PROJECT SELECTION IN URBAN RECYCLING

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Pavement recycling problems in the urban environment are different than those in rural areas. The size and magnitude of the projects are generally smaller in scope. Also, there are many more physical constraints ie: curbs and gutters, catch basins, driveways, cross gutters, median curbs, manholes, etc., which influence the design. A typical economic analysis is presented as well as evaluation criteria. Presentations should be made to local officials, planners and citizens showing that the benefits of recycling far outweigh any inconveniences a few may encounter. Encourage local contractors to obtain the equipment needed for recycling by demonstrating that it is economical and beneficial. Also inform them of the agencies intention to utilize this construction technique.

Project Selection

Is this project a candidate for recycling? This question should be asked on all reconstruction, resurfacing and widening projects. The answer will probably be yes, even if the project is very small (1/10 to 1/4 mile). No longer can the economic and environmental potential through recycling be ignored, but these considerations must be evaluated on each project. If the economics are not favorable, the removed asphalt concrete can still be utilized on a future project by stockpiling it, thereby conserving our natural resources and fuel. Environmental and economical considerations may dictate whether hot, cold or surface recycling should be used.

With a trend towards the 3 R's--resurfacing, restoration and rehabilitation of our interstate highways, county roads and local streets, recycling of the existing worn and tired pavements is a very important development and technique. Recycling should be added to the highway engineer's arsenal for the maintenance and construction of the transportation system.

In the urban environment, most of the roads and streets are improved with curb and gutters, catch basins, cross gutters, driveways and in some cases raised median curbs, which control the geometric and horizontal alignment and many times also provide the vertical control for finished pavement elevation. With these types of controls, considerable problems can be encountered in designing and placing a thick asphalt concrete overlay. Some of the typical problems resulting from thick overlays are excessive crossfall ie: car doors cannot be completely opened (Figure 1), ridability of cross gutters (Figure 2) and driveway access (Figure 3), reduced water carrying capacity when storm runoff either tops the curb or extends further out into the traveled portion of the roadway than originally designed, loss of curb height of median barrier curbs (Figure 4) and raising of manholes or utility vaults (Figure 5). Recycling of the existing asphalt concrete roadway can reduce the magnitude or eliminate some of the problems illustrated.

Public Relations

When evaluating a project and determining if recycling should be used, project location often limits the techniques available when working in a central business district, industrial or residential area. Traffic control considerations which must be evaluated are: Will a detour be required, can construction proceed utilizing a portion of the existing roadway or can the street be closed during construction?

Being good neighbors is a must and will require determining the effect the increased dust and noise will have on the adjacent properties when selecting inplace vs. offsite recycling techniques. With the the equipment available today, inplace cold mix or surface recycling can be accomplished in most urban areas without adversely affecting the environment. The location of existing asphalt batch plants or material storage areas for the removed asphalt concrete must be included as part of the economic study when determining fuel, aggregate and paving asphalt cost

savings through the use of recycled materials.

It is incumbent upon the engineer to inform their local officials and citizens about the value of reusing the existing pavement materials and that the economical and ecological benefits far outweigh any inconveniences a few may encounter. If necessary, be prepared to go before your local planning commission to request their cooperation in granting contractors permission to move in onsite crushing or mixing equipment, on a temporary basis, which may not meet the local zoning requirements. Stress that they are helping the local economy, the environmental and ecological balance by conservation of material resources and conserving energy when the asphalt concrete and untreated aggregate are recycled. Also point out that pollution is being reduced even though some additional localized noise and dust may be created.

