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QUARTERLY E-MAGAZINE JANUARY-MARCH 2023 ISSUE NO. 3

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by CEMEX/TCL

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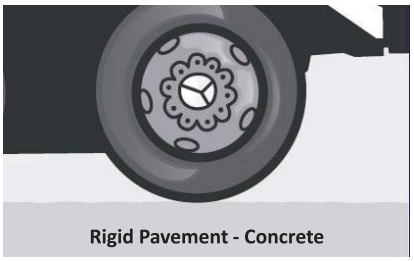

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# CONTENT





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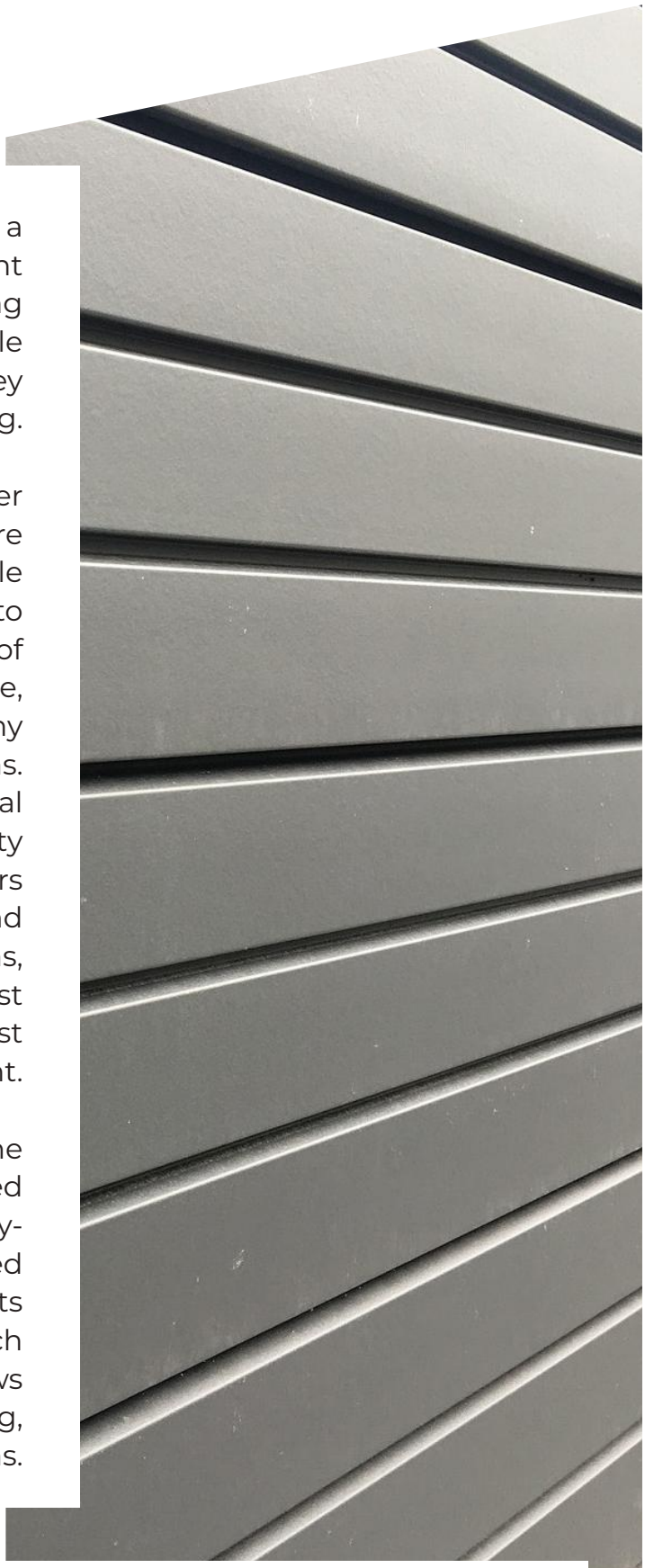
# PLASTIC LUMBER AS A SUSTAINABLE BUILDING MATERIAL

**Miguel Andrews - CARIRI**

The onset of global warming has forced every business to critically assess its operations from the perspective of environmental sustainability. This is also true for the timber industry.

Timber is one of the oldest, renewable, carbon-capturing building materials. It is employed for building housing, furniture, cabinetry, art and even for poured forms which use pumice or concrete. Every cubic meter of lumber stores essentially one ton of Carbon Dioxide ($CO_2$).



Despite this, every harvested tree has a negative impact on our global environment – increasing erosion and diminishing the Earth's ability to reduce and recycle atmospheric CO2 – which is a key contributor to global warming.

Currently several synthetic timber replacements exist – many of which are created from recycled materials, while owning superior or equivalent properties to indigenous or imported timbers. Many of these new materials are carbon negative, as they reduce the need to harvest healthy trees for building applications. Most plastic woods consist of natural wood fibers combined with high density polyethylene waste plastics, UV stabilizers and pigments to give a beautiful look and feel without the need for hazardous stains, varnishes and other treatments. In most instances, they are weather, rot and pest resistant.

Plastic wood can be processed with the same types of blades and bits that are used to process natural wood but require epoxy-based adhesives unless otherwise informed by the manufacturer. Many products have their own building systems which include brackets and proprietary screws for assembly – whether this be for decking, walls or furniture- based applications.

Most plastic wood comes in lengths of 1" x 6" x 16" or 8 board feet. The pricing tends to be between $30 to $50 TTD per board foot depending on the look and feel of the brand used; this figure is higher than other premium lumber prices such as Teak and Greenheart; however, builders choosing this material will save overall, as the synthetic material has fewer defects than natural lumber. Once a design has been completed, all that is needed is to cut and install. No straightening, flattening, staining, sanding and varnishing required. In addition, there is significantly less wastage because of the aforementioned facts. Other benefits include: no cracking, splintering or mold. The material is considered "low maintenance" and is the best choice for projects that have constrained or limited post-construction maintenance budgets.

Synthetic lumber should always be considered when planning a timber-based project. However, it is important to always review Materials Safety Data Sheets or "MSDS" documentation, as some of the dust residues generated in the cutting and drilling operations may pose significant risks depending on the type of plastics and resins that were used when manufacturing the boards. The MSDS' will ultimately identify the risks and recommend proper personal protective equipment to reduce the negative impacts.

When choosing a brand of plastic wood, it is always of benefit to investigate the manufacturer's ISO certifications. The two most commonly found amongst manufacturers of synthetic timbers would be ISO 9001 and 14001. ISO 9001 ensures consistency of product while ISO 14001 documents environmental benefits that this type of product possesses.

Using sustainable materials and building techniques is one strategy that builders can use to differentiate their companies from the competition – ensuring that their business is profitable and has a positive impact on our future.

**Author**
**Miguel Andrews**

**Caribbean Industrial Research Institute (CARIRI)**

Miguel Andrews is a professional Physicist and Analytical Chemist with both research and practical experience in the realms of renewable energy technologies – specifically electrochemical systems, which would include Photovoltaic, Fuel Cell and Battery Technologies. Despite these core competencies, he is also quite knowledgeable of Biofuel engineering processes. Mr. Andrews' professional career has spanned more than twenty (20) years and encompasses experiences across several industrial sectors including, but not limited to Instrumentation, Energy (Oil and Gas), Manufacturing, Software Engineering, Banking and Education. In addition to green technologies and all of the aforementioned, Miguel also manages an ISO/IEC 17025:2017 accredited calibration laboratory based in the Caribbean Industrial Research Institute of Trinidad and Tobago. Mr. Andrews is also an entrepreneur and innovator at heart and it is these qualities that drive his on-going and enthusiastic support for the Institute's research and innovation initiatives.

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# What you should know about Horizontal Core Hollow Clay Blocks

**Cecil Pope, Standards Officer I - TTBS**

There are many types of clay blocks that are manufactured around the world. However, the most popular building block used in Trinidad and Tobago is the horizontal core hollow clay block. It is described as horizontal because the double 'cells' i.e. the hollow areas running throughout the block do so horizontally. Why are these blocks so popular locally? The reasons include - the abundance of raw materials to manufacture it, durability, price and approval among building contractors.

