Suggested Methodologies for segregation of various categories of C&D waste

C & D waste can come from any source like house C&D, building C&D, Bridge C&D or any other type of C&D or repair activity.

However there are distinctions in the properties of waste material left behind after Construction and Demolition. Hence, I would like to treat construction and demolition waste separately.

The concentration and properties of construction raw material/waste can be retained in "unmixed/pure form". One can save time and money by doing so, as there will be no need to send C waste for segregation to the plant. It should be resold or reused and only be sent for recycling, if the need arises.

Also, I would like to add Repair activity as a part of this paper. In most of the Repair activities, first a part of structure is demolished and then re-constructed. Hence, Repair activity (for example – repair of bridges, buildings etc.) is a mix of demolition and construction. Repair activity also generates waste, which contains both demolition waste and construction waste.

Construction waste

1. Raw material arrives at the site of construction separately in "pure" form. It may be cement, concrete, iron/steel bars, sand, bricks, wooden panels, aluminum fittings, brass fittings, copper wires etc.

2. If the above material is kept in its "pure" form till it is used, wastage can be minimized. Buy and use only the required quantity. Also mix raw material only when required and in the quantity required. Avoid excess purchasing and mixing.

3. There will be some mixed raw material which will be left unused and hence will become waste. Concrete is a classic example.

Demolition waste

1. Demolition waste contains an uneven mix of a lot of material which need to be separated effectively and reused, recycled or discarded. The waste may contain Concrete, Wood (from buildings), Asphalt (from roads and roofing shingles), Gypsum (the main component of drywall), Metals, Bricks, Glass, Plastics, Salvaged building components (doors, windows, and plumbing fixtures), Trees, stumps, earth, and rock from clearing sites etc.

2. A demolition site will have large and small pieces of waste material. Large pieces of demolition waste should be lifted by equipment and sent to a nearest recycling facility. The large pieces should not be broken at site to prevent accidents and pollution.

3. Once the large pieces have been removed from the demolition site, all the smaller sized waste components should be collected by equipment and sent to the recycling plant. Again they should not be sorted at the site to prevent accidents and pollution. An automatic recycling plant will sort and recycle waste faster than humans with no accidents.

4. Finer mix components of waste like soil, sand, plastic, etc. may be picked up by a mobile vacuum suction machine and the collected waste material sent to the recycling plant.

Repair waste

1. Demolition takes place before construction. The waste generated during demolition is treated as Demolition waste.

2. Reconstruction takes place after demolition. The construction raw material is kept/treated as construction waste, as explained above and is treated as such.

Methods of waste segregation

There are two different conceptual approaches to sorting waste: positive sorting and negative sorting.
Positive sorting focuses on identifying and removing a desired fraction from the input waste stream (e.g. eddy current which targets specifically non-ferrous materials).
Negative sorting focuses instead on identifying and removing a non-desired fraction (e.g. eliminating plastic without the specific polymer properties required).
Generally speaking, positive sorting results in a high-quality material product, but at the cost of efficiency, whilst negative sorting tends to be more efficient, although at the cost of quality of the obtained materials.
In practice, waste sorting plants may use both approaches – e.g. the manual removal of contamination from the waste at the start of the sorting line (negative sorting) followed by automated removal of material fractions (positive sorting), then another round of manual sorting at the end of the line to remove any residual contaminants (negative sorting) to ensure quality.

Comparison of Manual and automatic sorting methods

There are two approaches to sorting waste into individual material streams: manual sorting and automated/mechanical sorting. Configuration of the sorting line is highly dependent upon the incoming waste stream, the purpose of the plant and the market it operates in.
In advanced countries, the market structure supports and demands sophisticated technology-based sorting solutions. In emerging economies like India, lower tech solutions may suffice and are more realistic given low labor costs and maintenance program.
The deciding factors in the choice of technology to be used are:

Performance: meet the output specification as desired from the business case;
Reliability: perform a required function under stated conditions for a specified period of time;
Costs: reflect the income and payback time of sorting facility;
Maintenance requirements: care or upkeep of machinery and property;
Environment, health and safety aspects: impacts on immediate surrounding and employees;
Risks: factors that could influenced technical and financial operation;
Familiarity with technology: knowledge about and opinion on available technology.

