Real Estate, National University of Singapore.
7. Opportunities for Change (Feb, 1998) Consultation paper on UK strategy for sustainable development.
8. McDonald, B. and Smithers, M. (1998) Implementing a waste management plan during the construction phase of a project: a case study. *Construction Management and Economics*, **16**, 71-78.
9. ENFO News (1999), A quarterly news letter of environmental systems information center, Asian institute of Technology, **20**(1), March.
10. Sandaratne, N. (1999), Global water scarcity in 2005. *Achievers*, July, 15,3.
11. Sivayogan, S (2000) Water and Health. *Daily News*, 09.03.2000, p12.
12. Low, S. P. and Mok, S. H. (1999) The application of JIT philosophy to construction: A case study in site layout. *Construction Management and Economics*, **17**, 657-668.
13. Blaras, C.A., Drousta, K., Argiron, A.A. and Asimakopoulos, D.N. (2000) Potential for energy conservation in apartment buildings. *Energy and Buildings*, **31**, 143-154.
14. Kadiragamer, R. and Emmanuel, R. (1999) Energy Efficient Cities. *Achivers*, October, **5**(4).
15. Howieson, G. and Lawson, A. (1998) Who is paying fuel price. *Environment by Design*, **2**(2), Autum.
16. Gan, G. (2000) Effective depth of fresh air distribution in rooms with single – sided natural ventilation. *Energy and Buildings*, **31**, 65-73.
17. Wijesekara, N.T.S. (1990) Surface water drainage systems to manage environmental consequences of development: An application to industrial state development in Sri-Lanka. *Engineer Journal of IESL*, **30**(3), September.
18. Kreimer, A. and Arnold, M. (2000) World Bank Report on Reducing Impacts of Disasters. *Natural Hazards Review*, February.

- 19 N. Lekakis, J.N. (2000) Environment and Development in a Southern European Country: Which Environmental Kuznets Curves?. *Journal of Environmental Planning and Management*, **43**(1), 139-153.
- 20 Broadbent, G., Martinez, C., Cardaci, E. and Zoilo, A. (1998) Design Studio Revisited. *Environment by Design*, **2**(1), Winter .
- 21 Takakura, T., S. Kitade, and E. Goto, (2000), Cooling effect of greenery cover over a building. *Energy and Buildings*, **31** , 1-6.
- 22 Pearce, D.W. and Warford, J.J. (1993) *World Without End, Economics, Environment, and Sustainable Development*. Published for World Bank, Oxford University press, 3-4,43,196-197,367.
- 23 Mason, R.D. and Lind, D.A. (1990) Statistical Techniques in Business & Economics, 7th Edition, Irvin Toppan, 357-371, 418- 438.
- 24 Jayasinha, C. and Perera, A.A.D.J. (2001) Hand Moulded Cement Stabilized Soil Blocks as a Material. *Transactions , Volume I part B, The Institution Engineers of Sri-Lanka*.
- 25 Ofori, G., Briffett, C. and Ranasinghe, M. (2000), Impact of ISO14000 on construction enterprises in Singapore. *Construction Management and Economics*, **18**, 935-947.
- 26 Graham, P. (2000) Building education for the next industrial revolution: teaching and learning environmental literacy for the building professions. *Construction management and economics*, **18**, 917-925.
- 27 Kibert, C.J., Sendzimir, J. and Guy, B. (2000) Construction ecology and metabolism: natural system analogues for a sustainable built environment. *Construction Management and Economics*, **18**, 903-916.
- 28 Cole, R. J. (2000) Building environmental assessment methods: assessing construction practices. *Construction Management and Economics*, **18**, 949-957.
- 29 Cather, B. (2001) What's new construction materials? The challenges of the imagination. *Construction Management and Economics*, **19**, 335-336.
- 30 Best, R and De Valence, G. (1999) Client's Expectations-Building in Value. *The Building Economist*, June.
- 31 Gann, D. M. and Barlow, J. (1996) Flexibility in Building Use-The Technical Feasibility Converting Redundant Offices into Flats. *Construction Management and Economics*, **14**, 15-66.
- 32 Farook, F. (2001) Green Wants Coordination on Environment, *The Sunday Times*, 30 December, P 6.
- 33 Ranasinghe, M. (1996) Mine restoration bond for clay mining and its impact on the prices of building materials in Sri Lanka. *Construction Management and Economics*, **14**, 165-174.
- 34 IUCN Sri Lanka (2000) The 1999 list of threatened fauna and flora of Sri Lanka. Part I, 5
- 35 De Silva, M.B.U.H. (2002) River sand abused. *Daily News*, 18 July, p.29.