This article will outline some essential facts about this type of building block; from its manufacturing process all the way through to its finished production for consumers.

## Manufacturing Process

Hollow clay blocks are manufactured from clay mined in Trinidad, from areas deemed fit for purpose. The manufacturing process involves the following steps:

1. Mixing clay with water and sand, then leaving it to 'sour' (forget its original state);

2. Passing the soured mixture through a mould called an 'extruder' which shapes the clay into the initial block shape;

3. The extruded clay block in its wet state, is then cut into familiar block sizes and dried;

4. Once the extruded clay blocks are dried, they are then transported to an industrial oven called a 'kiln'. It is in the kiln that the blocks are fired with large amounts of heat and their true strength develops;

5. After the blocks exit the kiln, they are left to cool and then they are packaged for sale.

## Quality Checks

The manufacturing process must take place with testing involved at each stage, viz. receipt of raw material, testing of clay, checks performed during processing, checks after extrusion, dryer temperature, and final checks of the end product. The final checks include:

1. Compressive strength;
2. Percentage water absorption; and
3. Dimensions and warpage.

The checks identified above are done to ensure the hollow clay block can withstand compressive forces and retain its strength (even if water is absorbed), as well have a uniform shape throughout its production.

The importance of quality checks is to ensure that the quality of the product meets both local and regional standards.

## Assessment of Quality

Ensuring that hollow clay blocks manufactured within Trinidad and Tobago conform to all regulatory requirements, takes place via enforcement of the National Compulsory Standard TTS 588:2015 (Hollow Clay Block – Horizontal Core – Specification). This standard references international standards and is enforced by the Trinidad and Tobago Bureau of Standards' (TTBS) Certification Division.

The enforcement process is referred to as Certification, which is a third party assessment of the product against a national, regional or international standard. Certification involves an audit of the manufacturer(s) processes involved in the manufacture and sale of the end product such as receipt of raw material, in-process checks, checks of the final product, competency, calibration of measurement and testing devices, traceability of end product to raw materials and how customer complaints are addressed.
Additionally, the end product is tested both at the manufacturer's warehouse and on the open market. Once all the requirements are met, the manufacturer's product is certified for a period of one year per certification cycle, during which surveillance testing is performed on a periodic basis.

## Benefit of Certification

The key purpose of Certification of a product such as hollow clay blocks, is to give the consumer the assurance that the product they purchase meets the necessary requirements to ensure it can perform as outlined in the standard. If the product does not meet the requirements of the end user (e.g. clay blocks purchased have defects such as a lot of breakage in a pallet, deformed blocks and brittle blocks), a certified manufacturer has a system in place to receive and treat with customer complaints and also tracks the finished products back to the raw materials they were produced from. This is important as it ensures the manufacturer can investigate the issue(s) and make the necessary correction and corrective action to prevent it from reoccurring.

What if a consumer purchases hollow clay blocks that are deformed, brittle or contain a significant amount of breakage? Well, a certified manufacturer has a system in place to receive and treat with customer complaints, as well as track the blocks in question back to the production source. This is important as it ensures the manufacturer can investigate the issue(s) and take the necessary corrective action to prevent it from reoccurring.

## Labelling of the end Product

Labelling is also critical in ensuring that clay blocks on the market meet the requirements of the standard. In most cases, every fourth block on a pallet is labelled. Labelling that can be identified includes the date manufactured and shift manufactured on. This requirement is important as it gives consumers a point of reference apart from their bill of sale, when making a complaint.

## TTBS has you Covered

So the next time you purchase horizontal core hollow clay blocks, rest assured that the product is certified by TTBS and if any issue arises, a customer complaint can be made to the manufacturer and redress sought. Members of the public wishing to lodge complaints, queries and questions are asked to contact the Consumer Liaison Officer via email at: complaints@ttbs.org.tt, or call (868) 662-8827 ext. 2268. Complaints must include the name, address and contact number of the complainant and a brief description of the problem. Complaints will be accessed via a set criteria based on the severity, safety, complexity, impact and possible immediate action.

TTBS remains committed to fulfilling its mandate to develop, promote and enforce standards in order to improve the quality and performance of goods, ensuring that quality horizontal core hollow clay blocks are available for purchase by the consumer. This will help build a solid foundation of standards and quality in T&T.

Author
Cecil Pope

**Standards Officer I**
**Trinidad and Tobago Bureau of Standards**

Cecil Pope has been employed as a Standards Officer I at the Trinidad and Tobago Bureau of Standards within the Certification Division (Product Certification) for the past six years. He graduated from the University of the West Indies with a BSc. joint major in Chemistry and Biochemistry and furthered his studies as a post graduate at the Australian Institute of Business with an MBA focusing in Marketing Management. He has gained experience throughout his professional life in the fields of auditing management systems, analytical testing, marketing and public speaking. His professional mantra is to give of his best in whatever role he is assigned to.

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## Certificate of Environmental Clearance (CEC) conditions and Best Management Practices for the

# Management of Waste for the Construction Sector

**Environmental Management Authority**

What is waste? Waste can be any solid, liquid, or contained gaseous material that is being discarded by disposal, recycling, or incineration (IFC, 2007). It can mean any garbage, refuse, sludge and other discarded material, resulting from industrial, commercial, mining, and agricultural operations, and community activities (USEPA, 2022).

Waste can be categorised as non-hazardous and hazardous. Hazardous waste includes those with properties that make it dangerous or capable of having a harmful effect on human health or the environment (USEPA, 2022).

The legal framework for waste management in Trinidad and Tobago includes the Waste Management Rules (WMR), 2021 and the Waste Management (Fees) Regulations (WMFR) 2021, which took effect on 31 May 2022. These were introduced to support the legal framework to improve the national management of hazardous and non-hazardous waste.

The purpose of the legislation is to regulate activities related to the management of waste, such as generation, processing, treatment, packaging, storage, transportation, collection, disposal, recovery, and through a permitting regime encompassing two groups, Waste Generators and Waste Handlers.

In the construction sector, waste materials typically consist of debris generated during the construction, renovation and demolition of buildings, roads, and bridges (USEPA, 2022). The non-hazardous solid waste generated at construction and decommissioning sites includes excess fill material from earthworks (i.e. excavation and grading), scrap materials including wood and metals, concrete from spills, and refuse from site office/staff facilities when part of construction activities (IFC, 2007).

Hazardous solid waste can include contaminated soils, potentially encountered on-site because of previous land use activities (IFC, 2007), for example, former service stations, fuel and chemical storage sites. Sources of hazardous waste include machinery maintenance waste materials, such as oily rags, used oil filters, used oil, and spill clean-up materials.

Waste management in construction is important as construction waste increases the burden on landfill sites and can cause pollution. Therefore, it is crucial for construction companies to manage waste responsibly, adopting industry best management practices.

