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Cover Story

Sustainability

The Pakistan Civil Engineer

Pakistan Society of Civil Engineers

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Editorial

This issue focuses on a subject that has become an existential threat to mankind – the changing environment of the planet earth. The fast transforming situation has set alarm bells ringing across the globe. The UN has already charted the course of action for the world community, identifying crucial actionable goals.

The cover story focusses on sustainability as the goal that everyone needs to target in all decision-making – sustainability. As the story explains, the civil engineering community has a special leadership role to play in this regard.

Looking forward to feedback from the readers,

Rizwan Mirza, CE
Editor-in-chief

Cover Story

Sustainability

Rizwan Mirza
Editor-in-chief

Environmental changes have become one of the biggest concerns for the mankind. They are threatening the very existence of life on earth. Ozone layer has been damaged, global warming has started exhibiting its detrimental effects, water cycle has been greatly disturbed, water streams are being polluted, speed of deforestation is increasing, some life forms are becoming extinct and the delicate ecological equilibrium of the mother has been disturbed. Scientists have concluded that complacence is no longer a choice. It is a wake-up call for everyone who lives on this planet.

Modern man has created a consumer society around himself. Resources are being plundered with a myopic vision. The insatiable needs for energy has already exhausted a good part of known reserves of fossil fuels. Indiscriminate pumping of ground water and its subsequent wasteful use in many urban areas is lowering the aquifer. With diminishing percentage of green space, precipitation is urban areas either evaporates or converts itself to surface runoff with negligible part being consumed for recharge. It does not occur to the mangers of the cities or the governments what the future has in store in terms of drinking water availability for these areas.

Large BOD municipal and poisonous industrial waste is finding its way to streams, with devastating effects on all life forms including human life.

So erratic has become our water cycle that hydrologic forecast, in the light of past data, is no longer a reliable exercise.

It has been estimated that by the year 2050, over two billion additional people would populate the earth, with around 95 percent in the developing or under-developed parts of the world. Such growth is expected to lead to a dramatic additional demand for resources including food, water, energy, space, housing, infrastructure, transportation, telecommunication, waste disposal and much more.

This growth will create unprecedented demands for energy, food, land, water, transportation, materials, waste disposal, earth moving, health care, environmental clean-up, telecommunication, and infrastructure. The role of engineers will be critical in fulfilling those demands at various scales, ranging from remote small communities to large urban areas, and mostly in the developing world. In 2007, engineers embraced a vision to contribute to the building of a more sustainable, stable, and secure world. We must train a new generation of engineers who can better meet the challenges of the developing world and address the needs of disadvantaged communities. Today, an estimated 20 percent of the world's population lacks clean water, 40 percent lacks adequate sanitation, and 20 percent lacks adequate housing.

'It is about time that projects be designed with a keen eye on the past, the present and perhaps most importantly on the future. Environmental stewardship has become the key responsibility of all professionals now, particularly that of civil engineers.'

In a nutshell, sustainability is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. The key point, therefore, is the state of globe we are going to leave for the posterity.

United Nations has asked all member states to contribute their fair share towards efforts designed to mitigate the mounting threat.

As alarm bells have been set ringing across the globe, governments are coming under increasing pressure to submit details of progress on identified actionable goals.

Civil engineers spearhead the intervention in globe through planning, design and construction activity involving multiple types of infrastructure. It is in the field if civil engineering that large sums are spent on projects related to dams, water streams, hydropower, water supply and water treatment, solid-waste management, transportation engineering and buildings. The community is fast realising its responsibilities for the paradigm shift that is required. Sustainability is gradually becoming a key consideration in the planning and design criteria of all civil engineering projects in the developed world.

It is about time that projects be designed with a keen eye on the past, the present and perhaps most importantly on the future. Environmental stewardship has become the key responsibility of all professionals now, particulars that of civil engineers.

With growing uncertainty, amongst other things, life-cycle analysis is now needs to be a necessary requirement for project and investment decisions.

Professionals now need to take the lead. Civil engineers, economists, sociologists, ecologists, urban planners, architects and architectural engineers need to pool their resources and evolve a joint strategy and to adopt an integrated – and non-compartmentalised – approach towards planning of all projects.

