Re-thinking use of Scrap Tyre's in Art and Architecture

B.ARCH DESIGN DESERTATION

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Abstract

Recycling of waste has drawn attention of society based on the slogan “There is gold in our garbage” on hand and on other hand growing concern about the environmental protection. And one such component of garbage is Tyre. The main constituent of a tyre is rubber and the largest single application of rubber is vehicle tyres.

Rubber is a main constituent of a tyre and it is largely applied in in vehicle tyres. The growth of automobile sector results in more requirement of tyres. Hence the demand for tyre is directly related to automobile sector and its growth. Production rate of automobiles will continue to rise according to the forecast, but the rate of annual discarded scrap tyre volume is growing same as rate of new tyre manufacture.

Only a fraction of these scrap tyres are being managed in an environmentally sound manner while the rest continue to pileup in cities and various urban centres. Currently, scrap tyres are stockpiled in consumers yards or continually dumped into the environment where they become a fire hazard, breeding grounds for snakes, bees and rodents particularly rats, and human disease vectors such as mosquitoes. This is all because appropriate disposal methods or technologies are lacking.

Further, open burning of tyres to recover steel wire as well as burning of tyres during riots pollutes the environment with dioxins and furans, posing serious respiratory risks to animal and human life. The aim of this project is to promote creative use of scrap tyres in Art and Architecture and thus to help the environment and human beings from getting affected from the hazardous effects of scrap tyres.

The Architectural intervention for the project would include workshops and

training centre for creating sculptures, installations and many more day to day usable products that will be made out of scrap tyres. Exhibition spaces to display and sell the created products. It will also consist of a training centre for teaching building construction from scrap tyres.

This project will also deal with a remolding plant and a pyrolysis plant which will be open for the people to see and understand. In the end it will be clear that even though the tyres are scrap but burning and landfilling is not the correct option, products can be recycled or have benefits even after the end of their end product life cycle, they have much more potential in which they can be used in eco-friendly ways.

To be fully tackled awareness has to be created among people about the impending crisis that may result to a tyre waste crisis in a few years considering more and more people buying personal vehicles.

Every Thing about Tyres

What is a Tyre?

A rubber covering, typically inflated or surrounding an inflated inner tube, placed round a wheel to form a soft contact with the road.

What is Tyre made up of?

Major components use in a tyre are:

Natural Rubber

Synthetic Rubber

Steel Wire

Carbon Black Textile

The components mentioned above are major part of a tyre. variety of materials like variety of rubber compounds, different carbon black, fillers like silica and clay , chemicals or minerals added to accelerate/decelerate vulcanization. The tyres also consist of many types of fabric for reinforcement, several kinds and

sizes of steel. Some of the steel is braided into strong cables.

Natural Rubber

Natural Rubber is a latex derived elastomer, some of the plants produce a milky colloid . These plants produce latex when they are wounded as a healing mechanism. Collection of latex is done in a vessel and it is allowed to coagulate. This process gives the solid rubber which is further processed in form of sheets. The Process of coagulation is controlled with help of chemicals like Ammonia, Formic acid.

Ammonia decelerates the process of coagulation whereas Formic acid helps to accelerates it. The purified natural rubber is same as polyisoprene. The monomer of Natural Rubber is 2-methyl-1,3-butadiene,$CH_2=C(CH_3)-CH=CH_2$. The properties of rubber which is required like elasticity, is mainly depends on the cis form of C_5H_8 rather than its trans counterpart.

As the natural rubber is formed by the process of coagulation of latex, the relative proportions of cis and trans are fixed which can results in degradation of some desired properties.

Synthetic Rubber

Synthetic rubber is made by polymerization of a variety of monomers that includes isoprene, 1,3-butadiene, chloroprene , and isobutylene with a small part of isoprene for crosslinking.

These polymers with other monomers are mixed in required proportions for physical and mechanical properties. This monomer has to be produced purely and the addition of impurities or additives is controlled by the design to give optimum properties to synthetic rubber. The polymerization of these pure monomers is stereo specifically regulated through catalysts to achieve the desired cis or trans double bonds.

different kind of synthetic rubbers that can be used in the tyre components like Styrene-butadiene, Polybutadiene because of the relatively low materials cost, low heat-build up properties respectively.

Carbon Black

Carbon black is produced by the process of incomplete combustion of heavy petroleum products like ethylene cracking tar, coal tar, etc.,
It is a amorphous form of carbon that has a very high surface-area-to-volume ratio and significantly lower PAH (polycyclic aromatic hydrocarbon).Carbon black functions as a pigment and reinforcement filler in all types of tyre. It helps in conducting the heat away from the tread and belt area of the tyre, reducing thermal damage and increasing life of the tyre.

The black colour of the tyre is because carbon black and fumed silica is used if any other color tyre is required with the same reinforcing properties .

Fumed Silica

Fumed silica also known as pyrogenic silica as it is produced in a flame, that consists of microscopic droplets of amorphous silica, chain like, The powder produced as the result has an extremely high surface area and low bulk density.

Its viscosity-increasing behaviour is the result of its 3 dimensional structure. when used as a thickener or reinforcing filler. Conventionally silica fillers had worse abrasion wear properties, but now the gradual improvement in technology has resulted where they can match with carbon black abrasion performance.

Vulcanization

Natural Rubber is too sticky and it deforms very easily when warm. It is also very brittle when cold. Vulcanization helps in betterment of some of the

properties like removing the sticky behaviour, increasing the young's modulus etc. compounds like Sulphur are added in this reaction which form cross-links between the long chain polymer molecules, resulting in conversion of rubber from a thermoplastic to a thermosetting polymer.

Antioxidant

An antioxidant is a molecule that prevents oxidation of other molecules. It is said that something is oxidized if it loses electrons, hence moving to a higher oxidation state. Oxidation reactions often produce free radicals which then result in polymerization. Antioxidants basically undergo oxidation reaction themselves to prevent oxidation of other compounds.

Antiozonant

Rubber has an unsaturated double bond, the continues exposure to atmospheric ozone may lead to breaking of double bond in to aldehydes or ketones, which can result in reducing the degree of polymerization which causes the degradation of properties. The cracks that occur on tyres are due to ozone and are also called ozone cracks.

Antiozonant are chemical compounds that is responsible for prevention or slowing down the degradation of material caused by ozone gas in the air.

Structure of a Tyre:

Tyre is a composite structure that has many layers. They usually consist of

1. Inner liner:
2. Body ply:
3. Side wall:
4. Beads, Apex:
5. Belt Package:
6. Tread:
7. Cushion Gum:.

Inner Liner:

It is an extruded halo butyl rubber sheet which is compounded with additives that result in low air permeability. The inner liner makes sure that the tyre will hold high-pressure air inside, without letting the air gradually diffuse through the outer rubber structure.

Body Ply:

The body ply is a calendared sheet that consists of consecutive layers of rubber and reinforcing fabric. They give the structural strength to the tyre. Passenger tyres typically have one or two body plies. The fabric cords are highly flexible but relatively inelastic.

Sidewalls:

Non-reinforced extruded profiles that also have additives to give the sides of the tyre a very good abrasion resistance and environmental resistance are called side walls. Sidewall extrusions are non symmetrical so as to provide a thick rubber area to enable moulding of sidewall ornamentation and raised letters.

Beads

They are high tensile-strength steel wire bands that are encased in the rubber compound. Bead wire are given coating of special alloys of bronze. Coating helps to protect the steel from resulting in corrosion. Beads are made to provide mechanical strength so the the tyre fits to the wheel. They are inflexible and inelastic.

Apex

The apex is a triangular extruded profile that mates against the bead.
The apex provides a cushion between the rigid bead and the flexible inner liner and body ply assembly. Belt Package Belts are calendared sheets consisting of a layer of rubber, a layer of closely spaced steel cords, and a second layer of

rubber. Belts give the tyre strength and dent resistance while allowing it to remain flexible.

Tread

The tread is a thick extruded profile that surrounds the tyre carcass and this is the layer which comes directly in contact with the. Tread compounds include additives to impart wear resistance and traction in addition to environmental resistance.

Cushion Gum

A lot of high-performance tyres include an extruded component between the belt package and the tread for isolation of the the tread from mechanical wear from the steel belts.

Size of Tyres:

Two Wheeler tyres are available in sizes of 15’-20’ in Diameter and their width varies from 3.5’-6’.