## WHAT ARE SOME OF THESE BEST MANAGEMENT PRACTICES?

### Waste Minimisation

• Establish and develop site waste management that is planned in accordance with a Waste Management Hierarchy that considers prevention, reduction, reuse, recycling, recovery, removal and final disposal of wastes (IFC, 2007) (City of London, 2019);
• Avoid or minimise the generation of waste materials, as far as practicable (IFC, 2007);
• Where waste generation cannot be avoided but has been minimised, recover and reuse waste (IFC, 2007);
• Where waste cannot be recovered or reused, treat, destroy, and dispose of it in an environmentally sound manner;
• Implement stringent waste segregation to prevent the commingling of non-hazardous and hazardous waste;
• Institute good housekeeping and operating practices, including inventory control, to reduce the amount of waste resulting from materials that are out-of-date, off-specification, contaminated, damaged, or excess;
• Substitute raw materials or inputs with less hazardous or toxic materials;
• Evaluate waste production and identification of potentially recyclable materials;
• Establish recycling objectives and formal tracking of waste generation;
• Assess the presence of hazardous substances in or on building materials (e.g., polychlorinated biphenyls, asbestos-containing flooring or insulation) and decontaminating or properly managing contaminated building materials;
• Assess the contents of hazardous materials and petroleum-based products in building systems (e.g. PCB containing electrical equipment, asbestos-containing building materials) and equipment, and removing them prior to initiation of decommissioning/demolition activities, and managing its treatment and disposal according to Hazardous Materials and Hazardous Waste Management;

### Storage

• Hazardous waste should be stored in a manner that prevents the commingling or contact between incompatible wastes, and allows for inspection between containers to monitor leaks or spills;
• Store in closed containers away from direct sunlight, wind and rain;
• Secondary containment systems should be constructed with materials appropriate for the wastes being contained and adequate to prevent loss to the environment. The available volume of secondary containment should be at least 110% of the largest storage container or 25% of the total storage capacity (whichever is greater);
• Provide adequate ventilation where volatile wastes are stored;
• Provide readily available information on chemical compatibility to employees/ workers, including labelling each container to identify its contents;
• Limit access to hazardous waste storage areas to persons who have received proper training;
• Conduct periodic inspections of waste storage areas and documentation of the findings;
• Prepare and implement spill response and emergency plans to address accidental release of hazardous waste
• Document all waste kept on-site, including transfer and consignment notes, licences, etc.

## TRANSPORT

• Transportation of waste should be conducted in a manner to prevent or minimise spills, releases, and exposures to employees and the public. Waste should be properly loaded, secured and labelled with the contents and associated hazards, and be accompanied by a waste manifest that also describes the load and its associated hazards;
• Procedures and training should be implemented to ensure safe delivery and handling of materials;

## TREATMENT & DISPOSAL

• On-site or off-site biological, chemical, or physical treatment of the waste material to render it non-hazardous prior to final disposal;
• Treatment or disposal at permitted facilities specially designed to receive the waste. For example, properly designed, permitted and operated landfills or incinerators designed for the respective type of waste; or other methods known to be effective in the safe, final disposal of waste materials such as bioremediation (IFC, 2007).



## CERTIFICATES OF ENVIRONMENTAL CLEARANCE

The Certificate of Environmental Clearance (CEC) process, is one mechanism used by the EMA to regulate development and mitigate environmental impacts. It is governed by the CEC Rules and the CEC (Designated Activities) Order (as amended).

Before embarking on any new activity, modification/expansion of existing structures and processes, decommissioning or the abandonment of projects altogether, persons must consult these Rules, which clearly lists 44 Designated Activities, that require a CEC. Some activities regulated by the CEC Rules include: agriculture, civil works, transportation and associated infrastructure, heavy and light manufacturing, natural resources and mineral extraction as well as waste handling and disposal.

## CEC conditions that address solid and hazardous waste/materials management

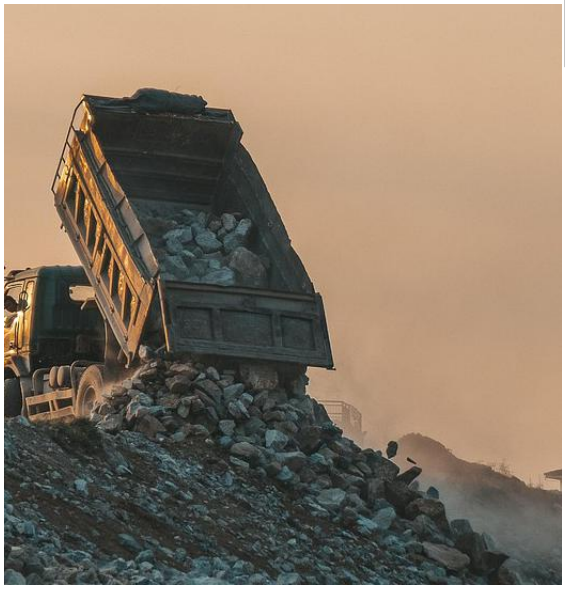
CEC holders shall:
1. Pursuant to Rule 4(3) of the Waste Management Rules, 2021 (WMR), submit an application for a Waste Generation Permit to the EMA at least forty (40) working days prior to the commencement of operations at the facility;
OR
Pursuant to Rule 4(2) of the Waste Management Rules, 2021 (WMR), submit an application for a Waste Generation Permit following notification by the EMA;

2. Ensure that any uncontaminated excavated material removed for infrastructural works are stockpiled and re-used, to the extent practical, for backfilling and landscaping on-site. Any uncontaminated material that is not re-used shall be removed from the site for recovery or disposal at a facility operated by the relevant Municipal Corporation or a person with the licenses, permits, trained/certified personnel, facilities, equipment and insurance to handle such material;

3. Ensure that at the end of the decommissioning/ demolition, site preparation and construction phases, the project site is cleared of all scrap material and debris;

4. Ensure that washings from premix concrete trucks, associated with the project, are not discharged into any municipal drains or watercourses;

5. Ensure that non-hazardous solid waste such as, but not limited to, domestic garbage, inert construction/ demolition materials and refuse including metal scrap and empty containers (except those previously used to contain hazardous materials) generated from all phases of the proposed project, is collected, sorted into recyclable and non-recyclables, and stored in receptacles which are clearly labelled, durable and sturdy, fitted with covers and of adequate capacity, until ready for recovery or disposal. As far as practical, such waste shall not be left easily accessible to pests and vermin, or allowed to litter the ground. The recovery or disposal of non-hazardous waste shall take place at a facility operated by the relevant Municipal Corporation or a person with the licenses, permits, trained/certified personnel, facilities, equipment and insurance to handle such waste;



6. Ensure that hazardous wastes (as defined in the WMR) are segregated from non-hazardous waste. Wastes shall be clearly labelled to include the name, quantity and hazardous characteristics, dated and securely stored in receptacles designed for such waste. Commingling of incompatible wastes shall be prevented and the storage area shall allow for inspection to monitor the integrity of receptacles and spills or releases. Inspection of stored waste onsite shall be conducted on a weekly basis and inspection reports maintained by the CEC holder and made available to any Inspector upon request.

7. Ensure that hazardous waste is not stored onsite for more than 90 days from the time the waste receptacle is full. The recovery or disposal of hazardous waste shall be handled by a person with the licenses, permits, trained/certified personnel, facilities, equipment, and insurance to handle such waste;

8. Ensure that contaminated materials and substances generated from spill response and spill clean-up are handled as hazardous waste;

## CEC conditions that address solid and hazardous waste/materials management

9. Ensure that empty chemical containers that possess one or more of the characteristics classified as hazardous under Schedule 2 of the WMR are handled as hazardous waste. Partially used or unused chemicals discarded as waste shall be secured in their original containers, where practical, and returned to the supplier for recovery or disposal or transferred to a person with the licenses, permits, trained/certified personnel, facilities, equipment, and insurance to handle such waste;

10. Ensure that a waste manifest accompanies the hazardous waste from its movement from the site on which it was generated to its final destination where it is subjected to treatment for recovery or disposal. Manifests shall be in accordance with Part VI of the WMR. Certificates of recovery or disposal shall be maintained by the CEC Holder and made available for review, upon request by the EMA;

11. Ensure that a waste management report is submitted within 30 working days of completion of the decommissioning works/ construction works. The report should include the following information:

- The type, characteristic and quantity of each type of waste generated at the facility during the decommissioning works/site preparation and construction works;

- The type and quantity of each type of waste sent for offsite disposal, and the identification of the facility which received the waste;

- The method of treatment, recovery or disposal for each type of waste generated;

- A list of each transporter used for transporting waste from the facility;

- A description of spills, releases or any incidents arising from waste generation at the facility;

- A description of measures implemented to reduce the hazardous characteristic(s) of waste generated.