Mostly, sorting plants use a combination of manual and automated sorting techniques, as some steps in the sorting process are best handled manually, while other steps benefit from more targeted, safer and less costly automation. This occurs particularly with centralized sorting facilities, where large volumes of mixed waste/ mixed dry recyclables or separately collected recyclables arrive from kerb-side collection system, together with recyclables from commercial and industrial sources.
Labor-intensive manual sorting operations are used for quality control at the end of the sorting process to ensure that the sorted fractions meet the demanded technical specifications. Manual sorting operations are also used for pre-sorting incoming materials. This removes unwanted or contaminated materials, enabling the downstream highly-automated systems to operate at optimal efficiency.
The successful use of automated sorting lies in determining how each material stream responds when introduced to certain technologies or techniques. The key is locating the right technology at the right stage in the sorting process to cause a single material stream to behave differently from others. Some automated sorting technologies rely instead on identifying and subsequently physically removing a particular material type.

Method of Construction waste segregation

This method is based on a very simple concept- do not mix raw material till they are required to be mixed and mix only in the required quantity.

1. Normally the raw material for construction is brought to the site separately, in “pure, concentrated form”. All the material should be kept separate from each other to prevent unintentional/accidental mixing. They should not be mixed unless and until they are required. Also the quantity of mixing should be carefully decided to ensure complete utilization of mixed raw material. Any leftover material can be classified as “construction waste in separate form”. This may include sand, gravel, steel bars, wooden doors/windows etc., bricks etc. All the leftover raw material in “separate form” should be sent to the market for reselling or to any other construction site. “Pure”, unmixed raw material should never be sent for recycling/discarding. This is a waste of money and time. Also the monetary value of unmixed raw material is more.

2. Construction activity may require displacement of soil from the construction site. The displaced "pure" soil may be consumed later at the same construction site or sent to another, nearest location where it can be re-deposited/reused effectively. Extracted soil may be re-deposited in lower areas or land fill or for planting trees or any other suitable activity.

3. Excess readymade concrete should be diverted to another site for utilization, if possible. However if it cannot be used, then it should be sent to recycling plant.

4. Since the material is already segregated and "pure", reusing and reselling are best options.

5. Any leftover material which cannot be used elsewhere or resold should be sent to recycling plant in "pure and separate form". The recycling plant should mix individual type with its own kind and process it further.
   The above steps will ensure that construction waste remains in segregated form for speedy reuse, reselling or disposal. No time, money or plant needed for segregating the construction waste. This is the most cost effective way.

C & D waste recycling plant equipment and waste segregation methods

Here the waste is brought, stored and processed. A typical plant will have several pieces of machinery integrating different technologies for faster and cost effective processing of waste material. The equipment/technology installed will depend on the kind and quantity of waste being handled by the facility.

Plant equipment

1. **Loader**: equipment to lift and place waste on the conveyor/machine entry.

2. **Crusher with magnetic separator**: crusher breaks the waste material into smaller manageable pieces and removes ferrous material with magnets.

3. **Wash tank**: entry level cleaning/washing may be required in some cases. A must, if automatic sorting/processing machinery is installed in the plant. Improves the quality of the final product output. Helps remove lighter pieces like films, wood, plastic, rubber etc. as they float on the surface. The heavier items sink to the bottom. This is one of the best ways to separate heavy and light waste material.

4. **Sand washing**: the sand and/or generated and collected during the process is cleaned before it is reused.

5. **Water recycling plant**: the plant may have a dirty water supply input which needs to be cleaned before using within the plant. The plant also needs to recycle its own dirty water, generated from different processes like sand washing, wash tank etc.

6. **Sludge management**: washing/cleaning of input raw material (also some of the incoming material may contain water) and sand washing will generate sludge and hence the plant needs a sludge management system.

7. **Dryer**: used to dry the wet and moist waste material.

8. **Shredders and grinders**: used to convert large waste components to smaller sized components. For proper recycling of C&D waste, especially concrete, finer granular output from the equipment is desired.
   Waste segregation equipment and methods

a. **Trommel screen**: an angled rotating cylinder with holes which allow waste of a particular size to fall through.
   https://en.wikipedia.org/wiki/Trommel_screen

b. **Disk screen**: a bed of vertical-spaced discs that transports large waste items but allows smaller items to drop through the gaps.

c. **Oscillating/vibrating screen**: a vibrating/oscillating declined be that allows smaller waste to pass through while transporting larger waste to the end.

d. **Grizzly screen**: A grizzly screen is a grid or set of parallel metal bars set in an inclined stationary frame. Typically used to limit the size of material passing into a conveyance or size reduction stage.