The task ahead is challenging but not unachievable if there is a real will.

UN Sustainable Development Goals

Rizwan Mirza
Editor-in-Chief

In September 2015, the United Nations General Assembly adopted the 2030 Agenda for Sustainable Development which includes 17 Sustainable Development Goals (SDGs).. Building on the principle of "leaving no one behind", the Agenda adopted a historic approach towards achieving sustainable development for all.

Proposed sustainability policy for civil engineers

Rizwan Mirza
Editor-in-Chief

Civil engineers can potentially a vital role towards achieving a more sustainable and hence a more liveable planet. The author expects the PSCE to do its best to take a lead in helping make this an achievable goal.

The possible guidelines for the civil engineers, at the macro-level are as follows:

Project Identification

Such projects must be identified, from amongst competing projects, as are most likely to maximise social, economic and environmental gains, for the communities serves and effected.

Evaluation Criteria

Evaluation criteria must include a life-cycle analysis.

ERR rather than IRR shall determine the relative merit of each project so that the dividends to the community are more rationally reflected.

Rational basis shall be adopted for converting social dividends to economic terms, for a fair holistic assessment.

A probabilistic approach is recommended in order to account for uncertainty.

For a fair and comprehensive comparison, a scoring system shall be adopted.

The existing Environmental Impact Assessment (EIA) and Environmental Impact Examination (AIE) systems shall be made more meaningful and responsive to the contemporary needs.

Planning and Design

Project planning and design shall take a holistic, multidisciplinary and integrated approach to each project weighing in all costs and benefits, direct and direct, internal as well as external, short-term, medium-term as well as long- term.

Design must optimise resource use and minimise – to the extent possible – the use of non-renewable resources.

A perfunctory addition of some ‘green’ features to a project shall not be considered an efficacious substitute for the above.

Sustainable architecture – a practical guide

Amina Rehman
Architectural Engineer
Sydney, Australia

Climate change has become one of the biggest challenges for mankind in our times. As the world braces itself for mitigating its damaging effects, the architectural community also bears a responsibility to play its role in helping create a more liveable world. The single word, that symbolises the goal, is sustainability. This goal is striking the required delicate balance between competing social, economic and environmental demands for a project.

This tripod of considerations, culminating in sustainability, merit special attention by designers, planners, decision-makers, designers and managers.

Some of the advanced countries already have either established voluntary movements targeting eco-friendly designs or governmental policies fostering such designs. Developing and under-developed nations must quickly learn from this experience and act before it is too late.

There is a lot that needs to be done by way of dissemination of technical information and training of professional.

Sustainable architecture cannot be divorced from sustainable urban planning. Urban development needs to provide interconnected green spaces, a multi-modal transportation system, and mixed-use development. New developments must create liveable communities that protect historic, cultural, and environmental resources.

It is obvious that new sustainable urban developments or re-developments should provide for a variety of commercial, institutional, educational uses as well as housing styles, sizes and affordability levels. Availability of sidewalks, trails, and private streets, connected to transit stops shall be a minimum requirement. An interconnected street network within the mixed-use developments shall foster mobility options and help reduce pollution by reducing vehicle trips. Walking, bicycling, and other mobility options should be encouraged throughout the urban mixed-use core and mixed-use neighbourhoods with accessible and well-defined centres and edges.

Bungalow architecture, reminiscent of early eighteenth century, with its use of encircling veranda, shades over windows and the use of ventilators is a good example of eco-friendly buildings responsive to the needs of British India. Office buildings, residences and rest-houses of that period reflect this tradition.

Figure 1: An example of bungalow architecture

Objective No. 1
Environmental Sustainability

Sustainable buildings strive to reduce their environmental impact through energy and water-efficient approach, utilising sustainable materials, and landscaping that impacts biodiversity and natural characteristics of the site.