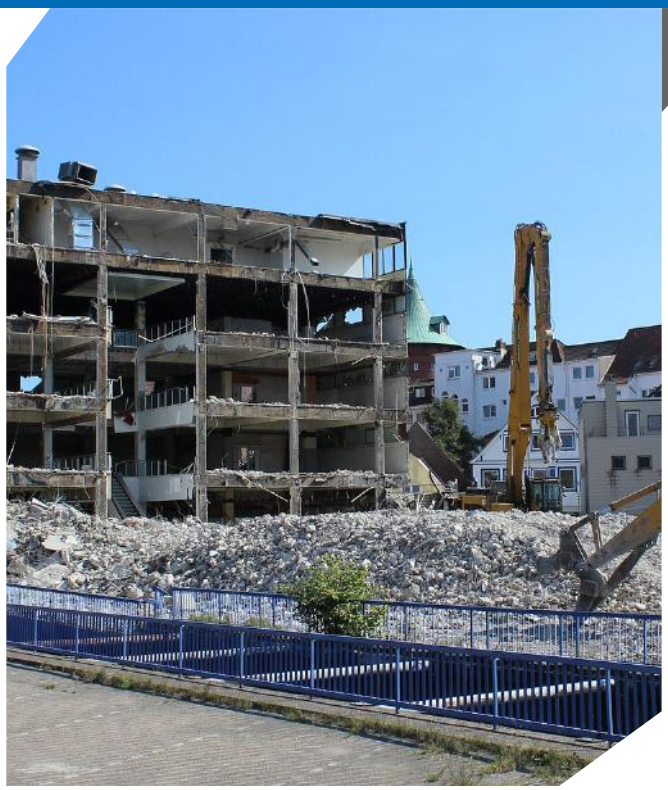
## CEC conditions that address solid and hazardous waste/materials management

12. Ensure that there are separate, secure, impervious bunded facilities for the storage of any fuels and, lubricants during the proposed activity, so as to minimise their release to the environment through spills and accidents. These bunds shall have a capacity of at least 110 % of the maximum volume of the largest tank (or 25 % of the aggregate total capacity of the tanks, whichever is greater) and shall incorporate a drainage sump and an additional minimum wall height of 150 mm to accommodate rainfall and fire-fighting foam;

13. Ensure that bunds are inspected monthly and accumulated water removed either manually or mechanically and treated, if necessary, to comply with Schedule II of the Water Pollution Rules, 2019 (WPR) before being discharged to the environment. Records of such inspection and treatment shall be retained by the CEC Holder and made available to any Inspector upon request.

Dispensing areas shall be on impermeable surfaces and located as far as practical from any natural waterbody.

Responsible construction waste management helps conserve the planet's natural resources and minimise environmental damage! Further information on the CEC Rules and the WRM is available at www.ema.co.tt.



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REFERENCE DOCUMENTS:
1. Environmental Management Authority (EMA), 'Waste Management Rules, 2021' (Accessed November 15, 2022)
2. Department of Markets and Consumer Protection, City of London. 'Code of practice for Deconstruction and Construction Sites' 9th Edition. December 2018.
3. Directive 2008/98/EC of the European Parliament and of the Council. Article 3, 'Definitions' (Accessed November 15, 2022)
4. International Finance Corporation (IFC), Environmental, Health, and Safety (EHS) Guidelines 'GENERAL EHS GUIDELINES' Section 1.6 'Waste Management', April 30, 2007.
5. International Finance Corporation (IFC), Environmental, Health, and Safety (EHS) Guidelines 'GENERAL EHS GUIDELINES' Section 4 'Construction and Decommissioning', April 30, 2007.
6. United States Environmental Protection Agency (USEPA).'Criteria for the Definition of Solid Waste and Solid and Hazardous Waste Exclusions' July 31, 2022.
7. USEPA, 'Stormwater Best Management Practice, General Construction Site Waste Management', December 2021.
8. USEPA, Sustainable Management of Construction and Demolition Materials', July 09, 2022.

# Evolving technologies of concrete or rigid pavements in the Caribbean and South & Central America

In the past two years during the Pandemic Mode of Operation, many observations/ realizations have been identified during that "slowing down time" of the general socio-economic environment of the country. With the general halt of the working public, the transportation network of Trinidad and Tobago became under-utilized and understandably neglected for at least those two years. During that short time, it was observed that the conditions of the roads became quite deplorable throughout many parishes in the country.

Also noted were the significant impacts from the rapid effect of climate change which saw significant increases in rainfall with each passing year leading to land movement and supersaturated soil conditions.

Trinidad and much of the Caribbean are vulnerable to two types of natural disasters:
- earthquakes and
- hurricanes and associated weather events

Except for Haiti, earthquakes have caused relatively little damage to the Caribbean over the last several decades. Natural-event damage to roads and related infrastructure has been considerable but has been largely from extreme rainfall events.

After any major disaster, the surface transportation network is usually critical to recovery; societies can recover by the extent that they can mobilize and deploy critical goods, services and supplies. The road network is crucial in this regard. Its robustness, durability and serviceability after major events are therefore important factors for national disaster management planning. Major rain events, mostly in mountainous or hilly terrain, present a considerable threat to roads and related infrastructure.

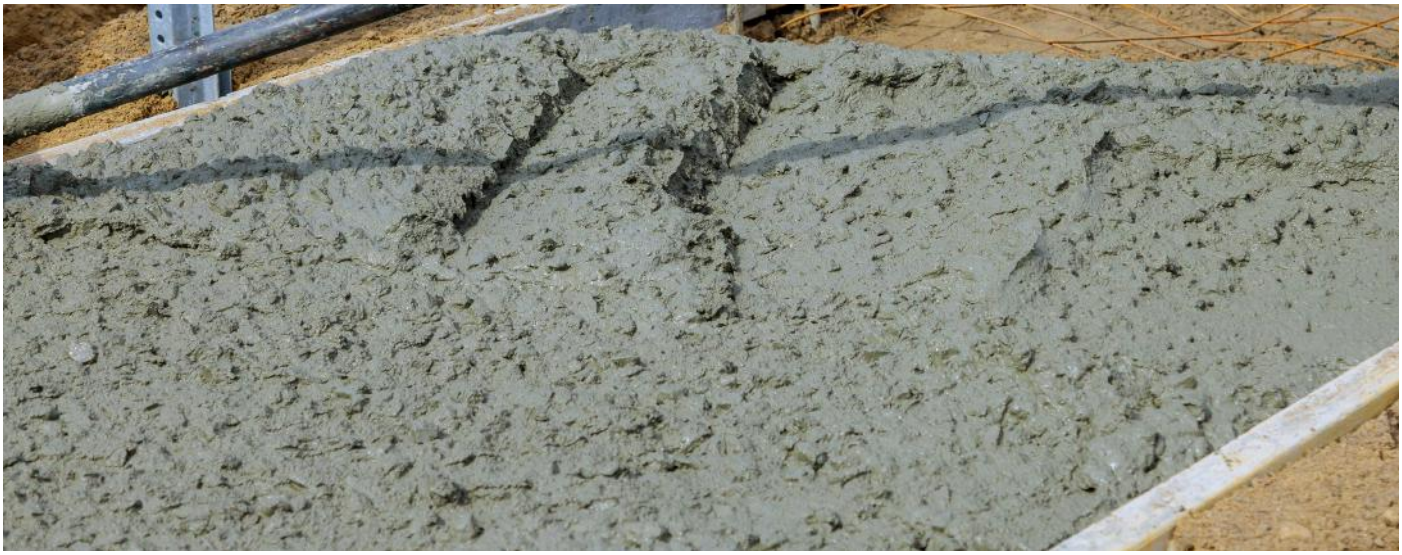
Important differences in the properties and behavior between rigid and flexible pavement systems are briefly compared in this article.

## ARE RIGID (CONCRETE) PAVEMENTS THE CRITICAL SOLUTION TO SUSTAINABLE ROADS IN TRINIDAD?

One can debate the age-old question of the above but then on the flipside agree that concrete roads though superior are more expensive when compared to flexible (asphalt) roads. The pun being it is an age old comparison. Technologies have evolved in the world of concrete from the use of low cost, low carbon cement, to additives, to more economical construction solutions and methods of construction.