Pavement Analysis

Should the project have only localized areas of distress, recycling can very effectively be used in the distressed areas and then an overlay or a surface treatment placed to complete the project. It has been demonstrated, when localized failures occur only in the surface portion of the structural section, that cold planing or milling out a portion of the asphalt concrete can make an economical repair with recycled asphalt concrete. In addition to the savings previously mentioned, a double benefit may be derived from trucks by having them haul the milled material to a plant or storage site and bring back asphalt concrete to the project site for placement in the milled area. This construction method has proven to be very effective in the business districts and industrial areas. Work can begin on the traffic lanes after the morning peak and have them completed and ready for use in time for the evening rush hour, thereby eliminating the need to barricade off a portion of the roadway or detouring traffic around the project. If the distress in the roadway is related to the untreated base material, then by recycling the asphalt concrete surface and the untreated base into an asphalt concrete material a significant structural improvement can be attained. Thus, the structural value and load carrying capacity of the pavement can be increased considerably with no increase in thickness or change in grade.

On the other hand, if a roadway is structurally adequate but has developed significant amounts of cracking due to aging, its integrity and ridability can be improved though recycling. It is also possible to reprofile a street with recycling. These generally can be accomplished through surface recycling techniques; however, cold or hot recycling can also be used if a considerable depth of asphalt concrete is to be removed.

Many projects which would be postponed awaiting funding or permitted to further deteriorate prior to reconstruction can be effectively rehabilitated at a lesser cost by using recycling.

Economic Analysis

A typical economical analysis for a small urban hot recycled asphalt concrete mix is presented in Table I. It should be noted that by recycling the existing asphalt concrete, significant savings can be accomplished, \$2,000 - \$2,800. These savings relate to lower project costs.

The relative locations of the aggregate sources, batch plants and dump sites to the the project location can greatly affect the savings. Both of these batch plants are about equidistant from the aggregate source. The Inglewood plant which is closer to the project site and further from the dump and refinery shows a greater savings when compared to the Gardena plant. However, the expected savings will probably be nearer the calculated maximum of \$2,800 due to the competitiveness of the two plants. This competitiveness can only be accomplished after demonstrating to the contractors that whenever the economic and design considerations are favorable, recycling will be specified.

Surface recycling was not considered on this project because of the pavement condition (Figure 6) and inadequate existing structural section. Cold recycling the surface with the existing sand subgrade was considered but discarded because of underground utilities and grade controls due to drainage problems.

The use of recycling must be approached in the same manner that an overlay or new construction project is being evaluated. That is, the project must be planned, programmed and scheduled to take maximum advantage of available economics.

Do not just plan one or two projects and then wait 5-10 years after they are constructed to thoroughly evaluate their effectiveness. Take advantage of the work previously done by other agencies and contractors. Review their reports, talk to the design, construction and maintenance engineers as well as the contractors and learn firsthand what their experience has been and how they have improved and refined their construction and design procedures. Before a local contractor will invest in recycling equipment, he must be assured that recycling is economical and part of an ongoing highway program. Economic studies of projects (even previously constructed nonrecycled projects) can help indicate the number of projects you may have per construction season. Once a market for recycling is created and more contractors become equipped to do this work, the greater will be the competition and also the savings to the agency.

Remember, that recyling of the existing roadways, combined with your resourcefulness, ingenuity and determination, will provide an additional economical method to continue to improve and maintain your highway and street systems to the highest standard.

TABLE I

PROJECT EVALUATION

Project: Mariposa Street Location: City of El Segundo

Limits: 565' W/O Nash to Douglas St. Length: 1850 ft.

Existing Structural Section: 3" AC on Native Sand

Condition: Badly Alligatored

Existing Improvement: Curbs & 1' gutters @ 25' from C.L.

Proposed Improvement: Curbs & 2' gutters @ 32' from C.L. and 4" AC on 10" Aggregate base.

Area: 1850 ft. x 60 ft. = 111,000 S.F.

Asphalt Concrete required: 4" x 111,000 sf. x 145 pcf. ÷ 2000 = 2700 tons (94.7% Aggr., 5.3% Asphalt)

Surface Course 1000 tons, Base Course 1700 tons. Recycled Asphalt Concrete to be used in base course only.