Passenger cars and Light commercial vehicle (LCV) tyres are available in size of 12’-16’ in diameter and their width varies from 5’-8’.

Types of Tyres based on Size of the Vehicle:

Commercial Vehicles:

Medium and Heavy Commercial Vehicle (MHCV)

Heavy Commercial Vehicle (HCV)

Light Commercial Vehicle (LCV)

Passenger Vehicles:

Car

Motorcycle

Scooter

Cycle

Others:

Farm Vehicles
Of the Road Vehicles (OTR)
Industrial Vehicles

Types of Tyres based on Structure:

Radial Tyre –
A radial tyre has a series of cord plies that are arranged at a 90 degree angle to the direction of tyre travel.
These plies of cord give the tyre it's reinforcement to be able to with stand the internal air pressure and external weight of the vehicle. These network of chords that gives the tyre it's strength is called a Carcass. If the tyre was manufactured with only radial cords, it would be unable to sufficiently contact the ground due to lack of rigidness.
As a counter action to this a coating of steel wire is done (steel-belted radial), Polyester, or Aramid fibres (i.e. Twaron and Kevlar).

Bias-Ply Tyre –
A Bias-Ply tyre's body utilizes ply cords that are extended diagonally from bead to bead. Typically laid on a 40 to 60 degree angle with successive plies set on opposing angles to form a crisscross pattern.
It is on top of these layers that the tread is applied. This type of design allows for the tyre body to flex more easily, and allow a more comfortable ride on rough terrain. However, the design is flawed at highway speeds, by disallowing good traction and increasing rolling resistance.

Manufacturing Process of a Tyre:
Compounding and Banbury mixing Rubber stock, carbon black and other chemical ingredients are combined in a Banbury mixer for the purpose of creating a homogeneous rubber material. Time, heat and raw materials are few of the factors that are made use of to engineer material composition. The

provision of ingredents to the plant is generally done by pre-weighed packages or are prepared and weighed by the Banbury operators from bulk quantities.

Most facilities have been given extensive emergency rescue procedures in place for the workers that are sometimes trapped in mills. Mill operators are almost always exposed to heat as well as the noise. Extruding and Calendaring The calendar operation continues to shape rubber. The calendar machine usually consists of one or more (often four) rolls, through which the rubber sheets are forced.

The calendar machine has the following functions:

- Preparation of the compounded rubber as a uniform sheet of definite thickness and width
- To place a thin coat of rubber on a fabric (“coating” or “skimming”)
- Forcing of the rubber into the interstices of fabric by process of friction (“fractioning”) The rubber sheets coming off the calendar are then wound on drums, called “shells,” with fabric spacers, called “liners,” to prevent sticking.

The extruder is most often referred to as a “tuber” because it makes tube-like rubber components. . This operation is referred to as booking treads, because the cart looks like a book with the trays being the pages. This configuration of the extruder as well as the weight and quantities of tread to be booked contribute to the ergonomic impact of this operation.

Numerous changes have been made to lessen this, and some operations have been automated. **Component Assembly and Building:**

The tyre assembly machine also consists of a rotating drum, on which all the above mentioned components are assembled, and the feeding devices to supply the tyre builder machine with the components to assemble. The components of

a tyre that are usually include beads, plies, side walls and treads.

The tyre is sometimes referred as a “green tyre” after all of the components get assembled. Tyre builders utilize many number of solvents, such as hexane, which allows the tread and plies of rubber to adhere. Exposure to the solvents is an area of concern.
After getting assembled, the green tyre is sprayed with a solvent- or water-based material to keep it away from adhering to the curing mould.

These solvents potentially expose the spray operator, material handler and curing press operator. Nowadays, a lot of water-based materials are mostly used. The following is a brief discussion about some characteristics of whole and processed waste tyres intended to help designers create new products from them. For the very most practical purposes, though tyres and tyre products function as homogeneous mixtures, but by processing these tyres the impact physical characteristics as size and shape are altered and as reinforcing wire and fabric are removed.

Some of the characteristics include:

Density:
Tyres are a little more heavier than water and can easily sink in water unless some t entrapped air provides them enough buoyancy to allow floating. This only occurs with whole tyres or fine crumb rubber particles of tyre. The density of whole and shredded tyres depends upon size, depth, and compaction.

Durability:
Tyre rubber contains UV stabilizers, carbon black and antioxidants for enhancement of the resistance to wear, chemical decomposition, and sunlight respectively. These characteristics are not at all dependent on the size of the particle. Strength of whole tyres can be further enhanced by reinforcing the wire

but this formed additional strength is lost when the wire and fabric are removed from smaller particles.

Abrasion resistance is illustrated by the long life of tyres in contact with roads. Tyres and shreds are not easily damaged by blunt trauma, but they can be cut or punctured by sharp objects.

Moisture Absorption:
Tyres and shreds have some capacity to trap water on the surface and in the irregular contours, but they are relatively impervious to actual absorption.

Temperature Tolerance:
Tyre rubber is capable of withstanding a full range of ambient temperature extremes without undergoing permanent property change. Some properties—like flexibility—change as a function of temperature, but this change is reversible and repeatable.

Flammability:
Tyre shreds have a reported flash point of 582º F, higher than some other materials used for architectural purposes such as paper, foam, wood and fabric.

Colour:
Passenger tyres are predominantly very black, but white pigment are also used at some point to provide visible sidewall lettering which results in shreds and crumb rubber made from passenger tyres have a mixture of black and white colouring. Truck tyres do not have white pigment, so resulting products are completely black. Colour can be an important performance characteristic.

The Indian Rubber Industry:

NATURAL RUBBER (NR)

Production Sector:

Natural Rubber production in India during the year of 2015-16 fell 12.9 per cent.. Reasons for this fall are adverse weather, grower's reluctance in harvesting or maintaining trees high wages, lack of skilled labourers, in response to the low NR prices have resulted in decreased production of NR.

per cent of the production. SR consumption has very much increased to 553,370 tonnes during 2015-16 registering a growth of 3.2% as against that of 536,130 tonnes consumed during 2014-15. The automotive tyre sector consumed 377,090tonnes of SR during the year of 2015-16 as against 367,798 tonnes during the year of 2014-15, recording a growth of 2.5%. Import of SR by the rubber goods manufacturing industry during the year of 2015-16 decreased to 351,301 tonnes compared to 402,170 tonnes during 2014-15.

As the domestic production increased during 2015-16, volume of SR imported into the country decreased.

Rubber Situation of world – 2015:

Production India is currently the sixth largest producer of NR in 2015 with a share of 4.7% of world production. According to the International Rubber Study Group (IRSG), the world NR production in the country has increased by 1.6% to 12.314 million tonnes in 2015, as compared to the production of 12.115 million tonnes in 2014.

During 2015, the output of production in the main rubber producing countries viz; Thailand, Malaysia, Indonesia, and Vietnam increased, whereas the rubber production in China and India decreased during 2015. Global SR production

during the year of 2015 was 14.46 million tonnes as against 14.179 million tonnes in the year 2014 registering an increase of 2.0 %. Consumption India ranks second with regard to NR consumption in 2015 with a share of 8.2% of world consumption.

Global NR rubber consumption increased to 12.167million tonnes in the year 2015 registering a growth of only 0.3% compared to 12.137 million tonnes in the year 2014. Consumption of NR in main consuming countries decelerated during 2015.

Consumption of NR in China, India and Japan decreased by 1.7%, 2.1% and 2.5% respectively during 2015 on year. NR consumption in the USA showed a small positive growth of 0.5% during the year of 2015 on year. Global SR consumption increased to 14.564 million tonnes during the year of 2015 from 14.267 million tonnes during the year of 2014, recording a growth of 2.1%. World NR and SR consumption ratio during 2015 was 45.5:54.5 and it was 46:54 during 2014.

The Indian Tyre Industry:

MRF started suit in the year 1946. Since then, the Indian tyre industry has grown very rapidly. Indian Tyre Industry now provides direct and indirect employment to nearly over one million people, including growers of Natural Rubber, dealers, retreaders, , employment in raw material sector etc.

The Indian tyre industry has become one of the most competitive markets in and around the world and with the help of new technology, ultra-modern production facilities and availability of raw materials at lower rate, the sector is set to grow further. At present, India has as many as 39 large and medium tyre manufacturing companies, out of of which the top 10 companies account for over ninety percent of the country's total tyre production.