9. Air separation

a. **Zigzag air classifier**: waste is dropped through an upward air current in a zigzag shaped flue. Light waste is blown to the top and heavier waste falls to the bottom

b. **Rotary air classifier**: a Trammel screen separator with an air current that captures the light weight waste particles

c. **Cross-current air classifier**: waste is fed on a conveyor and is dropped through an air stream. The light waste particles are blown horizontally to a collection point while heavier particles drop to the bottom

d. **Suction hood**: a hood above a conveyor belt to suck light weight waste particles directly above the conveyor belt

10. **Ballistic separation**: steeply inclined bed with a perforated plate screen deck, with alternating vibrating elements. Light fractions are lifted by cams to the top of the bed, heavier fractions fall to the bottom.

11. **Film grabber**: waste is accelerated onto a rotating drum with spikes. The spikes hook plastic films and let other waste drop

12. **Magnetic separation**: magnets either lift ferrous metal from the waste, or hold ferrous metal to the conveyor while letting other waste to drop

13. **Eddy current separation**: eddy currents are used to push non ferrous metals with magnets into separate collection points, with non metallic waste falling into another

14. **Electrostatic separator**: The Electrostatic Separator separates conducting from non-conducting materials in a size range of +45 microns to 4mm. The technology enables the recovery of metals commonly difficult to separate on an Eddy Current Separator and, subsequently, lost to waste.

15. **Manual sorting**: employees are positioned besides the conveyor and manually remove material in positive or negative sorting

16. **Waste identification and removal with sensor technology**

a. NIR (Near InfraRed): used to differentiate between plastics (PET, HDPE, PVC, PP and PS)
b. VIS (visual spectrometry): used to identify material based on color
c. XRF (X-Ray flouresence): used to differentiate between metals/alloys e.g. from copper and steel
d. XRT (X-Ray transmission): identifies and separates materials based on atomic density e.g. halogens and organic components
e. EMS (Electromagnetic sensor): identifies metals and separates them based on their conductivity

17. **Robotic technology**: a conveyor belt feeds the waste past a package of sensors including visible spectrum cameras, NIR spectroscopic cameras, 3D laser scanners and metal sensors, while robotic arms operate above the conveyor belt, removing materials as the waste moves past underneath. One of the key advantages of robotic technology is that it need not focus on a single waste fraction, but can be used to collect multiple fractions at the same time – depositing them into separate collection bins. Trials are currently focusing on the different material fractions in C&D waste, but there is no reason to assume that the technology will not be suitable for wider application in one form or another.

18. **Recognition technology**: Sorting techniques that do not rely on the physical properties of a material for separation require some form of material identification. Details above gives a brief overview of the sensor technologies currently used in the waste sorting industry. While the accuracy and sensitivity of these technologies continues to be honed, new technologies for identifying different materials in waste streams are being developed. For example, the use of RFID tags in packaging has been proposed to allow identification and classification of individual packaging items. The concept involves embedding RFID tags in individual packaging items, which could then be read either at collection or at the sorting plant to enable precise sorting of different plastic types. The main hurdle to wider use of this technology is price, but there are also concerns about the potential contaminating effect of the tag itself.

19. **Automatic C&D waste processing plant**: these are the most sophisticated and expensive plants which reduce the need for human hands. The entire process is highly automated and synchronized.

20. **Stationary and portable/mobile C&D plants**

a. **Stationary plant**: these plants contain large machinery fixed to the ground and cannot be moved. The machinery may be fixed to steel/concrete platforms on a permanent basis. Stationary C&D waste processing unit is an assembly/collection of different equipment which may involve a combination of some or all the technologies explained above. The raw material is transferred from one equipment/process to another and in the plant itself by conveyer belts. The plant and its equipment require several other technologies/equipment for dust control, noise control, water cleaning, air cleaning etc. The systems maybe either manual or semi-automated or completely automated units.
The capacity of the processing units also varies according to the need from 50 TPD – 2000TPD or may be more than that.

b. **Portable/mobile plant**: these plants can work from any level surface and the machinery does not need to be fixed to the ground. They are moveable and can be repositioned anywhere at will. Different equipment or a combination of equipment, are mounted on one or more than one mobile platform like truck etc. However all the equipment which can be installed in a stationary plant cannot be mounted on mobile platform. Mobile platform offers the advantage of moving to C&D sites in real time and performing waste processing tasks.
Their processing capacity is far less than that of stationary plant. Their processing facility also has less number of individual equipment module installed on platform/s.
Please see:
https://www.bibieke.be/mobile-recycling-plant-waste
http://www.krausemanufacturing.com/material-recovery-facility/construction-and-demolition-recycling/portable-c-and-d-recycling-systems/
https://cuirrose.it/mining1/9764-mobile-mobile-building-waste-crushing-recycling-unit.html
https://www.cameleonitsolutions.be/679cfa73b50f

Recommended methods of waste segregation for Indian conditions

India has a few unique conditions:
Being a tropical country India has a hot, sunny weather in most of the country.

a. Availability of cheap labor
b. Limited availability of financial resources and a strong desire to save them
c. Limited availability of water and the need to recycle it. Also in some cases even the input water may be dirty.