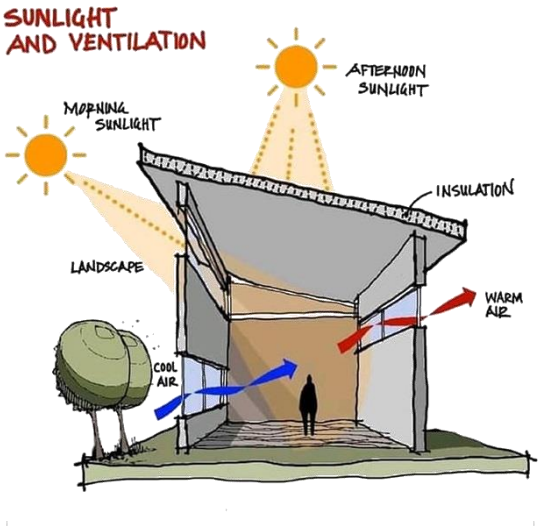
Following are some specific environmental design and construction factors:

Energy

Around 33% of the average home's energy is consumed by a cooling or heating system. Solar panels may be used to generate renewable electricity for heating as well as cooling.

Design components such as use of thermal insulation in walls and roof, use of double-glazed windows, provision of roof vents for ventilation, judicious orientation, sizing and location of fenestrations, window shading devices, light-coloured roof for heat reflection, and a hot water system installed close to where hot water is required can all help to increase a building's energy efficiency.

Cross-ventilation may be used in order to minimise dependence on mechanical air-conditioning. Occupants may need to be educated in this regard as fundamental changes in habits may be required on their part.



Water

Water reuse, where possible, must be considered. Water emanating from showers and wash-hand basins is now being successfully used for flushing of water-closets.

Rainwater harvesting may be made a part of the design.

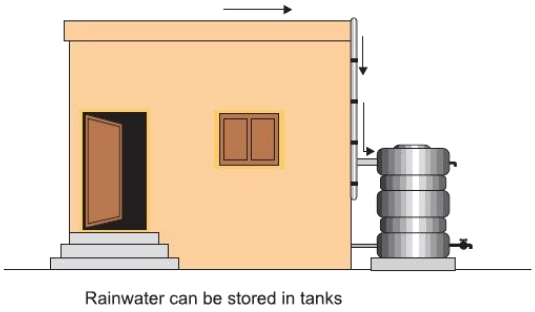


Figure 2: Rainwater stored in takes

Surplus precipitation shall be used for recharging the aquifer.

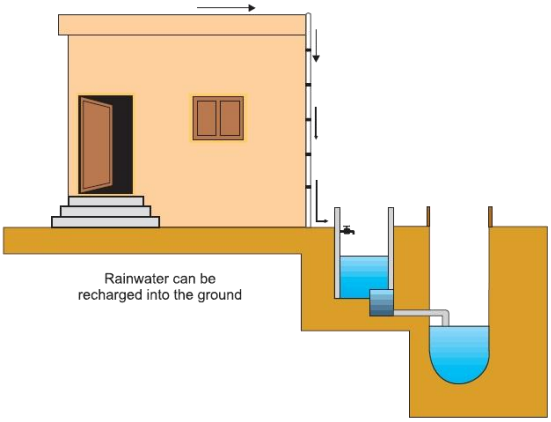


Figure 3: Rainwater used for aquifer recharge

Sprinkler irrigation must be considered for lawns.

Material

The construction of sustainable structures necessitates the most efficient use of available resources. This could involve the use of recycled materials, the reduction of on-site building waste, and the design of components such as run-off to rivers.

Landscaping & Site Impact

Working with, rather than against, a building's natural surroundings, effective landscaping entails maintaining existing vegetation, gardening in a way that takes minimal upkeep and water and providing a habitat that encourages native plants and wildlife to flourish.

Objective No. 2
Social Sustainability

Socially sustainable buildings are designed and built to meet the needs of their residents and visitors. They provide a healthy, comfortable, safe, and secure atmosphere that is conveniently accessible and appropriate for its surroundings.

Following are some examples of social design and construction factors:

Health & Comfort

People who live or work in a sustainable building should be able to feel at ease, which includes having adequate space, privacy, ventilation, and natural light. Sun exposure is minimised in the summer and maximised in the winter when the longer walls of a structure face north.