During 2015-16, the Indian tyre industry witnessed a turnover of Rs. 50,000 crore, producing 152 million tyres. Key Figures: No. of Tyre Companies: _39 _ _No. of Tyre Plants: _60 _ _Industry Turnover 2015-16 (est.): _Rs. 50000 crore (US$ 8.5 Bn) _ _Exports 2015-16 (est.): _Rs. 10500 crore (US $ 1.7 Bn) _ _ The Major Tyre Manufacturers in India: MRF APOLLO CEAT JK TYRES TVS GOOD YEAR BRIDGESTONE Market Share of the Manufacturers: _ MRF is leading the market share of tyre manufacture. MRF along with APOLLO tyres has over 50% market share, followed by JK tyres and CEAT.

MRF has been the leading manufacturer since the time it started, lately its market share has gone down with new manufacturers coming into the competition. Location of the major manufacturing Plants: __ Tamil Nadu has maximum number of tyre manufacturing plants followed by Maharashtra.

Nature of the Industry:

Tyre Industry is very raw-material intensive. Raw materials cost accounts for approx. about

63% of tyre industry turnover and 72% of production cost. The industry is the only major consumer of the domestically produced NR. Indian tyres constitute of 80% of natural rubber and 20% of synthetic rubber. The automotive tyre sector consumes total of 68 % of the rubber production of the country and balance by rubber based non-tyre industries.

Factors affecting the Industry:

Economic factors –

The Demand Cycle of the Tyre Industry Raw materials comprise almost 85 % of the cost of the tyre and because of devaluation of rupee, the import cost has gone up. The tyre makers are still importing rubber, a key raw material, as it is cheaper. The OE tyre market is sluggish while the replacement tyre market is very stable. In the current situation exports have become viable for the tyre companies.

Social Factors :

Explosion of the Number of Nuclear Families As a result of the joint-family system having gone down has led to tremendous increase in nuclear families throughout the urban areas, more small families have more demands for a two or four wheeler for themselves.

This is the reason which has directly resulted in higher sales of tyres in the past decade.

Higher Vehicle density per family:

The number of families that have more than 1 car from the upper class and upper middle class has been increasing exponentially. This turns out be to very true specially for urban areas where family members find it really difficult to commute without more than 1 car in the family.

With higher amount of disposable incomes coming in the family some of these families are finally able to afford this need.

Rubber has helped the farmers to get a steady income, and they are able to get

good money for their produce almost throughout the year. The best part about rubber is that it can yield almost throughout the year, only except for a brief gap in summer and here in winter.

If the economic growth improves, then consumption of rubber will also go up.

Technical factors:

As per the study, several “Greenfield” plants are in pipeline to include new capacities.

The implementation of brown-field projects is executed to cater to the growing demand. Greenfield units are expected to go on-stream in the coming years, just by the time when there will be an urgent need to bridge an increasing demand-supply gap in T&B radial tyre segment.

Environmental Factors:

Scrap tyres are becoming the latest headache for a government that has not yet found ways to get rid of already existing mountains of tyres. New methods need to be found to dispose the tyres that are stockpiled or put in landfills for a very long period of time every year. The problem is really huge. The number of tyres in use is forecast to increase by up to 60% by 2021, as the number of vehicles rises.

Every day, 60000 to 70000 are taken off cars, vans, trucks, buses and bicycles. It is a estimation that there are about 200 million tyres lying around the country. By their very nature, tyres are very difficult to dispose of. They are designed the ways so that they do not to fall apart while you're driving along the motorway, so they are one of the more intractable issues.

Although tyres mostly remain substantially intact as they are for decades, some of their components can break down and leach. Environmental concern centres

on the highly toxic additives used in their manufacture.

In such a dynamic scenario, it is a not at all practical to emboss the price on tyres due to market dynamics. Total Tyre Production in India: _ Truck & Bus Tyre Production _ LCV (Light Commercial Vehicle) Tyre Production _ Passenger Car (Incl. Jeep) Tyre Production _ 2/3 Wheeler Tyre Production _ Farm Tractor Tyre Production _ Otr Tyre Production _ Total Tyre Export _

Why this Project?

With the modernization of our society and change in life style of people, has arrived a latest Threat to the environment and the society, Tyres.

With tremendous increase in number of vehicles in past two decades has led to increase in number of tyres. Every new vehicle added on to the road leads to increase of no. of tyres by at least 4 folds. Increase in number of tyres has led to increase in generation of Scrap Tyres.

Especially in urbanized metropolitan city like Mumbai and cities around it where migration has been the reason of increase in population manifold which has let to indirect growth in the number of vehicles in the region.

It has been forcasted that number of tyres used is going to increase upto 60% by 2021, as the number of vehicles rises. Every day, 70,000-80,000 are taken off cars, vans, trucks, buses and bicycles. It is widely estimated that there are now more than 200 million lying around. Tyres are really dispose of because of the nature of their build, they are made to withstand harsh environmental conditions,

They are designed not to fall apart while you're driving along the motorway, so they are one of the more intractable issues. There are many factors that have led

to increase in the number of vehicles but the Major Factors are:

Development of Road Networks:

The efficient transport infrastructure facilities have been the pre-conditioned for the smooth and efficient development of trade.

Door to door service, reliability easy accessibility, flexibility of operations, have contributed towards a steady increase in the modal share of road transport in the movement of both goods and passengers. Road Transport has been exponential growth in the State by increasing number of vehicles. Road transport plays a key role, in promoting socio-economic development in terms of social, regional and national integration.

Up to March, 2015 the total Road Length maintained by the Public Works Department and local bodies in the state was 2.94 lakh kilometers out of which total surface road is 2.45 lakh kilometers. The Total Road Length per 100 sq. kilometer. of geographical area is 96 kilometer in the year 2014-15.

Increase in Population:

1. With increase in population arises the need of transportation. As per the 1991 census population of Maharashtra state was 7.89 crores and as per the 2011 census, the total population of the Maharashtra state is 11.24 crores and is the second largest populous state. Population share is about 9.3 percent against total the total population of India.
2. Urban Population is 45.2 percent whereas rural population is 54.8 percent. Whereas the population of Mumbai Metropolitan Region (MMR) in 1991 was 1.93 crores as compared to population in 2011 which is 2.86 crore. The increase is of 35% in just 20 years.

Explosion in the Number of Nuclear Families:

Explosion of the Number of Nuclear Families As a result of the joint-family system having gone down is the reason that has led to increase in nuclear

families throughout the urban areas, more small families have more demands for a two or four wheeler for themselves.

This is the reason which has directly resulted in higher sales of tyres in the past decade.

Higher Vehicle density per family:

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With higher amount of disposable incomes coming into the family, some of these families are finally able to afford this need. Higher Disposable Income and consumer saving habits: Shifting Savings to EMI culture: Another notable trend that seems to be fueling car sales (and therefore tyre sales) is the shift in the middle-class consumer saving habits. The Indian middle-class family has long been known for its saving frenzy.

Vehicular Statistics for state of Maharashtra:

Growth of Vehicles from 1971 - 2015:

The total number of registered motor vehicles in Maharashtra State, increased from 3,07,030 as on 31st March, 1971 to 2,55,92,175 as on 31st March, 2015. The growth in vehicle population stood at 8235% during 44 years.

Two wheelers contribute 72.69 percent of the total vehicles running on roads, as on 31.03.2015 whereas it is 28.25 percent as on 31.03.1971. The share of cars, jeeps and taxis in the total number of vehicles on roads was at 14.93 percent as on 31st March, 2015 making a very steep decline from 44.55 percent as on 31st March, 1971. Percentage of buses decreased from 2.93 percent as on 31st March

1971 to 0.42 percent as on 31st March, 2015. Goods vehicles, accounted for 17.39% as on 31st March, 1971 decreased to 5.31% in the State as on 31st March, 2015.

Other vehicles', 6.64% as on 31st March, 2015.

Category wise CAGR during 2005-15:
The total number of registered vehicles in the State drastically grew at a Compounded Annual Growth Rate (CAGR) of 9.92, between 2005 and 2015.