Here I explore different scenarios which exist in India. Each scenario will require a different combination of methods to sort/segregate waste.

Scenario 1

All the demolition waste generated is collected and sent to the plant by the generator, without segregating/sorting. Construction waste is already segregated.

OR

Scenario 2

All the demolition waste generated is collected and sent to the plant by the generator, without segregating/sorting. Construction waste is also sent to the plant in segregated or un-segregated condition.

Please refer to figure 1. Following steps are recommended for segregation.

1. **Inspection**: upon receiving the waste, manual inspection identifies and removes hazardous material like asbestos, lead etc. They should not be allowed to go further into the process as they will contaminate the entire load. Remove whole bricks for reuse.

2. **Manual Sorting, breaking and crushing with the help of heavy equipment like grapple, impactor and crusher**:

a. All contaminants, non-recyclable material should be removed at this stage.
b. Smaller pieces sized less than 200mm are sent directly to the next step.
c. All large pieces (sized more than 200mm) of recyclable waste are to be separated (use heavy equipment for very large pieces) and crushed. The material is sent back into the processing line after crushing. Size of the material should be 200-400mm.

3. **Magnetic separator**: ferrous material is removed, collected and stored separately.

4. **Manual sorting**: since labor cost is low in India, manual sorting will yield good results. Manual picking will remove all metals, wood pieces, plastic, cardboard, rubber etc. All the separated material should be kept in separate heaps. They should not be allowed to remix. Metals may be collected in one single heap, to be sorted later. Since metals are of highest value, they should be removed carefully.
   All metals collected are sent to an Eddy current separator so that different metals can be segregated and collected.

5. **Crusher**: crusher further reduces the size of material to 60mm.

6. **Magnetic separator**: ferrous material is removed, collected and kept separately.

7. **Wash tank**: the crushed waste is thrown into a water tank. Heavier waste particles sink to the bottom. Smaller and lighter pieces of wood, plastic, films, rubber float on the surface, are removed and kept separately.

   The floating and submerged material are not to be mixed with each other, again. It will be a good idea to install two different dryers for floating and submerged waste. The next steps should/may be performed separately on two different conveyors/lines from here onwards. Also, India being a tropical country, with continuous Sun shine all year round, the separated (submerged and floating) waste may be dried in the Sun after removal. It takes time and space to do so, but it makes dryers redundant. Arrangements should be made for protection during rains.

   Two separate processing lines are recommended from here onwards. One for floating material and another one for sunken/submerged material.

Processing line for floating pieces

8a. Dryer: the floating pieces are removed from the tank and sent to a dryer for drying. Alternatively the material can be dried in the sun. However this is time consuming. Take precautions to protect the materials during rain.

9a. Manual sorting: another set of workers remove and separates pieces of wood, plastic, rubber etc. from the floating material. All the separated material should be kept separately. They should not be allowed to remix.

Processing line for heavier, sunken/submerged pieces

8b. Dryer: the submerged pieces are removed from the tank and sent to a dryer for drying. Alternatively the material can be dried in the sun. However this is time consuming. Take precautions to protect the materials during rain.

9b. Magnetic separator: ferrous material is removed, collected and kept separately.

10b. Manual sorting: another set of workers remove and separates pieces of metal, other non required debris etc. from the dry submerged material. All the separated material should be kept separately. Since metals are of highest value, they should be removed carefully.
All metals collected are sent to an Eddy current separator so that different metals can be segregated and collected.

11b. T**rommel screen**: material is sent through a Trommel screen. Material sized 20-60mm, 10-20mm, 5-10mm and 5-75micro meter are separated in different heaps. Larger material is sent back to crusher in step 5.

Scenario 3

Demolition waste is segregated by the generator at the site. All metal, glass, plastic, rubber, wood etc. are segregated by the generator at the site and the rest of the waste is sent to the plant for processing. This waste will normally contain concrete, sand, bricks etc. However the waste may contain ferrous material/rebar embedded in concrete. Construction waste is already segregated.

Please refer to figure 2. Following steps are recommended for segregation.