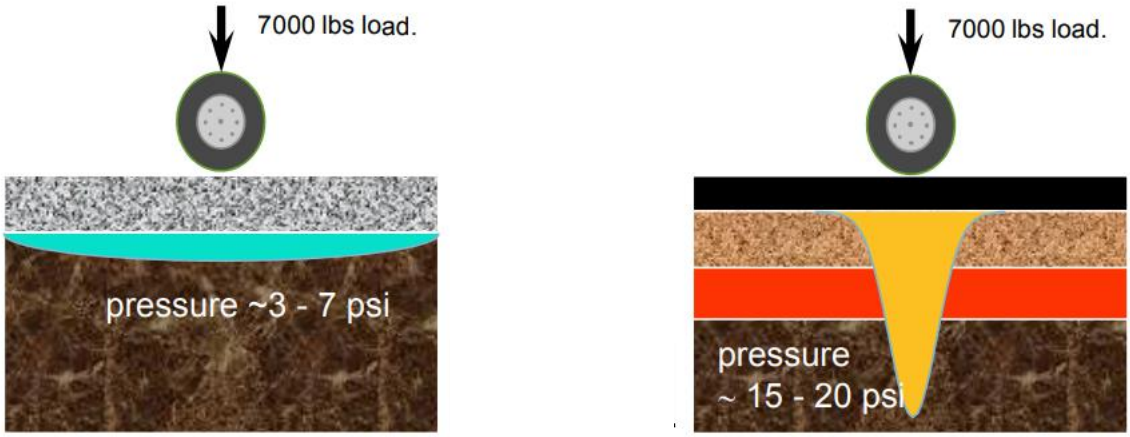
In 2018, when the Trinidad and Tobago Government ceased to manufacture refinery bitumen, which is? a key component for the building of flexible pavements, the cost of construction of the traditional flexible pavements increased as bitumen became an imported raw material. Coupled with the Covid-19 pandemic and the Ukraine/Russian war, we saw soaring freight prices. Cement on the other hand is manufactured locally and cheaply. Coupled with improved technologies, the cost of Concrete roads has become comparable to Asphalt roads, if not less expensive. However, according to Source (PCA, 2011), since 2008 the costs of asphalt pavements in the USA have been greater than those of their concrete equivalents, thereby reversing the traditional lower-capital-cost advantage of asphalt.

Notably the important differences in character and performance between the two pavement systems have not been fully recognized in Trinidad along with the suitability of one or the other for use in particular situations. Competing claims have continued to be made regarding capital cost, maintenance requirements, skid resistance, ride quality, noise generation, CO2 emissions, sustainability, lighting requirements at night and vehicle fuel economy.



## HOW CONCRETE & ASPHALT PAVEMENTS ARE DIFFERENT

| Concrete Pavements are rigid | Asphalt pavements are flexible |
|---|---|
| Loads are distributed over a large area through slab action.<br>Minor deflections.<br>Low subgrade contact pressures.<br>Subgrade uniformity is more important than strength. | Loads are more concentrated.<br>Deflections are higher<br>Subgrade, base and subbase strength are very important.<br>usually require more layers and greater thickness for optimally transmitting load to the subgrade |




In the Caribbean, the concerns of construction have to do with steep terrain and heavy rainfall, where the vulnerability of the pavement system to:

(i) erosion of the pavement itself by surface water

(ii) removal of pavement support due to erosion or undermining by running water

(iii) softening of the supporting subgrade – even when it is not actually removed, and

(iv) eventual total failure,

are particular challenges. The failure of roads often leads to disruption in the commuting population. Hidden extra costs to the society include: loss of productive time in commuting, increased vehicular fuel consumption, increased vehicular wear and tear. (Osborne, R.W.A. and Burgess, K.H.,1992)

The short slabs technology for concrete roads introduced by Cemex-TCL for the past 5 years has been quite progressive and has been now well established in the Caribbean in countries like Guyana, Grenada, Jamaica and Trinidad. It has been slow to progress in the public domain due to the traditional approach, contractors' knowledge and technology readily available in local construction.

## WHAT IS THE SHORT SLABS TECHNOLOGY FOR CONCRETE PAVEMENTS?

Pavement systems containing cement-bound layers have been used worldwide for over a century, with great success. Portland cement can be used in virtually every layer in a pavement system. Typical applications include:

· Improving the quality of subgrade soils and stabilizing base materials.

· Integrating multiple cement-based layers into a pavement design which may provide a cost-effective method for achieving a stronger, more durable, sustainable pavement. For instance, using a cement-modified soil and cement-treated base as opposed to an unbound granular base placed on an unprepared subgrade can reduce the required thickness of the base material.

· Cement treated bases which may decrease the thickness needed for the concrete or asphalt surface, resulting in less materials being requiredand overall reduced cost.

· New concrete pavement and concrete overlay surfaces

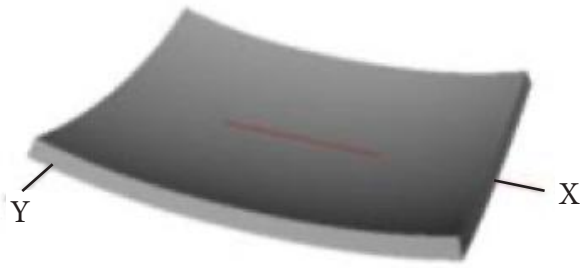
· Other unique surface applications of cement including roller compacted concrete (RCC)

· Precast pavements

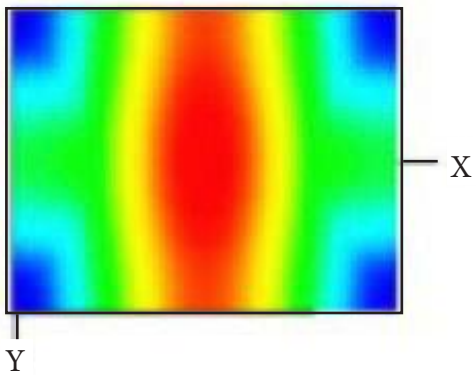
· And pervious concrete pavements. Cement is also used in numerous pavement repair techniques, as well as an array of pavement recycling and reclamation applications.

### Design Method- Optimized Slab Criteria (TCP)

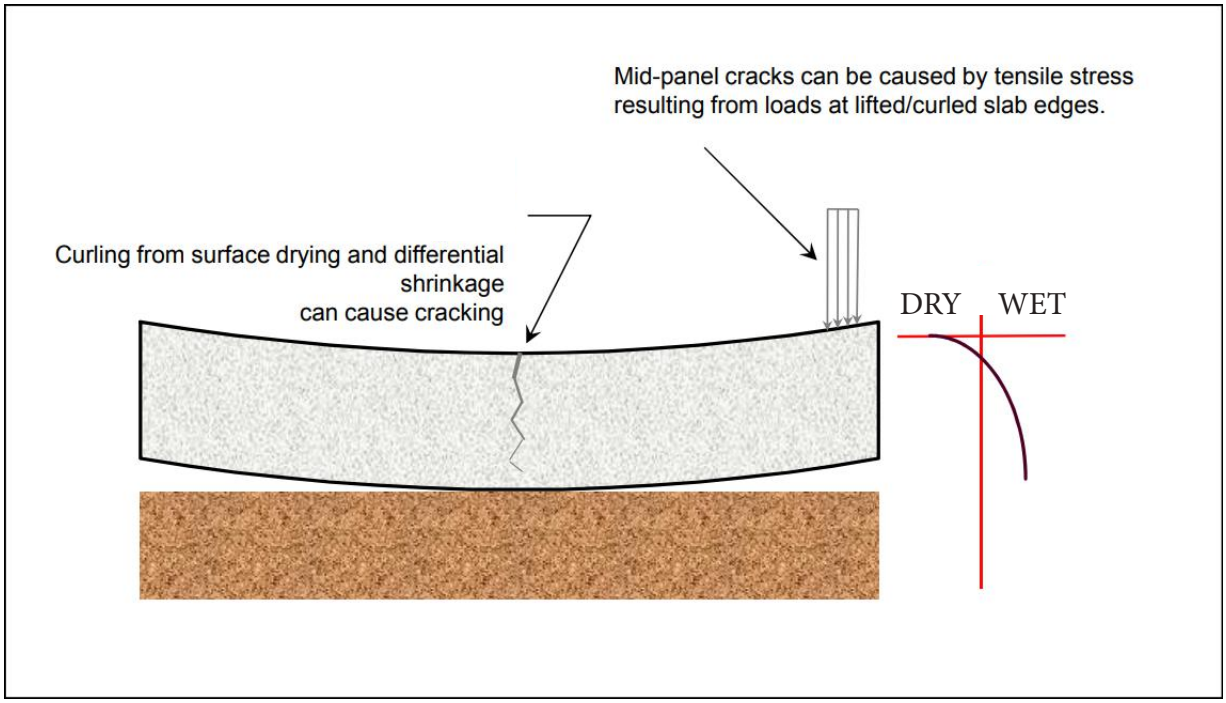
The American Concrete Institute (ACI 360 & ACI 302), normally recommend joint spacing criteria to 24 times the slab thickness for unreinforced slabs. In order to reduce the tensile stress originated by the front and rear axles of a vehicle loaded simultaneously at the edges of the slab when it is curled upward, the slab is optimized by reducing the joint spacing near to 10 times the slab thickness and letting reduced the concrete pavement thickness on condition that the tensile stress is equal or lower than traditional design.




