Dar Al Riyadh Insight #74
Construction Environmental Sustainability - Energy and Water

Dar Al Riyadh Insights reflect the knowledge and experience of our Board, executives and staff in leading and providing PMC, design and construction management services. Dar Al Riyadh believes in the importance of broadly sharing knowledge with our clients and staff to improve project outcomes for the benefit of the Kingdom of Saudi Arabia.

Site waste management

The construction industry is considered to be among the major contributors to the emission of greenhouse gases (GHGs), approximately responsible for about 19% of the overall GHG emission globally. For a given construction project there are two major components of CO2 emissions, Direct emission (operational CO2) and Indirect emission (embodied CO2).

Direct emissions include those associated with energy consumption of construction equipment such as bulldozers, excavators, cranes, and pile drivers; onsite transportation of labor and materials; construction electricity use of all types; assembly and miscellaneous works such as welding and chemical use; and onsite worker activities.

Strategies to improve energy related environmental sustainability during construction include:

- Powering large, mobile construction equipment with alternative fuels. Manufacturers are investing in alternative fuels, such as natural gas, propane, biodiesel and hydrogen, so watch this space.
- Hybrid and electric vehicles for labor and light duty transport.
- Electric, natural gas or hydrogen powered buses for crew transport on larger sites
- Alternative sustainable energy sources such as wind and solar for site and task lighting, general purpose uses, and battery recharging
- Scheduling peak electricity use during grid and local community off-peak periods
- Microgrid for economic and environmental dispatch of on-site diesel generators (higher in-service load factors are more efficient)
- Green provision of temporary power, especially for indoor operations where electric motors replace carbon fuels
- Use of recycled equipment and materials

Indirect emissions associated with embedded carbon are a growing focus area.

The following table provides some guidance on current embodied carbon levels and underscores some of the advantages of the use of recycled materials and the addition of fly ash to cement.

Embodied Energy and CO_2^e		
Material	**Embodied Energy (MJ/kg)**	**Embodied $CO_2^{equivalent}$ (kg/kg)**
Aggregate (Gravel/Crushed Rock)	0.083	0.005
Aluminum Casting - Average	159.335	9.22
Aluminum Extruded - Average	154.265	9.08
Asphalt (4% binder)	2.86	0.066
Asphalt (8% binder)	5.00	0.086
Cement (CEM II/A-V) – Mean (6-20% fly ash)	4.895	0.825
Cement (CEM II/B-V) – Mean (21-35% fly ash)	4.065	0.685
Cement (Average CEM) – Portland Cement (94% Clinker; 0% fly ash/slag)	5.5	0.95
Copper – EU Tube and Sheet - Virgin	57.0	3.81
Copper – EU Tube and Sheet - Recycled	16.5	0.84
Steel – Engineering - Recycled	13.1	0.72
Steel Bar and Rod – World Average	21.6	1.86
Steel Bar and Rod – Recycled UK	8.8	0.45
Steel Plate – World Average	32.0	2.21
Stainless Steel 304 – World Average	56.7	6.145*
Source *- AMEE Inventory of Carbon & Energy Methodology for Materials by Mass; Version 2.0; AMEE UK Ltd*	***Notes –*** *all values are from cradle to gate; transport and installation not included*	** Includes CO2 only, no other GHG equivalents included*

Increasingly, water related impacts are growing in importance. Water impacts must not be viewed homogeneously but rather look at three distinct water types:

- Green water – rainwater consumed insofar as it does not become run-off water
- Blue water – consumption of water along the supply chain but excluding non-consumptive water use (example – cooling water); Consumption' refers to loss of water from the available ground-surface water body
- Grey water – water pollution related volume of freshwater that is required to assimilate the load of pollutants given natural background concentrations and existing ambient water quality standards.

In addition, attention must be paid to runoff and waste water discharges from the site. These factor broadly into grey water described above but also represent pathways for hazardous material discharges from the site. Attention is required to both surface waters as well as less obvious underground plumes.

Water related sustainability strategies include rainwater harvesting for site dust control and other general purpose uses; recirculation of water in process units; use of harvested water for washing and cleaning roads and tire wash stations (reduce fugitive dust); toxic waste spill plan and provisions; erosion control including natural plantings; and reuse of human derived wastewater streams for secondary uses (general irrigation).

Summary

Environmental sustainability during construction represents a significant global opportunity and our industry has the opportunity to make an earth changing difference. Environmental sustainability during the construction phase is best begun during the project selection and planning phase and best leveraged within a broader life cycle context. Sustainability's economic and social dimension cannot be ignored, and an appropriate balance must be struck. But there is much scope for our industry and new materials, new forms and sources of energy and new materials hold great promise. Our industry is challenged to leverage these developments for meaningful effect.