1. **Inspection**: upon receiving the waste, manual inspection identifies and removes hazardous material like asbestos, lead etc. They should not be allowed to go further into the process as they will contaminate the entire load. Remove whole bricks for reuse.

2. Manual Sorting, breaking and crushing with the help of heavy equipment like grapple, impactor and crusher:

a. All non-recyclable material should be removed at this stage. This material can be sent to land fill later.
b. All large pieces of recyclable waste are to be separated and crushed. The material is sent back into the processing line after crushing. Piece size 60 mm.
c. All large pieces (sized more than 60mm) of recyclable waste are to be separated (use heavy equipment for very large pieces) and crushed. The material is sent back into the processing line after crushing. Size of the material should be 60mm or smaller.

3. **Crusher**: all pieces of waste are crushed into smaller pieces, about 60 mm or any other size you may be comfortable with, with the help of a crusher. The pieces should be small enough to be to be processed in the next steps.

4. **Magnetic separator**: ferrous material is removed, collected and stored separately.

8. Wash tank: the crushed waste is thrown into a water tank. Heavier waste sinks to the bottom. Smaller and lighter pieces of wood, plastic, films, rubber float on the surface, are removed and kept separately.

The floating and submerged materials are not to be mixed with each other, again. It will be a good idea to install two different dryers for floating and submerged waste.

The next steps should/may be performed separately on two different conveyors/lines from here onwards. Also, India being a tropical country, with continuous Sun shine all year round, the separated (submerged and floating) waste may be dried in the Sun after removal. It takes time and space to do so, but it makes dryers redundant. Arrangements should be made for protection during rains.
Two separate processing lines are recommended from here onwards. One for floating material and another one for sunken/submerged material.

Processing line for floating pieces

8a. Dryer: the floating pieces are removed from the tank and sent to a dryer for drying. Alternatively the material can be dried in the sun. However this is time consuming. Take precautions to protect the materials during rain.

9a. Manual sorting: another set of workers remove and separates pieces of wood, plastic, rubber etc. from the floating material. All the separated material should be kept separately. They should not be allowed to remix.

Processing line for heavier, sunken/submerged pieces

8b. Dryer: the submerged pieces are removed from the tank and sent to a dryer for drying. Alternatively the material can be dried in the sun. However this is time consuming. Take precautions to protect the materials during rain.

9b. Manual sorting: another set of workers remove and separates pieces of metal, other non required debris etc. from the dry submerged material. All the separated material should be kept separately. Since metals are of highest value, they should be removed carefully.
All metals collected are sent to an Eddy current separator so that different metals can be segregated and collected.

10b. T**rommel screen**: material is sent through a Trommel screen. Material sized 20-60mm, 10-20mm, 5-10mm and 5-75micro meter are separated in different heaps. Larger material is sent back to crusher in step 3.

All the above equipment can also be installed on movable platforms like trucks, and create mobile C&D waste processing plant.

VERY IMPORTANT NOTE:

A wash tank in operation requires clean water for proper working. Most of the sites have equipment/facilities to recycle wash tank dirty water. Dirty water from outside can be supplied to the water recycling plant for cleaning and then using it in the wash tank. Also the dirty water from the wash tank is cleaned and reused in the wash tank. This method further saves clean water.