Economic Analysis based on asphalt concrete batch plant located in Gardena

Distance:	Aggregate source to batch plant	30 miles
	Paving Asphalt source to batch plant	8 miles
	Batch plant to project site	9 miles
	Project site to dump site	8 miles

Costs to get materials to batch plant

All new aggregate asphalt concrete

Virgin Aggregate	2700 tons x 94.7% x 30 mi x $0.10/ton-mi	= $7,671
Paving Asphalt	2700 tons x 5.3% x 8 mi x $0.60/ton-mi	= $ 687
	Total	= $8,358

Recycled asphalt concrete (30% reclaimed aggregate + 70% virgin aggregate) to be used in base course of asphalt concrete only.

Base Course asphalt concrete

Reclaimed Aggregate	30% x 1700 tons x 94.7% x 9 mi x $0.30/ton-mi	= $1,304
Virgin Aggregate	70% x 1700 tons x 94.7% x 30 mi x $0.10/ton-mi	= 3,381
Paving Asphalt	70% x 1700 tons x 5.3% x 8 mi x $0.60/ton-mi	= 303
	Subtotal	= $4,988

Surface Course Asphalt Concrete

Virgin Aggregate	1000 tons x 94.7% x 30 mi x $0.10/ton-mi	= $2,841
Paving Asphalt	1000 tons x 5.3% x 8 mi x $0.60/ton-mi	= 254
	Subtotal	= $3,095
	Total	= $8,083

Haul costs & dump fees for removed existing asphalt concrete pavement.

Haul to dump (30% of 1700 tons)	510 tons x 8 mi x $0.30/ton-mi	= $1,224
Dump fee	510 tons x $1.00/ton	= $ 510
	Total	= $1,734

Savings using recycled aggregate =

Asphalt Concrete (new aggregate)	+	Haul & Dump Costs (exist pavement)	−	Asphalt Concrete (recycled aggr.)	
$8,358	+	$1,734	−	$8,083	= $2,009

Economic Analysis based on asphalt concrete batch plant located in Inglewood

Distance:	Paving asphalt source to batch plant	16 miles
	Aggregate source to batch plant	33 miles
	Batch plant to project site	4 miles
	Project site to dump site	8 miles

Costs to get materials to batch plant

All new aggregate asphalt concrete

Virgin Aggregate	2700 tons x 94.7% x 33 mi x $0.10/ton-mi	= $8,438
Paving Asphalt	2700 tons x 5.3% x 16 mi x $0.30/ton-mi	= 687
	Total	= $9,125

Recycled asphalt concrete (30% reclaimed aggregate + 70% virgin aggregate) to be used in base course of asphalt concrete only.

Base Course asphalt concrete

Reclaimed Aggregate	30% x 1700 tons x 94.7% x 4 mi x $0.30/ton-mi	= $ 580
Virgin Aggregate	70% x 1700 tons x 94.7% x 33 mi x $0.10/ton-mi	= 3,719
Paving Asphalt	70% x 1700 tons x 5.3% x 16 mi x $0.30/ton-mi	= 303
	Subtotal = $4,602	

Surface Course Asphalt Concrete

Virgin Aggregate	1000 tons x 94.7% x 33 mi x $0.10/ton-mi	= $3,125
Paving Asphalt	1000 tons x 5.3% x 16 mi x $0.30/ton-mi	= 254
	Subtotal = $3,379	
	Total	= $7,981

Haul costs & dump fees for removed existing asphalt concrete pavement

Haul to dump (30% of 1700 tons)	510 tons x 8 mi x $0.30/ton mi	= $1,224
Dump fee	510 tons x $1.00/ton	= 510
	Total	= $1,734

Savings using recycled aggregate =

Asphalt Concrete (new aggregate)	+	Haul & Dump Costs (exist pavement)	−	Asphalt Concrete (recycled aggr.)	
$9,125	+	$1,734	−	$7,981	= $2,878

Figure 1.

Figure 2.

Figure 3.