The details of CAGR for various categories of vehicles for the decade 2005-15, is as below:

Yearly Registration of Vehicles: Total number of vehicles registered during the year 2014-15 is 22, 39,935 having increased from 10, 29,979 as in the year 2005-06. Thus, percentage increase in a decade is 117.47 % .
Year wise vehicular registration during 2005-06 to 2014-15 is shown below: –
Vehicles on Road as On 31.03.2006 to 31.03.2015: As on year 2005-06 there were 1,09,66,434 vehicles plying in the Maharashtra State, whereas in the year 2014-15 the number grew to 2,55,92,175 (increase in a decade is 133.37%).

Category wise vehicle growth during 2014-15:
Station Wagons grew at 250.00% during the year 2014-15 followed by Auto Rickshaw 88.70%, Articulated Multi axel Vehicles 64.95%, Tourist Cabs 44.42% & Jeeps 18.83% over previous year. Category wise Growth of Vehicles on Record as on 31.03.2015: Arti. Multi axel Vehicles grew at 13.71% as on 31.03.2015, followed by Motor Cycle at 10.93%, Scooters at 10.44%, Tractor at 10.17%, & Car at 9.84% over previous year.

Office wise vehicular growth during the year of 2014-15:

Latur office has showed maximum number of registration of vehicles i.e. 37.15% during the year 2014-15 followed by Hingoli at 36.54%, Vashi at 28.96%, Akluj at 27.76%, Vasai at 25.46% over previous year.

Office wise Growth of Vehicles on Record as on 31.03.2015:

Nagpur (East) office has showed maximum amount of growth in registration of vehicles i.e. 45.52% as on 31.03.2015, followed by Vasai at 44.49%, Panvel at 26.34%, Karad at 22.77% & Akluj at 20.05% over previous year.

Region wise Share of Vehicles:

Region wise motor vehicle shown below.

Pune is leading the top position in terms of vehicle population at 20.72% followed by Thane at 11.29, Nashik at 10.64%, Greater Mumbai at 10.05% and Kolhapur at 9.75%.

Category wise Share of Vehicles:

Category wise vehicle share is shown below below.
Two wheelers contribute 73 percent followed by Four Wheelers which contribute to 14 percent, goods vehicles also contribute to good amount of 5 percent and other vehicles together contribute about8%. _ With such high growth rates of vehicles the production of tyres is going to only increase the number of scrap tyres. So as to tackle this growth of scrape tyres we need to come up with some environment-friendly ways that will reduce the scrap and not affect the environment.

Aim:

To promote Environment-Friendly Reuse of Scrap tyres in Architecture in form of Art and Recycling.

Objectives

1. Promoting the use of Scrap tyre as a Building Material.
2. To create innovative sculptures, installations, furniture out of scrap tyres.
3. To mount an exhibition of ideal designs using used tyres as raw materials.
4. To explore creative use of scrap tyres to provide raw materials usable in design of new products Extending the product's useful life.
5. Planning strategies for the recovery of resources at end-of-life, facilitating reuse,remanufacturing and recycling, and reducing waste.
6. To create awareness among people of the potential use of scrap tyres and environmental threats if not disposed of properly.

Scope of Work:

This project is mainly based to Mumbai Metropolitan Region (MMR) and other close surroundings, as this region has the largest number of motor vehicles as compared to the rest of the country. The project will look into how scrap tyres can be promoted in the creation of Sculptures, Art, Installations, Architecture

(Building Construction), Furniture and other day to day use products along with Retreading and Tyre Derived Fuel (TDF).

Thus serving the purpose of protecting the Environment and Humans from hazardous effects of scrap tyres getting piled up.

Justification of the Project:
Tyres that are simply thrown away and are a serious environmental threat. Recycling and Reuse of scrap tyres on a global scale can drastically reduce waste yards, soil and atmospheric contamination caused by dump yards and large scale tyre fires.

Scrap Tyres (A big trouble):

Report by the Environmental Protection Agency (EPA): Tyres are not subject to spontaneous combustion.

However, as a tyre fire grows in intensity it generates higher temperatures, allowing the fire to spread and the generation of large plumes of dense smoke and other combustion products. The pile composition affects the rate and direction of fire spread. Fires occurring in piles of whole tyres tend to burn down into the middle of the pile where air pockets allow continued combustion.

Fires that occur in pile of shredded tyres spread over the surface of the pile. Whilst some areas around the world are grappling with the harmful effects of coal fired kilns, in developing nations like India, tyres with some other materials made of rubber are being used as a source of energy for kilns giving rise to still bigger problems.

Unfortunately tyres provide a cheap and widely available source of energy. Even where they are not the primary energy source, scrap tyres are often used as a supplement fuels such as coal or wood because of their high heating value.

Typically, 1 pound scrap tyre rubber burned provides 15,000 BTUs of energy. A single tyre burns for about 50 minutes, and yields around 25% greater than from coal.

However, the black fumes emitted from burning tyres contain harmful pollutants and heavy metals that stay in the air and can lead to acute to chronic health hazards. “fire emissions of tyre burning include ‘criteria’ pollutants, like carbon monoxide (CO) and sulphur oxides (SOx). They also include ‘non-criteria’ air pollutants that are hazardous (HAPs), polychlorinated biphenyls (PCBs); and a few metals like, nickel, zinc, mercury, chromium, arsenic, cadmium and vanadium.” Non-criteria and criteria pollutants are believed to cause a significant health effects.

The EPA again tells us: “length and degree of exposure is what the these health effects depend upo which include irritation of the skin, respiratory effects, central nervous system depression eyes, and mucous membranes, and cancer”, and has suggested any unprotected exposure should be avoided to these emissions. Furthermore, the uncontrolled tyre burning has proven to be Sixteen times more mutagenic – capable of inducing genetic mutation – than traditional residential wood combustion in a fireplace.

Even more troubling is the exposure to which children and other at-risk groups such as the elderly, asthmatics, and immune suppressed individuals living within these communities are inadvertently being subjected. Pollutants inhaled by nursing women are transferred to their babies through the fat in breast milk. Unfortunately in small villages and other developing areas where tyre-burning kilns sustain on the local economy, current practices make widespread and longer exposure to such toxins inevitable.

Wind, earth and tyre The tyre fumes not only have a negative impact on human health but the practice also gives rise to water and soil pollution. According to

the EPA: “for about 1million tyres consumed in fire, about 55,000 gallons of runoff oil pollutes the environment unless contained and collected.” If uncontained, this runoff is carried away by the rainwater to local water sources contaminating them.

The remaining residue: “can causes two major types of pollution; these are immediate pollution by liquid decomposition products penetrating soil, and gradual pollution from unburned residues following any water entry”. While burning of tyres cannot be considered recycling, there has been some argument around whether it is worse to landfill tyres or combust them to recover energy.

On the other hand, in less developed parts around the world environmental regulations and technology of this kind rarely exist to the same degree, and in the worst cases citizens are exposed to the environmental and health effects of uncontrolled tyre burning. Decomposition Products A wide range of products of decomposition are generated during scrap tyre fires.

Many of these decomposition products are characterised in test burns and including Ash (containing carbon, zinc oxide, titanium dioxide, silicon dioxides, etc.) Sulphur compounds (carbon disulphide, Sulphur dioxide, hydrogen sulphide) (benzo(a)pyrene, chrysene, benzo(a)anthracene, etc.) are usually detected in oil runoff aromatic and paraffinic oils oxides of carbon and nitrogen particulates Various aromatic hydrocarbons (such as toluene, xylene, benzene, etc.).

These decomposition products are extensive and varied depending on variety of factors, including: Tyre type Burn rate Pile size Ambient temperature Humidity. Potential Environmental Impact Uncontrolled tyre fires have major environmental impacts, which include:

Air pollution:

black smoke and volatile organic compounds are released in the atmosphere

Water pollution:
the intense heat of fire allows pyrolysis of the rubber to occur, which results in an oily decomposition product.

Unusable Land Space:
Tyres are very bulky, and 75% of the space a tyre is a void, so that the landfilling of scrap tyres has several difficulties: Whole tyre landfilling requires a large amount of space. Because of the above mentioned difficulties that result in high costs, tyre stockpiles have turned up across the country.

Mosquito Breeding:
Tyre piles are excellent breeding grounds for mosquitoes. Because of their shape and impermeability of tyres, they hold water for long periods of time and provide sites for mosquito breeding. Tyre stockpiles also contribute to the introduction of non-native mosquito species when the used tyres are transported to various places. The new species are often more difficult to control and spread more disease.