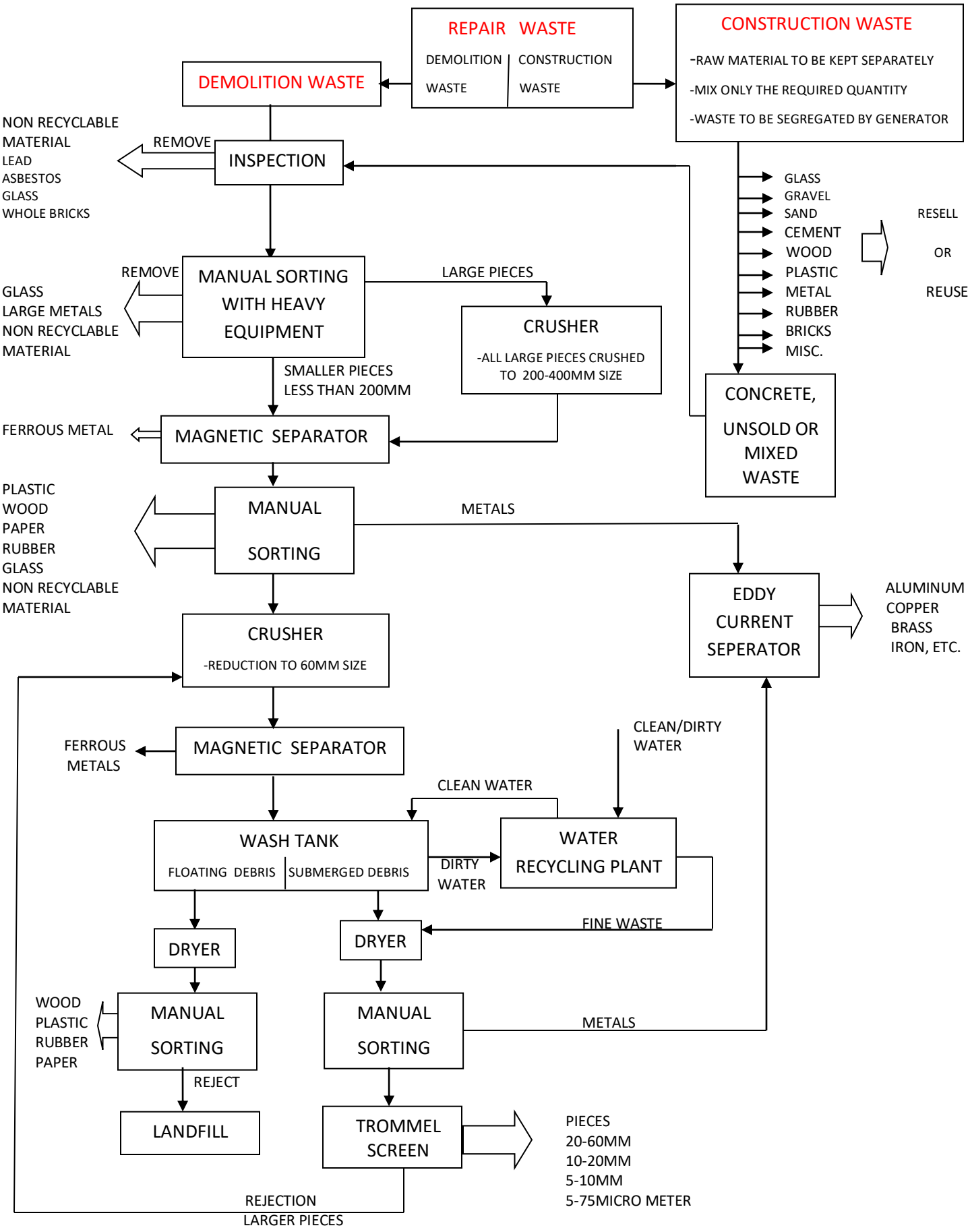
REPAIR WASTE
DEMOLITION WASTE
CONSTRUCTION WASTE
CONSTRUCTION WASTE
-RAW MATERIAL TO BE KEPT SEPARATELY
-MIX ONLY THE REQUIRED QUANTITY
-WASTE TO BE SEGREGATED BY GENERATOR
NON RECYCLABLE MATERIAL
LEAD
ASBESTOS
GLASS
WHOLE BRICKS
REMOVE
INSPECTION
GLASS
GRAVEL
SAND
CEMENT
WOOD
PLASTIC
METAL
RUBBER
BRICKS
MISC.
RESELL
OR
REUSE
REMOVE
GLASS
LARGE METALS
NON RECYCLABLE MATERIAL
MANUAL SORTING WITH HEAVY EQUIPMENT
LARGE PIECES
CRUSHER
-ALL LARGE PIECES CRUSHED TO 200-400MM SIZE
SMALLER PIECES LESS THAN 200MM
CONCRETE, UNSOLD OR MIXED WASTE
FERROUS METAL
MAGNETIC SEPARATOR
PLASTIC
WOOD
PAPER
RUBBER
GLASS
NON RECYCLABLE MATERIAL
MANUAL SORTING
METALS
EDDY CURRENT SEPERATOR
ALUMINUM
COPPER
BRASS
IRON, ETC.
CRUSHER
-REDUCTION TO 60MM SIZE
FERROUS METALS
MAGNETIC SEPARATOR
CLEAN/DIRTY WATER
CLEAN WATER
WASH TANK
FLOATING DEBRIS
SUBMERGED DEBRIS
DIRTY WATER
WATER RECYCLING PLANT
FINE WASTE
DRYER
DRYER
WOOD
PLASTIC
RUBBER
PAPER
MANUAL SORTING
MANUAL SORTING
METALS
REJECT
LANDFILL
TROMMEL SCREEN
PIECES
20-60MM
10-20MM
5-10MM
5-75MICRO METER
REJECTION
LARGER PIECES

FIG. 1.