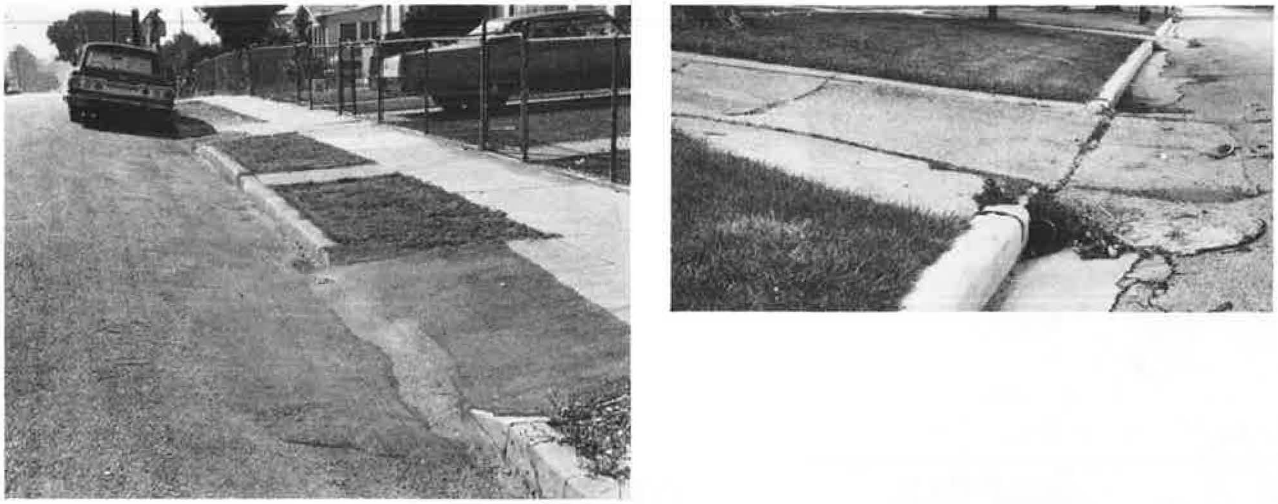

Figure 4.

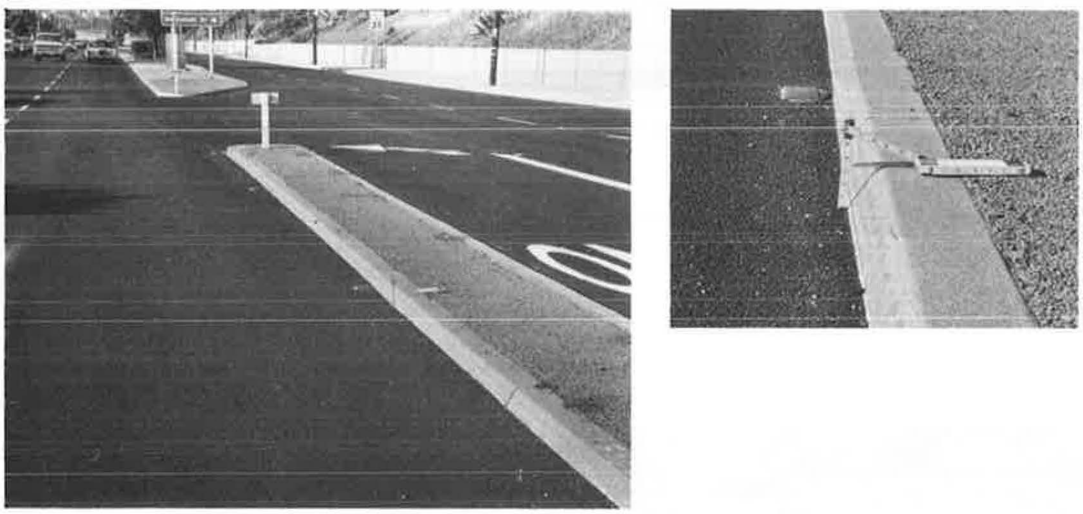

Figure 5.

Figure 6.