Potential Health Hazards:
The health hazards of open tyre burning depend on degree and length of exposure. Following are few of the adverse effects of open tyre burning:
Genetic Mutation,
Cancer
Central Nervous System Depression
Respiratory Illness
Mucous Membranes
Irritation of Skin and Eyes

Use of Tyre in Architecture:

For thousands of years, housing was built from found materials like stone, earth and logs.
Today, there are huge mountains of by-products of our civilization that are already made and are spread all around the areas. These materials can act as natural resources of the modern humanity. One of these major resource is Scrap Tyres. Tyres can be recycled and used as a building material. Although still not very commonly seen or recognised, it would be really advantageous to see this material recycled and taken advantage of in the construction industry.

Each year, nearly 30-40 million tyres are disposed of in India. Out of these about only 50% get used for different purpose, leaving about 15-20 million scrap tyres to be stockpiled or landfilled or burnt. The market for scrap tyres going to increase with time.

With such a huge amount of generation of scrap tyres we need to think about using it more efficiently then it is being used right now. Construction Industry is one of the largest industry all over the world, and using these Scrap Tyres in Architecture as a Building Material could help us overcome the trouble of tremendous increase in scrap tyres.

Properties of tyre that make it a good building material:

Flammability:
Tyre shreds have a flash point of 582º F, higher than many materials used for architectural purposes such as wood, paper, foam, and fabric.

Reduces the Carbon footprint of the structure as the amount of concrete being used in the building reduces tremendously.

Durability:
Tyre rubber contains carbon black, antioxidants, and UV stabilizers to enhance

resistance to wear and sunlight, respectively.
These characteristics are independent of particle size. Moisture Absorption: Tyres and shreds can trap water on the surface and in irregular contours, but they are relatively impervious to actual absorption.

Temperature Tolerance:
Tyre rubber is capable of withstanding a full range of ambient temperature extremes without undergoing permanent property change.
Some properties—like flexibility—change as a function of temperature, but this change is reversible and repeatable.

Cost effective:
As the raw material comes from scrap, it is available very cheaply and sometimes even free of cost, as people want to get rid of it. Very efficient for earthquake-resistant structures: tyre are made from rubber which has good elasticity and thus a good option for earthquake prone areas.

Provides relatively consistent interior temperatures:
The tyre walls are all filled with rammed earth which acts as a thermal mass and does not allow much temperature variation inside the structure.

Low Maintenance:
tyres are made to withstand harsh environmental and physical conditions like heat, wear and tear. Once they are scraped out and used as a building material there is hardly any condition that can make them loose their strength.

Builds passive-solar residences
Strong, durable & flexible

Where all can Tyres be used??
Walls Foundation Window Frames and Ventilator openings Flooring Roofing

Steps Landscape Furniture (Chair, Table, Bed, Sofa and many more) Double Façade Retaining Walls Boundary Walls Pergola Chandeliers Planter Box Storage Boxes Children Playing area Sculptures Installations Parking Spaces Embankments Pathway

Types of Construction:

Rammed-Earth Construction Rammed-earth homes are designed to maximize energy-efficiency, remaining relatively warmer in the winter months and cooler in the summer months.

Recycled automotive tyres filled with compacted earth form rammed-earth bricks and are used in place of traditional concrete framing. Soil is tightly packed into the frame of the tyre, with a cardboard sheet placed across the base. A typical 2,000 square-foot home uses 1,000 scrap tyres on average. Small gaps in the frame, because the tyres being round, are filled with recycled materials, typically aluminum cans or bottles and adobe.

_ _ _ _ Tyre-Bale Construction

An alternative of rammed-earth tyre bricks is tyre-bales are being used recently as a way of utilizing scrap resources without the intense labour of packing 1,000 tyre bricks. A tyre-bale is a square brick of approximately 100 compressed tyres, weighing about 2,000 pounds. Building with tyre bales uses thousands of compressed tyres, much more than standard rammed-earth bricks.

They are stacked as oversize bricks to frame the outside walls of the building. After the walls of rammed-earth and tyre-bale walls are smoothed with earth, they are finished with layers of plaster. _ _

Continues Access to scrap tyres?

The tyre production in financial year 2015-16 was 152.03 million, and with CAGR of around 10% these numbers are going to in increase drastically every

year.
The highest CAGR was 22% in year 2010-11 which saw increase of 20 million tyres in a single year. In Country like India which is heated up all year round and has rough roads, the average life of a tyre is not more than 3-4 years. On an average every year about 10-15 % of tyres get scraped out of the total manufactured. That amounts to about 22.5

million scrap tyres every year which is about 62,000 tyres every day. These scrap tyres can be collected by the collection centres and then transported to the desired location. The following are be two options in which we can have access to these tyres on regular basis: _ There are about 20-25 scrap tyre collection centres in Mumbai, Pune, Nashik and Thane all together, which collect tyres all year round as and when they get and they already have tons of tyres with them.

They provide tyres as and when required with rate of Rs. 4 per kg in off season and about Rs. 8 per kg in peak season. Tyres can be collected from these centres as per requirement or on a contract basis of a particular time period. The second option can be putting up independent collection and storage centres at various localities and making people aware that scrap tyres are purchased at a good amount. So here either costumers will directly drop off their scrap tyres by themselves or the garages will give away the tyres they have with them.

This way the project will be totally Independent of any exterior source. A new set of guideline is being prepared by the government to manage waste tyres that will put a large part of the onus of tyre disposal on tyre companies as well as dealerships.

According to the draft in the Waste Tyres Management Rules 2017, tyre companies have been asked to prepare and also execute an 'integrated waste tyre management plan' which should necessarily include "operational mechanisms for the collection and disposal of waste tyres equivalent to its

annual production and/or import quantity". In other words, tyre makers will need to follow through with their own waste management plan and comply with it within a given time period of time.

In such case contracts can be made with the tyre manufacturing companies for continues supply of waste tyres that they are generating, which will also reduce their work. Any of the above methods could be applied to gain continues access to scrap tyres or if required combined methods could be used at same time.

Site Selection Criterion:

As the project is Institutional cum Industrial, the Transit connectivity plays a very vital role for selection of the site, and due to the industrial functions of project the site would be preferable around or in the Industrial Zone.

The institutional section will be catering to numerous people throughout the year travelling from various parts of the city, state and country. So it is very important to locate the site at a place which will have good rail and road transport in the very vicinity of the site.
For the industrial section, transportation of raw material is a core concern. As the raw material will be transported from areas like greater Mumbai, Thane, Pune and Nashik.
Connectivity these locations to the site will play a vital role.

The Site:

Location:
2/1/B, TTC Industrial Area, MIDC, Turbhe
Landuse:
Industrial Zone
Site Area:
1,75,000 Sqm _ _

Location Map Site Justification: The Proposed site is located at the arrival point

to the city. The site is utmost to the centre of the areas that it will be getting its raw material from.

It has frontage of Mumbai-Pune Highway, Sion-Panvel Expressway, and Thane-Belapur Road. The Mumbai-Pune highway and Sion-Panvel expressway have exit Points at about 100 m away from the site. The Site also has good connectivity with Nashik via Nashik-Mumbai Highway and Mumbai-Agra Expressway (NH-160).

Juinagar Railways Station is at a distance of 500m while Sanpada is at 1km. _ Connectivity to the Site _ Site Loaction Strength: The proposed site is very well located at the arrival point to the city. The edges of the site are defined by Mumbai-Pune Highway, Sion-Panvel Expressway, Thane-Belapur Road and Service roads on 2 sides.

Opportunities: Proposed site lies on emerging Growth Vector. The site is big enough to create its own Micro Climate. Service Roads on 2 sides, gives chance for multiple Entries. Weakness: The site being in Industrial zone which is near to the residential zones can be a cause of concern.

Site Analysis: _Site Vicinity _Site Neighborhood _ Natural-Man made Features _ Built Open Space _ Land-use

Tyre Re-treading:

Retread, also known as "remold" is a re-manufacturing process for tyres that replaces the tread on worn tyres. Re-treading is applied to casings of spent tyres that have been inspected and repaired. When tyres become worn, they can be restored with new tread. There is not much difference in quality between new and recapped tyres.

Many tyres can be retreaded a few number of time, till the casing has the

required strength, thus resulting in delay of the the landfill disposal of the tyres helping our environment enhance through recycling. Large truck tyres are typically recapped as part of a routine tyre – management program. There are two reasons why re-treading is preferred, Firstly the low costing to retread the tyres makes it a cost effective measure for modern tyre-management.