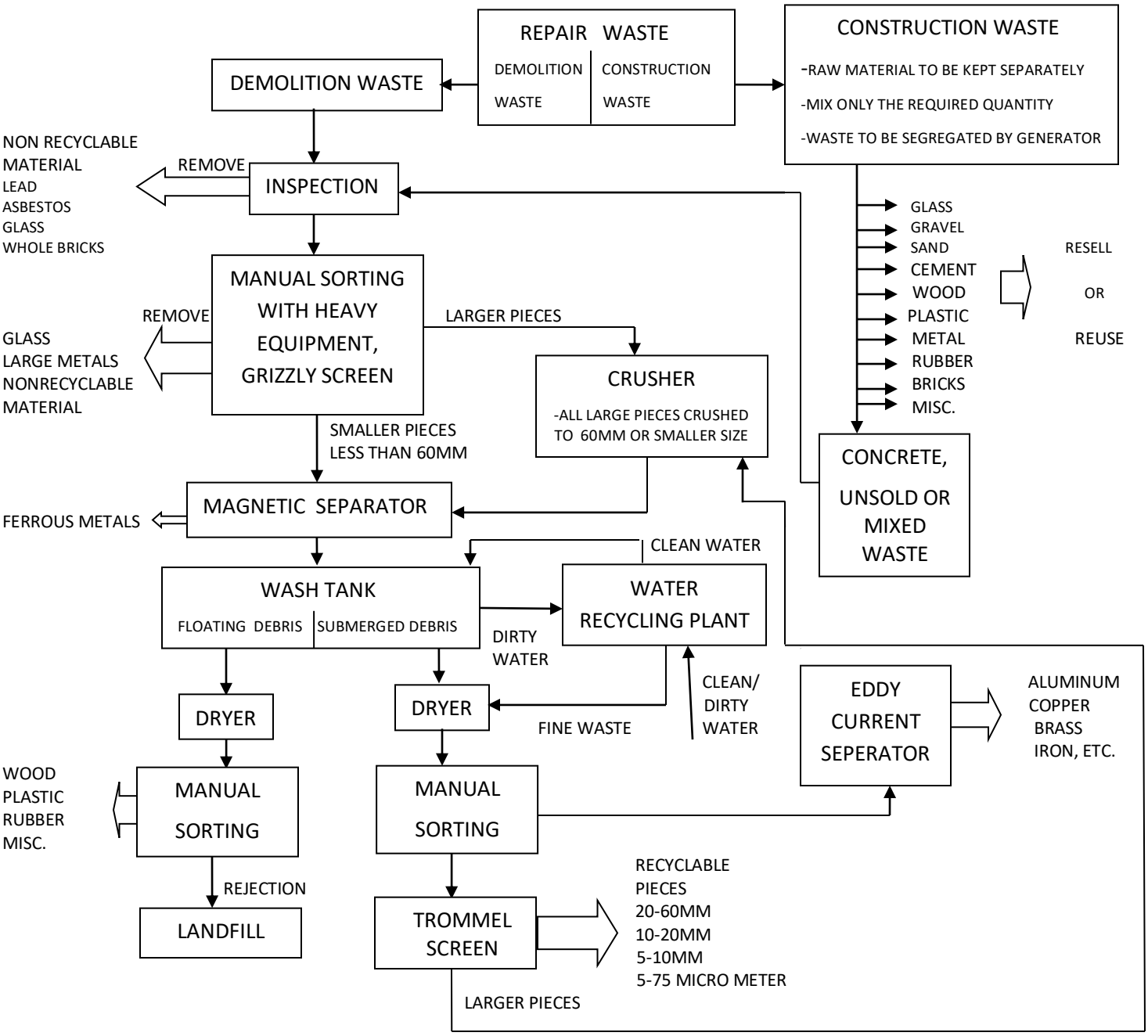
REPAIR WASTE
DEMOLITION WASTE
CONSTRUCTION WASTE
DEMOLITION WASTE
CONSTRUCTION WASTE
-RAW MATERIAL TO BE KEPT SEPARATELY
-MIX ONLY THE REQUIRED QUANTITY
-WASTE TO BE SEGREGATED BY GENERATOR
NON RECYCLABLE MATERIAL
LEAD
ASBESTOS
GLASS
WHOLE BRICKS
REMOVE
INSPECTION
GLASS
GRAVEL
SAND
CEMENT
WOOD
PLASTIC
METAL
RUBBER
BRICKS
MISC.
RESELL
OR
REUSE
MANUAL SORTING WITH HEAVY EQUIPMENT, GRIZZLY SCREEN
REMOVE
GLASS
LARGE METALS
NONRECYCLABLE MATERIAL
LARGER PIECES
CRUSHER
-ALL LARGE PIECES CRUSHED TO 60MM OR SMALLER SIZE
SMALLER PIECES LESS THAN 60MM
CONCRETE, UNSOLD OR MIXED WASTE
MAGNETIC SEPARATOR
FERROUS METALS
CLEAN WATER
WASH TANK
FLOATING DEBRIS
SUBMERGED DEBRIS
WATER RECYCLING PLANT
DIRTY WATER
DRYER
DRYER
FINE WASTE
CLEAN/ DIRTY WATER
EDDY CURRENT SEPERATOR
ALUMINUM
COPPER
BRASS
IRON, ETC.
WOOD
PLASTIC
RUBBER
MISC.
MANUAL SORTING
MANUAL SORTING
REJECTION
LANDFILL
TROMMEL SCREEN
RECYCLABLE PIECES
20-60MM
10-20MM
5-10MM
5-75 MICRO METER
LARGER PIECES