Slab when it is curled upward



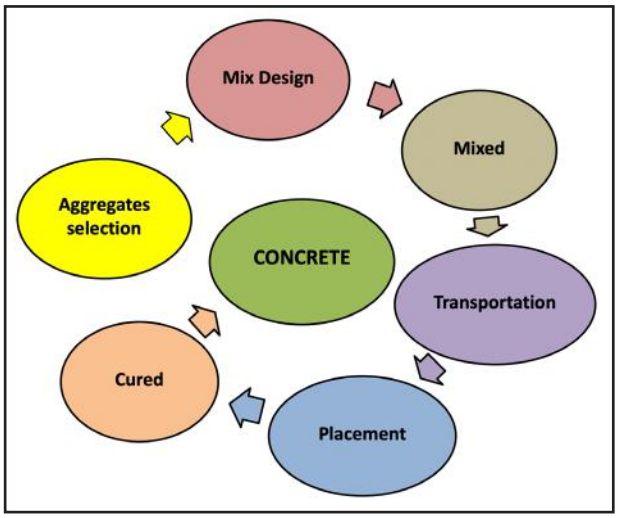

Maximum tensile stresses



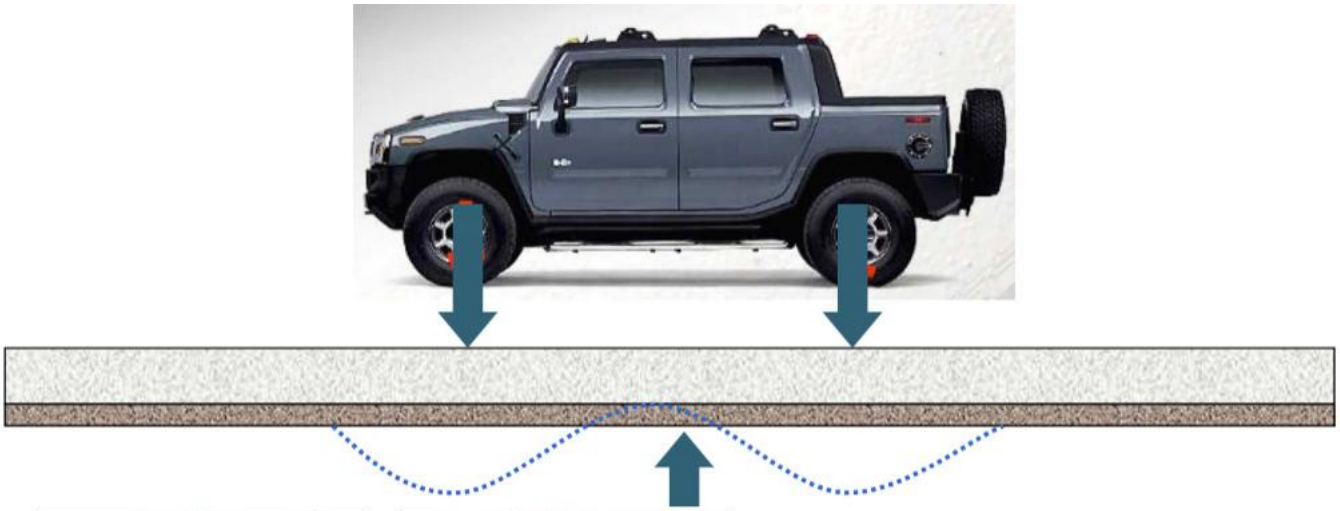

Traffic information is analyzed by the AASHTO method to determine the critical Axle Load that damages the pavement structure most. The AASHTO method is normally used to calculate the concrete pavement and the critical axle load according to the daily traffic information given by NWA. Traffic Tridem Axels are the most critical axle loads that can damage the structure; therefore the maximum tensile stress analysis is performed by the Tridem Axel in 3D finite-element software (EVER FE 2.4)

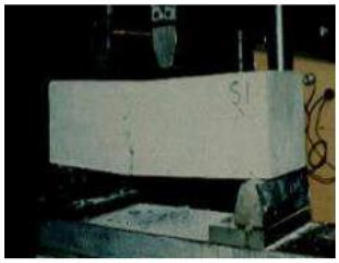
The design concept of optimized unreinforced slabs has been realized by understanding the effects of the tensile strength of concrete along with other keys factors such as:

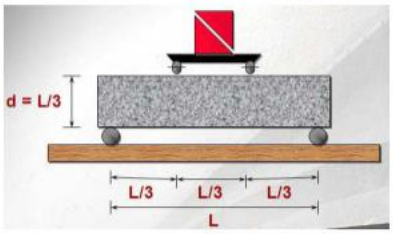
- Concrete specifications and properties
- Durability – material proportions
- Effective load transfer – load transfer efficiency
- Abrasion – W/C ratio
- Shrinkage - Admixtures
- Cohesivity - Admixtures
- Low Permeability - Admixtures
- Workability - Admixtures



**Concrete MR Modulus of Flexural Rupture:**



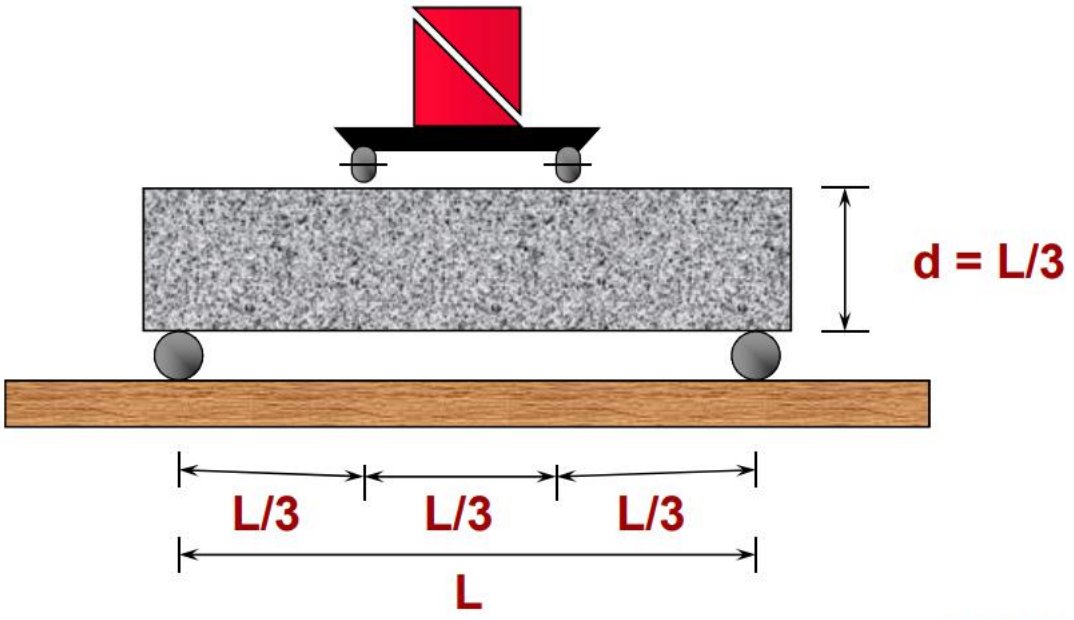





ASTM C78

THIRD POINT LOADING METHOD

The flexural strength of the concrete is determined by the modulus of rupture test conducted on beams 6x6x30 inch