Secondly, precured retread tyres are supposed to have higher mileage return than new tyres. This means more cost savings for the wise fleet managers. This turns to be very true on specialty wheels that prove to be very costly to replace. The Re-treading Process: Initial Inspection: This inspection has to be done so as to verify that the casing acceptable for re-treading using a thorough process of inspection of each tyre inside out. This process also helps to identify if the tyre has any injuries and determine whether it is repairable.

Reject or approve the casing for processing. Buffing: The tyres received for re-treading are worn out and damaged. The injuries to the tyre need to be removed after initial inspection. Buffing is done to prepare worn out tread surfaces of the tyre to receive a new tread. The old tread design is removed to provide the casing with the necessary dimensions and surface texture.

_ The Buffing Machine Tread Preparation and Building: In process of buffing new tread rubber is applied to the buffed and prepared casing. An uncured solution that develops the bonding between new or premolded tread and casing is applied to the casing. Premolded or new treads are cut to the perfect required length, applied and splice on the casing.

_ Tread Preparation (Curing):

In the mould cure process uncured tread compound is applied as a strip directly to the casing. Enveloping: In the premold process the uncured cushion compound has to vulcanize while the premolded tread has to be kept in position. Therefore the tyre is put into an envelope which presses it through a vacuum

system, the premolded tread uniformly on the cushion and casing.

_ Enveloping Vulcanizing: In the process of curing specified heat and pressure is applied over a period of time to unvulcanized rubber so that the rubber is cured to the best point of physical properties and maximum adhesion to the surrounding elements. Enveloped tyres are put into an autoclave whereas in the moulded process the tyres are cured in proper tyre moulds.

_ Electric Chamber for Vulcanization Final Inspection: In this tyre is passed through a thorough inside out visual inspection to insure a quality. It is made sure that the tyre meets all government regulation. Some retreaders also use instrumented inspection like X-ray, shearographie or High pressure tester. Unacceptable tyres are rejected and scrapped. Retreads are extremely environmentally friendly.
Firstly, the production of a retread saves substantial amounts of fossil fuels. In fact, the manufacture of a passenger retread requires 4.5 gallons less oil than a new tyre.
Secondly, retreaded tyres are sold almost exclusively that are manufactured within the very same territory itself, which means they need not be shipped from the other side of the world, unlike many budget new tyres, a high proportion of which are manufactured in China and other Far East countries.
Retreading is also one of the the best practical environmental option for tyre recycling. Every new retread done means one less new tyre saving in its natural resources.

It also means that less tyres ultimately have to be burned, thereby reducing pollution. The retreaded tyres life is almost equivalent as of the new tyre. But the expense of retreading is only 45 to 50% cost of the new tyre. _ Plan of Retreading Centre

Tyre Artist and Sculpture: Mick Davis

About the Artist: He is an artist living and working near Dingle, Ireland. For years he worked primarily with stone. As a regular cyclist with an interest in recycling he was concerned about the hazardous issue of recycling tyres.

In April 2014 Mick began experimenting and creating sculpture from old tyres. He uses a welded steel structure to build up the tyre form on. Striving for a classical elegance while exploration of the human form has been the lifelong theme running through his artwork. Using tyres, a new and original medium, he combines a classical style with a contemporary take, to facilitate a wider appreciation of this unique art form.

His hope is that through his sculptures he can showcase an alternative way of thinking when it comes to recycling tyres.

His working method:

For making his sculptures out of scrap tyres, he first makes the skeleton of the sculpture that he is making, using welders. He cuts the tyres of the rims using knife. He then places tyres inside and outside of the welded steel skeleton and screw them together.

The Steel frame hold the tyres solidly together, and this gives him a solid hard base to work up the shape that he is making. He uses a lot of scissors, blades and knives to cut and shape the tyres and also a lot of screws and screw gun. He also uses spray paints to finish off his sculptures sometimes.

He mostly uses bicycle tyres for his work, until and unless he is making something big in size then he uses car tyres. The shopkeepers are glad to give away their tyres to the artist because if not they have to pay money to get rid of the scrap tyres. He collects the tyres from the shopkeepers every few weeks. He

has his own workshop where he carries out all his artistic creations.

Not much space is required for doing this. If the sculptures that are to be made are humongous in size or are to made in larger quantities at same time then the space required would be bigger in size. He says that the space should be we lit and ventilated due to the fumes while welding work.

Over all this work of making sculptures out of scrap tyres is not as difficult as it is considered and is independent of size of the space available. Contact Information: Website: https://www.mickdavissculptor.com/ Phone: Tel: + 353 877606 798 E-mail: mickdavisoz@gmail.com Photos of his Workshop: . _ _ _ _ _ _ Some of his Finished Sculptures: _ _ _ _ _

Use of Scrap tyre for Industrial Fuel:

Tyre Derived Fuel (TDF) Conventional use of tyre as industrial fuel is through Combustion or direct burning in the kilns. Waste tyres can be used straightly as fuels in the incinerators.

By incineration of the scrap tyres electrical power can be generated. The initial cost of this process.is very high and after processing it also causes a lot of pollution. The major drawbacks for this process are: no material improvement, need for flue gas cleaning, large capital cost, CO2 emission, high operating costs.

In the recent years a newer method has been developed to derive fuel from waste tyres, and this method is much more efficient and economical and environment friendly than conventional combustion. This process is called Pyrolysis.

What is Pyrolysis?

- Chemical decomposition of an organic material at elevated temperature in the absence of oxygen or any other reagents, except possibly steam. Is known as pyrolysis.

The waste tyres are fed in the horizontal batch reactor 10T capacity at a time as shown in figure and heat is supplied by mean of oil and sometimes by wood and this all takes place under controlled conditions of temperature and pressure. The process takes place in absence of oxygen and it also converts in to vapour and gases. These vapour and gases come in to separator where heavy oil fraction is separated from gases.

_ The Batch Process:

The waste tyre are fed into the reactor vessel and initial heat with gas, wood, oil or coal under controlled conditions of temperature and pressure. The process brings about the required molecular restructuring of the rubber and it converts into the vapors and gases. This vapors and gases come into vapor gas separating tank.

Then, these vaporized gases are then passed through the heat exchanger and convert vapor into liquid form as tyre oil. During this process we also get pyro gases, this gases most of the times are used for heating reactor and excess gasses are burnt. During this same process, carbon black and steel are also generated. The heat exchanger use swater for cooling as a condensing medium and this water is re-circulated through process.

The carbon black is pulled out from reactor and put into packing bags. The oil is automatically collects in the machine storage tank. At the end steel wires are pulled out. Pyrolysis by product details:

Fuel Oil (40% - 45%):

Pyrolysis oil is the major component of the process of pyrolysis which has got many commercial uses. There are 2 types of oil we get from this plant, one is

normal tyre oil and other is heavy oil. The final percentage of oil is 40 to 45% in the recycling of tyre pyrolysis process which is used as a fuel component for heating in fire chamber. Pyrolysis oil have flash Point between 66° C. Purest quality of pyrolysis oil equivalent to industrial diesel: selling price equivalent to industrial diesel light diesel oil (LDO).

Carbon Black (30% - 35%):

Carbon black is the 2nd major product of the process of pyrolysis. It is about 30 to 35 percent of the total products. It is used as coloring agent in many pigment industries and also as strengthener in rubber.. carbon black produced by pyrolysis has got a very competitive price as compare to petroleum carbon black, so this carbon black is an economical option over the petroleum carbon black.

_ Steel Wire (10% - 15%):

Steel wire is the 3rd product of the process of pyrolysis which is available abou 10 - 15%. Waste tyres also contain fibers. Shredded tyres mainly contain of the steel and sometimes the majority of the fiber is removed. The steel wire can be separated from the carbon black with magnets for recycling after pyrolysis process & sold to the steel trader.

Pyrolytic Gases (About 10%):

The final product that we get from pyrolysis is the Pyrolytic gases. The amount of gas generated is nearly 10%. Methane is the main component of all the gases (CH4), this gas cannot be condensed and stored. This gas is used to heat the reactor and other heating applications. Advantage of Pyrolysis: scrap tyres and plastic are the main raw material for pyrolysis plant which are abundantly available in any part of the world. The raw material is cheaper.

