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Recycled Aggregate Products



Recycled Aggregate Products

- Road Base
- Dry Coarse Aggregate
- Pipe Utility Bedding
- Engineered Structural Backfill
- Landscape Dimension Stone
- Vehicle Tracking Rock
- Trail Surfacing
- Ready Mixed Concrete (Green Crete)
- Biota Cap and Cover
- Top Soil Amendment
- Under Slab Bedding
- Drainage Rock
- Stackable Landscape Stone
- Washed Aggregate Products

Recycled aggregate yields more volume by weight, up to 15%

Product Standards & Specifications

- In accordance with ASTM & AASHTO
 - Specifications used by engineers
- Minimal deleterious
 - Contaminates such as wood metal etc...
- Non-reactive
 - Alkali Silica Reactivity (ARS)
 - (Not a typical property of recycled aggregates)

Recycled Ready-Mix Concrete



Interstate Highway Experience

Recycled Mix Design: I-70 & Peoria Project

| Design: | C/A Ratio: | 7 Day | 14 Day | 28 Day |
|--------------------------------|-------------------|---------------------|--------------------|----------------------------------|
| Flexural Strength | 25% RC 75% NAT | 710 PSI 4600 PSI | 760 PSI NO DATA | 760 PSI 5730 PSI |
| | | | | |
| Flexural Strength | 50% RC 50% NAT | 640 PSI 4560 PSI | 690 PSI NO DATA | 700 PSI 5530 PSI |
| | | | | |
| Flexural Strength | 75% RC 25% NAT | 665 PSI 4700 PSI | 690 PSI NO DATA | 800 PSI 6230 PSI |
| Flexural Strength 650 PSI * | | | | Project Average 697.55 PSI |

* Department of Transportation's design specification

75% Recycled Mix Design



I-70 & Peoria Project

Recycling Terminology

- Application Engineering
 - Engineers design project with recycled materials use in mind
- Value Engineering
 - Cost effective engineering solutions
- Re-use planning
 - Owner, Developer, Contractor, Recycler, Engineer all involved from beginning of project design/plan
- Sustainability
 - As part of project goals:
 - Economic, Social, & Environmental

Recycling Equipment



Urban Redevelopment as an Aggregate Resource

- Highway Re-construction
- BRAC
- Shipyards
- Rail & Industrial
- Airports
- Dam & Reservoir
- Large Infrastructure
- Demo with Intent to Recycle:
 - Re-use Planning
 - Sustainability Goals
 - Application Engineering
 - Recycled Aggregate:
 - **Base Materials**
 - **Utility Bedding**
 - **Drain Rock**
 - **Trail Cover**
 - **Concrete Rock**
 - **Clean Rock Uses**

“The Worlds Largest Recycle Project” #1




Stapleton International Airport
Denver, Colorado

Stapleton Project Overview

- 5,000 Commercial International Airport
- Over 1000 Acres of Paved Hardscape
- Removal of Taxiways, Runways, & Aprons
- Vertical demolition
- 10 year project
- Developer: Forest City
- Municipality: City & County of Denver



Recycling Stapleton

- 6.5 Million Tons of Concrete & Asphalt Removed & Recycled
 - Re-use of 1/3 of the recycled aggregates in the re-development of Stapleton
 - 6 years continuous removal
 - Creation of an “Urban Quarry” for Stapleton and other public construction projects
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- A large orange and black forklift or material handler is visible in the background, positioned in a construction or recycling yard. The machine has a long, low-profile body and two vertical mast structures. The background shows a flat, open area with some distant structures under a clear sky.



Re-Use Planning

- Project plan involves re-use
- Stated as a project mission-driven by economies of re-use
- Schedule, Handling, Specialties
- Buy-in of:
 - Owners
 - Engineers
 - Contractors
 - Partnering Concept

Sustainability Goals

- Planning Evolves Goals
- Recycle for Sustainability
- Re-Use of Resources Where Economic
- Mitigate Depletion
- Reduce Impacts:
 - Traffic Rounds
 - Emissions
 - Land Fill Impact 1:1 Concrete vs. 10:1 Trash

Application Engineering

- Utilization of the Recyclable Resource
- Recycle Alternates
- Reduction of Virgin Materials
- Pavement Sections
- Mix Designs
- New Applications



The Urban Quarry



Denver



Stapleton Project Challenges

1. Quantity Survey
2. Material Quality
3. Application Acceptance
4. Volume Relative to Market
5. Cost Revenue Model

“The Worlds Largest Recycle Project” #2



El Toro MCAS
Irvine, California

El Toro Project Overview

- BRAC Closure
- 5,000 Acre Military Base
- 800 Acres Paved Hardscape
- Removal of Taxiways, Runways, & Aprons
- Vertical demolition
- 8.5 year project
- Developer: Lennar & Great Park
- Municipality: City of Irvine & Orange County



Recycling El Toro



- 4 Million Tons of Concrete & Asphalt to be Removed & Recycled
- Re-use of 100% of demolished recycled aggregates in the re-development of Public and Private sectors
- 4-5 years to remove—additional 2-3 years to utilize
- Creation of an “Urban Quarry” for on-site re-development

El Toro Project Challenges

- Adaptation of material specifications
- Acceptance of materials in engineered applications---structural
- Re-use and sustainable partnering
- Permitting and licensing at local level—restrictive to the general contractor and no exceptions for the re-use applications

Project Comparison

Stapleton vs. El Toro

- Design and construction of materials of runway---commercial aviation vs. military
- Runway layout and site design
- Elimination of approx. 400K truck rounds import & export at El Toro vs. 600K at Stapleton
- 100% material re-use at El Toro vs. 1/3 material re-use at Stapleton due to Partner Planning & Application Engineering

Summary

- Project specific recycling on a major re-development project offers opportunities to utilize a major urban resource, reduce and eliminate disposal waste, reduce project impact on the community and dramatically reduce costs.
- Recycled Aggregates are proven to be of equal quality and in some cases are superior to virgin aggregates.
- Application Engineering, Value Engineering and Re-use planning concepts translate to near zero solid waste stream.
- Uniform acceptance and use should result from continued development of unilateral standards.