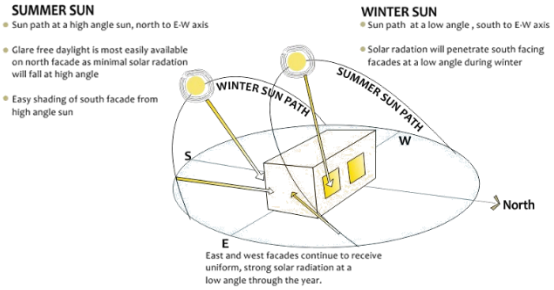


Figure 4: Building orientation

Safety & Security

Buildings should be constructed to reduce the risk of accidents and injuries, such as by using non-combustible and low-formaldehyde materials and low-VOC paint, and by making entryways and walkways easily accessible well illuminated. Sensor lights and alarm systems are two examples of security fixtures and fittings.

Fire alarm and fire fighting need to be ensured, as an integral part of architectural design.

Figure 5: Installation of appropriate fire-extinguishers

In addition to fire-alarm and fire extinguishing systems, suitable means of egress need to be ensured.

Figure 6: Fire-safety escape plan

As another example of safety features, secure stairs need to be ensured in each building.

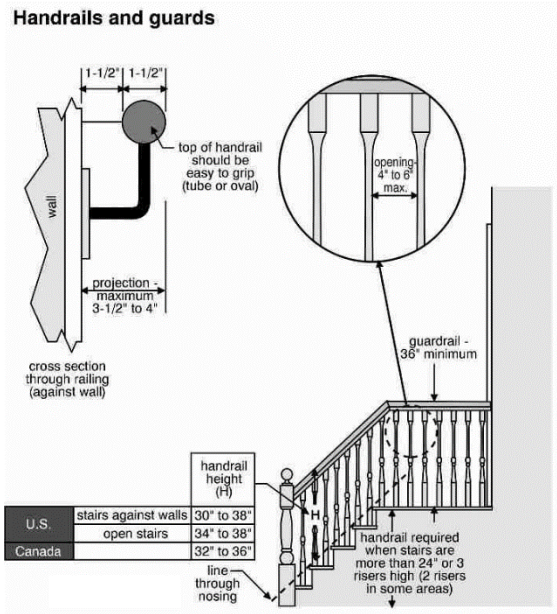


Figure 7: Stair safety

Objective No. 3
Economic Sustainability

Economically sustainable buildings provide long-term financial savings due to energy-efficient design elements, materials, and appliances that reduce continuing operating and maintenance expenses.
Following are examples of specific economic design and construction factors:

Construction Costs

Building size and materials, for example, should be cost-effectively evaluated during the design phase. Employing local and recycled materials during the construction process, where available, can assist reduce costs and lead to long-term cost-effectiveness.

Running Costs

The continuing maintenance costs of a building is a significant consideration after it has been built. A building constructed with sustainability in mind, such as using passive design elements and sustainable materials, fixtures, and fittings such as solar panels and dual-flush toilets, will have lower continuing maintenance costs due to less reliance on artificial light or climate control.

Liveability of our cities

Dr Muhammad Irfan

Are our cities more liveable now than they were five decades ago? Are we developing sustainably?

Figure 8: Walled city, Lahore

Economist Intelligence Unit (EIU) prepares a list of most liveable cities in the world. Walkability, cycle-friendliness and the availability of a public transport system are among the major factors affecting liveability indices of cities.

Cities like Tokyo, Melbourne, Zurich, London, etc., which rank high in the global liveability index, are all pedestrian-friendly, have a huge population using bicycles as means of commuting and have a well-structured public-transport infrastructure network.

Discussion with someone who has seen major Pakistani cities, such as Karachi, Lahore or Islamabad, evolve over years would tell you that compared to today they fared much better in at least walkability and cycle friendliness five decades ago. Unfortunately, the unplanned, or ill-planned, urban sprawl and infrastructure development has rendered our cities unfriendly for pedestrians and bicycles at large.

Figure 9: Mall Road, Lahore in the 1950s

Multi-lane boulevards often split the communities apart. Underpasses and flyovers kill walking opportunities and are generally not built by keeping cycles and pedestrians in mind.