It is very feasible technology with a really small amount of investment, high availability of raw materials, short recovery period . 100% recycling of waste

tyres takes place and no disposable materials are left at the end of the process. The output products have great demand in today's market. No catalysts are being used in this machine during process. It is a pollution free process.

Scope of the Output Products of Pyrolysis

Pyrolysis Oil (Industrial Fuel Oil):
The major product of this process is the pyrolysis oil. The oil that is derived from the process its density lies between LDO (Light Diesel Oil) & FO (Furnace Oil). LDO density is around 0.85 to 0.89 gm/cc at 27 degree centigrade. Calorific Value – Approx. 10500 kcal/kg. FO density is around 0.95 to 0.97 gm/cc at 27 degree centigrade. Calorific Value - Approx.

10500 kcal/kg. Pyrolysis Oil density is around 0.89 to 0.91 gm/cc at 27 degree centigrade Calorific Value - Approx. 10500 kcal/kg. The oil is equivalent to Furnace Oil which is used as industrial fuel in many industries. Scope of the pyrolysis oil- Normally Steel Industries consume about 2000 liters of Furnace Oil.

Furnace Oil rates are varies around from 40 to 50 Rs/litre Pyrolysis Oil rates are always less than Furnace Oil and are around approx. 30 to 40 Rs/litre Calculation- If manufacturer is using Furnace Oil. Daily consumption of oil is aproxx 2000 liters Furnace Oil Rate- 50 Rs per litre Input Fuel Cost- 2000*50 = 1, 00,000 Rs. If manufacturer is using Pyrolysis Oil.

Daily consumption of oil- 2000 liters Furnace Oil Rate- 40 Rs/litre Input Fuel Cost- 2000*40 = 80,000 Rs. Saving of 20,000 Rs/day. Total monthly saving - 20,000*25= 5, 00,000 Rs Total yearly saving - 20,000*300= 60, 00,000 Rs. Hence many industry now started to the use of pyrolysis oil instead of furnace oil, just because it saves huge amount of input cost.

Applications of pyrolysis oil:

Used in the industries where burning process is required.

1. Mostly use in Hot Mix plants
2. Steel Industries.
3. Rolling Mill Industries.
4. Chemical Industries.
5. Used in the Boilers for the heating purposes.

Potential Buyers-

1. Manufacturers of above mentioned industries.
2. Traders.

Carbon Black

This carbon black is of lower quality as it has around 10% of ash content in it, as a result it is used in manufacturing lower grade quality products. Carbon Rate- approx. 1 to 2 Rs per kg. Applications where carbon black is used:

1. in steel industries for burning process.
2. in footwear industries to make rubber soles.
3. Used in polish industries.
4. in ink industries.
5. in colour industries as pigment.
6. Used by traders to mix with higher grade carbon.
7. Used in Iron industries.

Potential Buyers-

1. Manufacturers of above mentioned industries:
2. Traders.
3. Steel Wires- steel wires can be easily sold out to scrap shops. Steel Wire Rate- approx. twelve to fifteen Rs/kg.
4. Heavy Oil- This oil is of less quantity at around approx. 50 to 100 liters. Heavy oil Rate approx. nine to twenty four Rs per liter Rates depends on

the location where sold Road Construction Industries rate would be approx. 10 Rs/kg.

5.

2. Auto Garage rates would be approximately around. 9 to 12 Rs/litre.
It can also be used this as a paste on wood so that wood can catch the fire fast. And as a result consumption of wood is also decreased. Regarding Pollution-: In this process there are 3 important points where chances of pollution increases.

1. **Treatment of gas generated due to burning of wood for initial heating**: Smoke Handling System- It is known as smoke scrubber system which is placed at the top of the cover of reactor.

In this process the smoke generated during the burning of wood or coal is absorbed by the blower and that gas is treated with water wherein the carbon, wood and ash particles are collected in the block & white smoke which is pure smoke is emitted out of the chimney.

2. Pyrolytic gases treatment :

Pyrolytic gases are generated during the process out of which 80-85% are reused for the heating of the reactor & remaining 15 to 20% gases are burned off separately in the burning room avoiding pollution.

3. **carbon Collection from the reactor:**

In this process the direct outlet is given to collect carbon. Installation of a pipe is required to collect carbon and then this carbon is filled in carriage bags, and thus resulting in non exposure of carbon in the atmosphere. and avoiding pollution due to carbon. Technical Specifications for a 10 Ton Plant: 10-tons per day _ _Sr.

No _Details _Specification _ _1 _ Equipment Model _DBM/10/01 _ _2 _ Raw Materials _Waste Tyres & Plastics _ _3 _ Reactor Type _ Horizontal Rotary _

_4 _ Reactor Size _2600*6600 mm _ _5 _ Cooling Type _Water Cooled- Cell & Tube Type Condensing System _ _6 _ Heating Type _Direct Heating _ _7 _ Heating Material _Wood, Coal, Gases, Oil etc _ _8 _ Required Power _30 HP _ _9 _ Working Pressure _0.05 to 1 Bar _ _10 _ Control System _0.4

rpm _ _11 _ Reactor Rotation Speed _Computerized PLC / Manual _ _12 _ Reactor Weight _Approx. 12 Tons _ _13 _ Machine Weight _Approx. 40 to 42 Tons _ _14 _ Process Timings _24 hours/batch* _ _ Land, Power, Water and other important Requirements for a 10 Ton Plant: Open Land: 1500 – 2000 SqM It includes space for machine area, storage area and office Space.

Covered Area: Machine area: 30 x 85 = 2550 SqFt Storage area: 40 x 90 = 3600 SqFt Power Requirement: Power Requirement: 25 HP Gen-Set Requirement: 30 KVA Water Requirement: 1ooo liters per day Labour Requirement: Skilled Manpower: 1 Unskilled Manpower: 5 Initial Burning Fuel Requirement: Wood: 800 – 1200 kg Coal: 700 – 800 kg LPG Gas: 500 – 600 Kg Oil: 300 – 400 Liters

Earthship Biotecture:

A sustainable building must make use of local (indigenous) materials, those ‘naturally’ in the local area.
These materials and the techniques needed for using them need to be accessible to the common man in terms of price and skill required to use them. Primary Building Block: The most important structural building component of an Earthship is tyre filled with compacted earth to form a earth rammed brick encased in steel belted rubber. This earth brick and the resulting bearing walls it forms are virtually indestructible.

Aluminum cans and Glass/ Plastic bottles: These act as little bricks and are a great and simple way to build interior, non-structural walls of the structure. Walls made of Aluminum can make very strong walls. The little bricks create cement-matrix which is very strong and very easy to build. Bottles create

beautiful coloured walls through which the light shines.

The Nature of these Materials In keeping up with the design and performance requirements of an Earthship, the nature of the building materials to be used for an Earthship must have certain characteristics established. These characteristics hsould align with, rather than deteriorate, the environment of our planet. The characteristics and requirements describes the nature of the ideal 'building block' for construction of the the most ideal building for residential and commercial applications.

Many conventional building materials that are used around in past few years satisfy one or two of these characteristics but no conventional materials satisfies all of them. _ _ Indigenous: Materials are found all over the planet. Shipping materials for long distances is not sustainable and uses excessive amounts of energy. In order to make the Earthship easily accessible to the common man and to maintain a low impact on the planetary energy situation, a "building block" found all over the globe would be required.

Able to be fashioned with a very little or no energy: If any building material is found that is indigenous around many parts of the planet but it requires a huge amount of energy to fashion into a usable form, then it would not be sustainable and not considered. The main building materials for an Earthship should require little or no manufactured energy to fashion it into use.

Wood is light and porous these qualities of wood make it a unsatisfactory building material. This is not to mention the fact that trees are our source of oxygen. For building structures that will last without chemicals, we need to look around for materials which have potential durability as an inherent quality rather than trying to add on durability.

Since any earthquakes involves a horizontal movement or shaking of the

structure, this suggests a material should have resilience or capacity to move with this shaking. Brittle materials like concrete, break, crack and fracture. in such scenario ideal structural material for dealing with this kinds of situation should have 'rubbery' or resilient quality to it.

This kind of material used, will allow movement without failure. Low specific skill is required: If these materials are easily obtainable then the housing are to be truly accessibly to the common man they must, by their very nature, be really easy to learn how to assemble.