FIG. 2.

There is no such thing as a standard, readymade METHODS/equipment which will work everywhere and under all conditions. The list below will also be an evidence of different types of equipment, METHODS, their use and cost effectiveness under different conditions.

List of companies manufacturing equipment and interesting reading

https://www.zerowasterecycler.com/trommels/
http://coparm.net/vibrating_screen_worldwide.htm
https://www.zerowasterecycler.com/ballistic-separator/
http://www.ecomanindia.com/flip-flop-screen-manufacturers.html
https://www.impactairsystems.com/separation-solutions/zigzag-air-classifier-quality-waste-streams/
https://www.generalkinematics.com/product/msw-destoner/
https://www.amutgroup.com/amutecotech/en/film-grabber
https://www.bollegraaf.com/technologies/shredders/bollegraaf-filmgrabber-2
https://www.impactairsystems.com/separation-solutions/film-vacuum-system-plastic-bags-film-separation-manual-sorting/
https://www.jkmagnetic.com/magnetic-separators-for-waste-and-recycling-industries/
https://steinertglobal.com/us/magnets-sensor-sorting-units/magnetic-separation/
https://www.mswmanagement.com/recycling/article/13028684/magnets-electromagnets-and-eddy-current-separators
https://www.mastermagnets.com/eddy-current-versus-electrostatic-separation/#:~:text=Eddy%20Current%20Separation,and%20large%20non%2Dferrous%20metals.
https://www.eriez.com/NA/EN/Products/Metals-Recycling/Nonferrous-Recovery/Eddy-Current-Separators.htm
https://www.goudsmitmagnets.com/solutions/magnetic-recycling-sorting/eddy-current-separators.html
https://www.valluriorg.com/blog/sensor-based-sorting-of-waste/
https://www.wasteminz.org.nz/wp-content/uploads/Ernie-Beker.pdf
https://www.prominetech.com/plant-module/
https://matecpacific.com/settore/cd-waste-recycling/
https://www.peaks-eco.com/optical-sorting-system/NIR-optical-sorting-system-supplier-16.html
https://www.nrtsorters.com/equipment/
https://www.w-stadler.de/us/unternehmen/Presse/Press_Stadler_Garbage-in_MSW-Sep-Oct-2014.pdf
http://www.krausemanufacturing.com/recycling-equipment/optical-sorting-equipment/
https://steinertglobal.com/magnets-sensor-sorting-units/sensor-sorting/x-ray-sorting-systems/
https://redwave.com/en/
https://www.vivis.de/wp-content/uploads/WM3/2012_WM_139_148_Weiss.pdf
https://www.environmental-expert.com/products/ems-model-ds3500-density-separators-350481
https://www.environmental-expert.com/products/ems-overband-magnets-ferrous-separation-402264
https://zenrobotics.com/
https://www.ijert.org/research/smart-garbage-separation-robot-with-image-processing-technique-IJERTCONV6IS12005.pdf
https://anasasorter.com/
https://wasterobotic.com/en/
https://www.machinexrecycling.com/products/samurai-sorting-robot/
https://www.tomra.com/en/sorting/recycling
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Statement as required as per the details given in the website:

I am an electronic engineer. I have a deep interest in technology and its applications. I have very good imagination.

I would be interested in partnering with the Seeker, if they so desire, at the conclusion of the Challenge. However such a relationship/agreement should be on mutually beneficial basis. The final terms and conditions of such an arrangement can be worked out later, if required.