ASTM C78

## Concrete Strength: MOR

- Compressive strength ($f'_c$) is specified and used for quality control on most projects
- Modulus of rupture ($M_R$) is used for thickness design
- Recommended design strength of 4000 psi (MOR = 600)

Round Aggregate

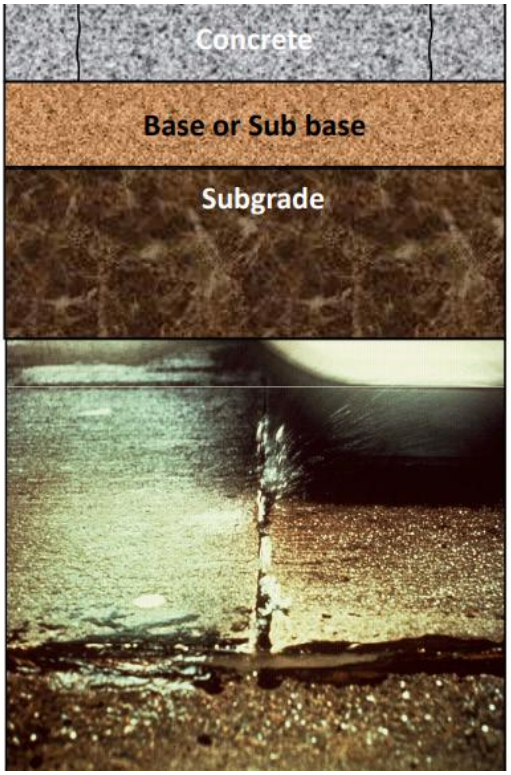
$$MOR\ (psi) = 8\sqrt{f'_c}$$

Angular Aggregate

$$MOR\ (psi) = 10\sqrt{f'_c}$$

The design of the concrete roads takes into consideration the soil conditions on which the road is being constructed. The most important aspect for obtaining good concrete pavement performance is UNIFORM SUPPORT. Concrete's Rigidity spreads the load over a large area and keeps pressures on the subgrade low.

- Subgrade
  - Uniform compacting and support – avoid isolated weak areas
  - For poor soil, use cement stabilization (3 to 6% cement, 6″ to 8″ deep) or lime
- Base or Sub base
  - Used to mitigate:
    - Expansive soils
    - Frost-susceptible soils (frost heave)
    - Pumping (erosion from underneath the pavement slabs due to slab deflections)
  - Use a sub base in Heavy Duty areas (for good soils):
    - Slab thickness > 8.0 in.
    - Truck semi-trailer volumes > 200 / day
  - Exclude sub base if:
    - Standard duty areas



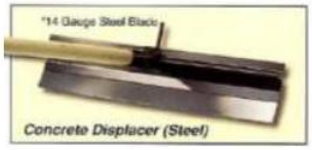
**The recommendations for the control of subgrade pumping:**

| Conditions for Pumping | Solutions for Pumping |
|---|---|
| 1. Subgrade soils that will go into suspension<br>2. Free water between slab and subgrade<br>3. Frequent heavy wheel loads | . Short slabs<br>. Contraction joints only & fill<br>. Good joints with aggregate interlock<br>. Thickened edge<br>. Provide proper surface drainage<br>. Maintain joint sealants/fills<br>. Use soil stabilization<br>. Granular base<br>. Dowel bars |

**Tools for construction:**

- Central batching plants
- Concrete transport equipment
- Slipform pavers, vibrating screed or triple roller
- Stringline or Stringless system / leica system
- Dowel Bar Inserter (DBI) system
- Tie Bar Inserter (TBI) system, if necessary
- Texturing / Curing equipment
- Zero Clearance pavers, if necessary
- Pavement profile and IRI[1] meters
- Drilling equipment
- Concrete spreading equipment, if necessary
- Surface corrective equipment , if necessary
- Cutting machine

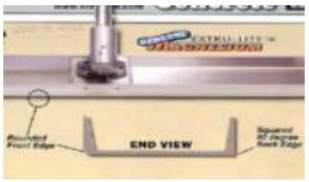
## Tools for construction:




**CONCRETE DISPLACER**: This tool is used to spread the concrete. It provides a high efficiency and helps avoiding concrete segregation.

**SQUARE POINT SHOVEL** : This tool is used to spread the concrete and to reach the concrete when is need it to correct the surface.

**BUMP CUTTER or STRAIGHTEDGE:** These tools are used in concrete placement with a sliding formwork to correct irregularities on the surface and to have an appropriate index of the pavement profile




**CHECK ROD:** This tool is used to correct small imperfection on the surfaces using the straight side and the float to open the pores and to release the air on the surface

**MAGNESIUM FLOAT (Channel Type):** It eliminates the waves left by equipment and allow the exit of small amounts of air and water that are present on the surface.

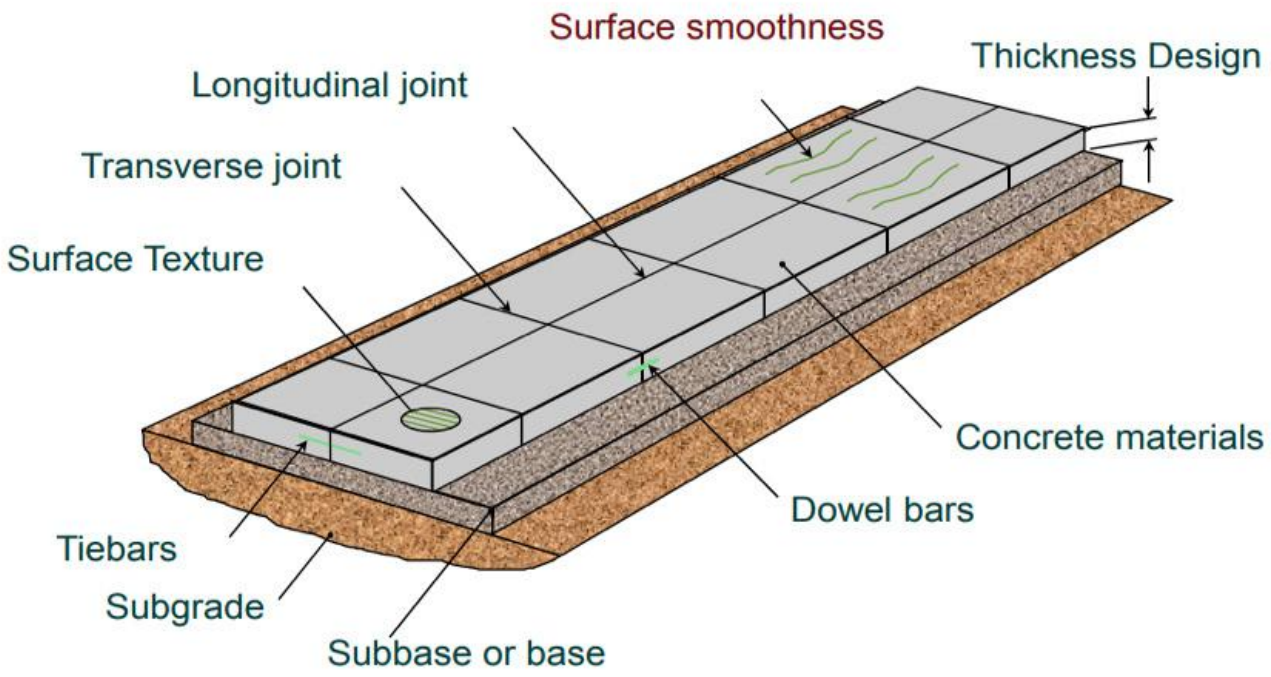
**FRESNO FLOAT MAGNESIUM OR BIG D BULL FLOAT 72" x 12:** It Flattens and compacts the slab surface and closes the open pores left by the floating works. It is used immediately after passing the Check Rod or Magnesium Float.