Many US states have started removing the inter-city highways constructed some 50 years ago, and have started replacing them with parks, community spaces, and public buildings, etc. This can be good case study for us to look into the future and plan our urban centres in a sustainable manner. This is only possible through long-term infrastructure development plans with sustainability and environment at their core.

Figure 10: Murree Road, Rawalpindi

Many major boulevards in global metropolitans like Champs Elysees in Paris, Ginza Dori in Tokyo, etc., are converted into pedestrian-only streets over the weekends not only to encourage pedestrian access but also to reduce city's carbon footprint. Replicating similar smart strategies in Pakistan would bear no to minimal cost with enormous long-term benefits.

Figure 11: Avenue des Champs-Élysées, Paris, France

Good city squares are not unknown in the world. Trafalgar Square is a large city square in London, UK, commemorating Lord Nelson's victory against Napoleon's navy at the Battle of Trafalgar, in 1805. It is one of the most famous city squares in the United Kingdom and attracts visitors as well Londoners.


Figure 12: Trafalgar Square, London, UK

Compared to aforementioned cities where the percentage of population using mass transit is well in-excess of 50%, our use of whatever mass transit we have built is meagre. Research in the US has shown that every $1 billion invested in public transport capital and operations creates and supports an average of 36,000 jobs; and every $1 invested in public transport generated $4 in economic returns (APTA, 2013).

But there is good news also. Walled City Lahore Authority is taking many corrective steps, already. Chowk Purani Kotwali, Walled City, Lahore, used to be a Mughal police kiosk. After its construction food-stalls have been located around an open space, thus providing a much-needed breathing-space.


Figure 13: New-look Chowk Purani Kotwali, Walled City, Lahore.

Lahore heritage guided tours are another case in point while counting the already adopted correct steps.


Figure 14: Lahore heritage guided tours

But it is also clear that the current zeal in Pakistan for vertical growth of housing units, guided though it must be by a very noble objective, needs to be tempered with required complementary change in policies. These changes include greater focus on sustainable urban planning regulations and revisiting of human-settlement policies. One must also not be oblivious of the fact that demographic changes that are taking place in the country may well defeat best of well-meaning policy changes on other fronts.

We, in Pakistan, need urban modelling and remodelling which targets humans having an inherent need for green areas, quiet and open squares, streets, sidewalks, bicycle tracks, walkways accessible by public transport. We also need urban planning and regulations that reduces avoidable vehicular trip patterns. Perhaps self-contained units within cities, having their own mixed-use building, public libraries, education, recreational and health-care facilities may be the road forward to sustainability.

Recycling

Rizwan Mirza
Editor-in-Chief
with
Uzma Iqbal
Civil and Structural Engineer, UAE

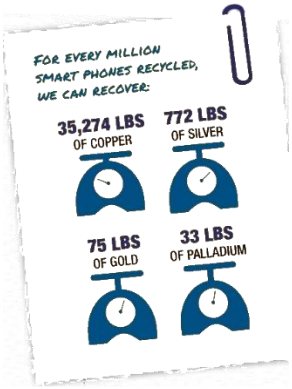
Modern men and women have created a consumer's society on this globe, with insatiable and arguably wasteful use of resources having become one of its hallmarks. Economic activity, consumption patterns and population growth generate different types of waste is being generated, including municipal solid waste, hazardous waste, industrial non-hazardous waste, agricultural and animal waste, medical waste, radioactive waste, construction and demolition debris, extraction and mining waste, oil and gas production waste, fossil fuel combustion waste, and sewage sludge.

In order to maximise their profits, manufacturers increasingly tend to produce non-durable goods. Similarly, there is a growing tendency amongst consumers to frequently replace their goods, such as vehicles, electronics and furnishings. These goods end-up in junkyards thus complicating the existing challenges for the managers of solid-waste management.

Most developed countries have very stringent laws governing the process of waste disposal.

Figure 15: E-scrap

Americans throw out approximately 416,000 mobile phones each day, according to 2014 figures from the EPA. That equates to more than 151 million phones thrown away in one year.



Many of the abandoned goods can be retained by their uses thus greatly mitigating the nature and quantum of solid-waste management required. In the alternative, goods rendered unusable, may be sent for repair and then sent back to consumers.