The nature of the materials that are used in building an Earthship should allow for assembling skills to be learned in a matter of hours and not years. These skills need to t be so basic enough that any specific talent is not required to learn them

_ Why Earthship:

Brilliant Water Recycling:

Even the most arid of climates around the planet can provide enough water needed for daily use through only a rain-harvesting system. The entire roof of the Earthship structure funnels rain water to a cistern, which pumps it to sinks and showers when needed. this t ‘grey water’ is then pumped into the greenhouse for purpose of watering the plants.

The water is pumped up to the bathrooms for use in the toilets, After it is cleaned by the plants. After it is flushed, the now ‘grey water’ is pumped to the exterior garden where it is used to water to non-edible plants. _

Warmth & Shelter

The most amazing piece of engineering in the Earthship is their ability to sustain comfortable temperatures year round.

70° Fahrenheit (22° Celsius).This phenomenon is the result of the solar heat being absorbed and stored by ‘thermal mass’ — or tyres filled with earth, which make up most the structure of the Earthship. The thermal mass which acts as a

heat sink, releasing and absorbing the heat it when the interior cools or heats up, respectively.

The large greenhouse windows infront of the house always face south so as to allow the sun to heat up the thermal mass throughout the daytime Energy Solar panels that are placed on the roof and the optional wind turbines provide the Earthship with all of the required power.

Cheap Earthship are extremly economical than conventional houses. The most basic Earthship can cost aabout $7000 (The Simple Survival model) and the most glamorous model can cost around $70,000 and up, depending on how flashy the owner wants to be with his decorating.

With these cost options, Earthship can easily fit the needs of each t and everyone — from the least privileged to the most worldly. Made of recycled materials most of the materials used to build an Earthship are recycled. For starters, the structure is built with scraped tyres filled with earth. Tyre Building Code ,Building Code developed for bearing and retaining walls that are made from earth rammed tyres.

The aim of Earthship Volume is to make this concept physically available to all the owner and builders. If thses methods put forth in these books are followed properly, it would result in a very “substantial living module.”. This is true of any building technique. This is the reason for having building inspectors. These building inspectors have a code (the Uniform Building Code - UBC) to follow.

This code provides criteria for that is helpful to an inspector to relate to in determining whether a particular building technique is being executed properly or not. The purpose of this building t code for bearing and retaining walls that are made from earth-rammed tyres is to provide that same kind of criteria for an

inspector to that will be helpful relate to in determining whether a tyre building is being executed properly or not. Any building technique can be executed in a competent manner or an incompetent manner.

Tyre bearing walls and the peripheral details are not an exception either. The walls are the only aspect of a tyre building that is significantly unconventional. The roof and the floors are made out of conventional materials and are covered by the existing Uniform Building Code. Therefore a thorough presentation of the standards that can be used for bearing and retaining walls made from automobile tyre casings rammed with earth will be used as a guide to those whose job it is to inspect tyre buildings for structural integrity, safety and quality.

1. TYRE SIZES USED IN BEARING & RETAINING WALLS
   Automobile tyres come in various sizes like 13”, 14”, 15” and 16”. These sizes are related to the radius of the tyre, 13” tyres being the smallest tyres used in a bearing or a retaining wall and 16” tyres being the largest.

2. TYRE WALL AS FOUNDATION
   In this tyre wall is already wider than its required foundation, it becomes a monolith which is both foundation and wall .

A. The first course of tyres of any tyre wall must be properly leveled and dug deep into undisturbed soil that if free of organic surface matter like tree roots or biodegradable substances or plants.
B. first course of tyres need to be as large in diameter as or larger in diameter than any other tyre in the wall. No tyre must appear in a wall which larger in diameter than the tyres on the ground level of that wall.
C. Tyre walls over six courses high must have a ground course of tyres 15” or larger exclusively.

3. COURSING
A. All tyre walls must use staggered running bond coursing.

B: Joints between tyres on any of the course should t be aligned with the central part of all tyres on courses above and below. Non of the joint between tyres on any given level may align with any joint on the levels just above or below.

4. HALF TYRE TECHNIQUES

A. CONCRETE HALF TYRES

Concrete half tyres must use a mix of 3 parts cement-4 parts sand-5 parts gravel with engineering fibers. In which concrete half tyres are most substantial half tyre method, they will be specified in some situations by the architect. All two story tyre wall applications will use concrete half tyres.

B. RAMMED EARTH HALF TYRES

Rammed earth half tyres are made by cutting a tyre in half and leaving tabs on the sides to screw into the adjacent tyre. Rammed earth half tyres can be used only in tyre walls five courses high or less and never at the end of a wall.

5. BEARING WALLS

A. Bearing walls which are built from earth rammed tyre should follow articles 1 to 4 of this code.

B. All bearing walls that are built from earth rammed tyre must have a continuous bond beam of concrete.

C. All bearing walls eight courses or higher for their entire length built from earth rammed tyre should have a continuous bond beam that connects to a continuous bond beam on adjacent non bearing tyre walls.

6. RETAINING WALLS A.

All retaining walls which are built from earth rammed tyre should be stepped back or lean into the earth that they are retaining.

7. FREE STANDING WALLS

DEFINITION - Any wall not tied into the roof structure of a building.

A. the free standing walls over the height of 2 courses high that built from earth rammed tyre should have continuous arcs that are built into the design of wall. These walls should not be straight for any distance.
B. Free standing walls that are built of earth rammed tyre should not t be over 5 courses high.

8. PLATES AND BOND BEAMS

A. All tyre walls that are integral part of the roofed structure should have a continuous concrete bond beam. This bond beam should be anchored to the tyre wall with half inch anchor bolts set in concrete every other tyre or 1/2" rebar driven down through three courses of tyres and bent over the top of the wood plate or set in the concrete bond beam.
B. Concrete bond beams shall be a minimum of 8"deep x 8"wide and have two pieces of 1/2" rebar continuous.

9. OPENINGS IN WALLS

A. The openings made in walls of earth rammed tyres shouold have half concrete blocks on both sides of opening.
B. The concrete bond beam that isspanning over the opening should be increased in thickness by a at least of 8".
This extra thickness shoul extend on both side of the opening a at least of 2'-4" and should set on and be anchored to a concrete bearing block that is equivalent in thickness to the tyre coursing height.

10. TWO STORY

A. A continuous 9" deep x 2'-0" wide concrete bond beam must be place at each floor level.
B. All tyres on the first level should be 15” or larger.
C. All tyres on the second level should be 14” or smaller.
D. All blocking must be made of concrete.
E. All void packing on the first floor level walls must be made of concrete.

11. LENGTH OF WALLS

A. There is no limit to for length of earth rammed tyre walls, since rammed earth tyre walls are not made of a rigid material that is sensitive to expansion/ contraction cracks.

12. HEIGHT OF WALLS

A. The maximum height that straight earth rammed tyre wall which is integral part of a structure with a roof or floor load is 10 feet. At this height a concrete bond beam needs to be installed.

B. The maximum height that a circular earth rammed tyre wall which is integral part of a structure with a roof or floor load is 12 feet. At this height a concrete bond beam must be installed.

13. LOADING OF WALLS:

A. Loading on earth rammed tyre walls must be distributed loading only from joists, beams or rafters that are set on a continuous concrete bond beam.

B. soils bearing capacity determines limits of evenly distributed load, an earth rammed tyre wall can accept that the earth rammed tyre wall is set on.

In cases where t an earth rammed tyre wall is set on rock or a concrete foundation which is more swider than the tyre wall itself and more than typical roof or second story loading is desired, the bearing capacity of the tyre wall will be determined by a licensed architect or engineer.

14. FILL OF WALLS:

A. Earth rammed tyres walls rammed with any type of clay, earth, sand.

B. All tyre casings need to be packed tight to 90% compaction with a 6” to 9” sledge hammer. Soft spongy tyre packing is not acceptable.

15. VOID FILLING:

A. All voids between tyres in earth rammed tyre walls must be packed solid with

mud in a four coat procedure.

16. EARTH CLIFFS:

A. All Earth cliffs shall be 12" minimum from an earth rammed tyre wall.

17. JOINTS:

A. All connections in the earth rammed tyre walls need to be assembled in such a way that there are no voids are occuring within the earth rammed tyre wall. These voids need to be properly filled with concrete or 90% compacted earth contained in a double layer a rubber tyre casing. B. All connections in earth rammed tyre walls must employ over lapped tyres and joining methods that is does not result in stacked joints occurring over each other.