**MANUAL FLOAT:** It helps float the surface of the edge extracting small amounts of air and water found on the surface


**HAND TROWEL:** This tool is used to give a uniform toweling to the surface and closes open pores left by the floating works. It is applied right after the previous manual float.

**Flat wire texture blooms 48" largo, wire wide 3.2mm (1/8") @ 2cm (3/4"):** This tool is used to texture the surface.

## The basic components of the concrete pavement:




## The Concrete Road Construction Process:

1) Compacted CTB

2) Setting out of Formwork

3) Vibrating of Concrete (Immersion Vibrator)

4) Placing of Screed

5) Leveling of concrete (bump cutter)

6) Floating (Chanel & Magnesium Float)

7) Texturing (Rake)

8) Curing

9) Initial Saw Cutting

10) Sealing of Joints

## Proper Jointing Impacts performance more than thickness design:

The concrete *will* crack after placement

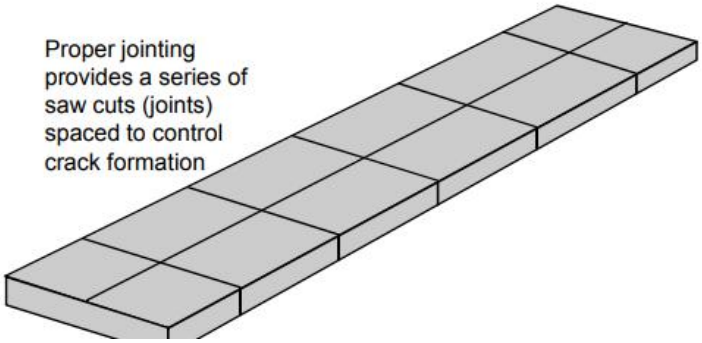
- Joints tell the concrete where to crack

Why does concrete crack after placement?

- Concrete drying shrinkage
- Changes in temperature and moisture
  - Ambient (contraction)
  - Gradient (curling)
- Subbase restraint (friction or bond)
- Service loads

Erratic crack patterns due to no joints

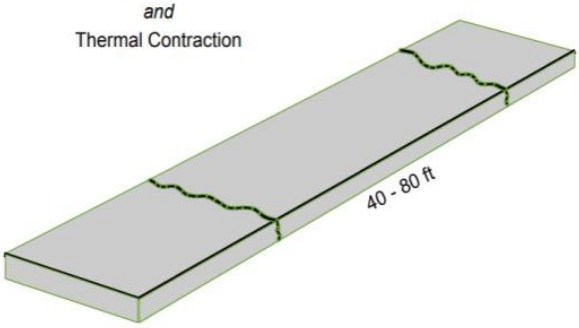
Proper jointing provides a series of saw cuts (joints) spaced to control crack formation



## Natural and Secondary Crack Development:

NATURAL CRACK DEVELOPMENT

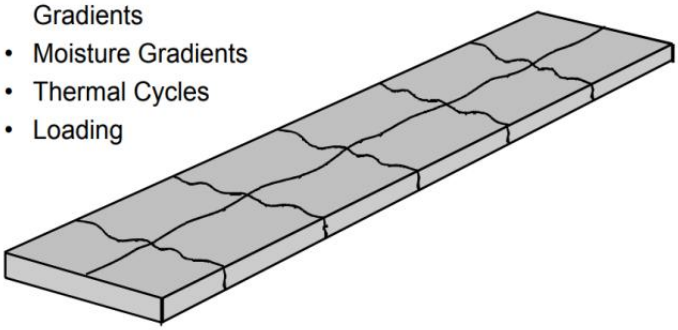
Initial shrinkage caused by moisture loss *and* Thermal Contraction




SECONDARY CRACK DEVELOPMENT

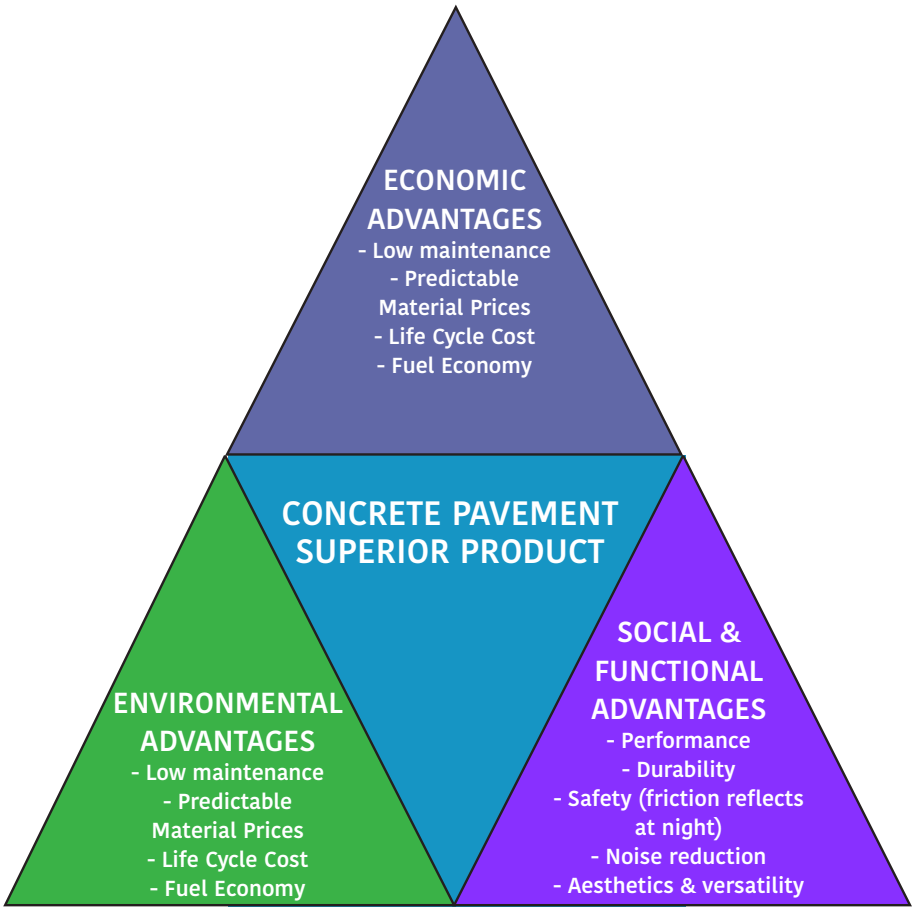
Caused by……

- Temperature Gradients
- Moisture Gradients
- Thermal Cycles
- Loading



## Conclusion:

**The benefits of concrete roads are highlighted below that falls into economic, social and environmental advantages.**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Avaleen worked for the past 18 years with the TCL Group in their cement companies in Trinidad, the Caribbean and South America on multi-million upgrades for optimization of efficiencies of the cement plants.For the last ten years Avaleen has been working on establishing markets for the alternative uses of cement primarily through sustainable pavement solutions and eco-housing.

**PROFESSIONAL MEMBERSHIPS:**

- Member of the Association of Professional Engineers of Trinidad and Tobago
- Registered engineer with the Board of Engineering
- Member of the Powerful Ladies Of Trinidad and Tobago (PLOTT)

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