As a result of many demolition or reconstruction processes, many civil engineering materials are retrieved which are generally considered a waste but the growing concerns regarding sustainability have forced civil engineers to seriously consider recycling them.

Figure 16: Construction and demolition waste

Construction and demolition waste includes:

- Concrete
- Wood (from buildings)
- Asphalt (from roads and roofing shingles)
- Gypsum (the main component of drywall)
- Metals
- Bricks
- Glass
- Plastics
- Salvaged building components (doors, windows, and plumbing fixtures)
- Trees, stumps, earth, and rock from clearing sites

Civil engineers have a great responsibility at their shoulders in wisely managing construction and demolition activities for achieving the goals of achieving the key goals of sustainability.

Many construction and demolition building materials material and components can be either reused or recycled where markets exist. Asphalt, concrete, and rubble are often recycled into aggregate or new asphalt and concrete products. Wood can be recycled into engineered-wood products like furniture, as well as mulch, compost, and other products. Metals – including steel, copper, and brass – are also valuable commodities to recycle.

The following figure diagrammatically shows the concept of the recycling of asphalt:

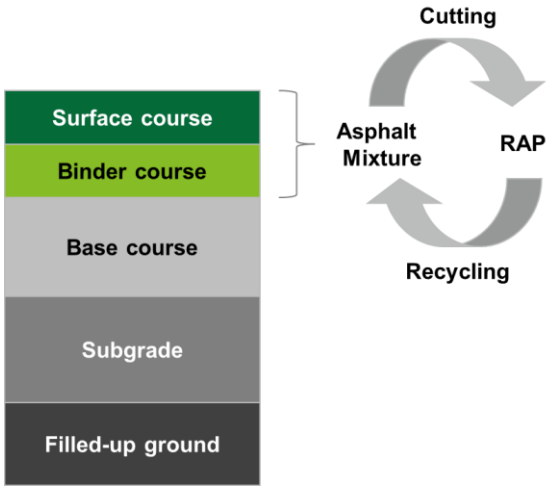


Figure 17: Recycling asphalt

The following figure shows how demolished concrete debris is being reused:

Figure 18: Recycling concrete

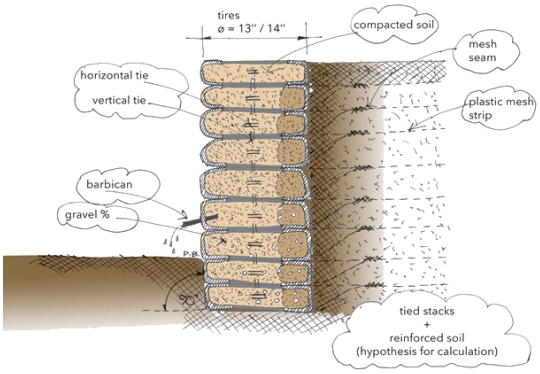
It is clear that governments, being fairly large spenders in construction industry, need to take the required steps, so that an enabling environment is created.

Scrap tyres generate a lot of waste.

Figure 19: Scrap tyres

Following are some of the uses made of recycled tyres:

- Retaining wall backfill
- Slope stabilization
- Vibration migration
- Landfill applications
- Lightweight embankment fill
- Road repair
- Septic system draining fields
- Subgrade road insulation



Very successful experiments have been made to recycle part of the water which was wasted in the past. The grey water generated in the wash-room is now being used to flush toilets, either directly, or after some treatment or even after some mixing with fresh water.

Figure 20: Recycling water

In a nutshell, the need for recycling in well-established in a resource-starved world and its possibilities countless.

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a) Articles
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c) Details of significant civil engineering projects
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e) News of professional significance including newspaper clippings, citing source
f) Other important professional information
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You do not need to be a writer in order to contribute; your professional skill is all we need. Please allow us to make editorial changes before we finally adopt a contribution.

Please make sure that your contributions are free of plagiarism. Where you rely on other sources, please acknowledge and provide complete reference.

Also, please do send us your text contribution in editable format. The editorial board would have the authority to accept or reject any contribution and also to make editorial changes in the content.

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