A STUDY OF DEMOLITION RECYCLING

TENNESSEE NFL STADIUM

Nashville, Tennessee

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I. Purpose of the Study

In the past, it has been rare for a major construction project to incorporate a recycling effort into its plans. In the future, it may be advantageous because (1) it is financially beneficial; (2) the company will be looked upon as a "friend" of the community for the effort; (3) it may be dictated to the contractor by new laws and regulations. The Tennessee Stadium Group (TSG) was successful through the efforts of its consultant, Wilmot & Associates (W&A), incorporating a recycling effort in both the demolition phase and the construction phase of the project. This study is written to record for future use the plans, procedures and lessons learned which made the demolition phase of the recycling effort such a success. A second study of the construction phase recycling will be produced at project completion.

II. History of Recycling Effort

The Tennessee NFL Stadium is a 67,000 seat, open air, state-of-the-art NFL stadium constructed for the Oilers as their new home after moving to Nashville from Houston. It is constructed on the East bank of the Cumberland River directly across from downtown Nashville. The land, approximately 120 acres, utilized for the stadium development, was occupied by old warehouses, light industrial facilities and small businesses. The buildings were a mixture of structures. Most had concrete foundations, retaining walls and slab on grade with masonry load-bearing exterior walls and steel roof structures.

The logistics of the demolition effort was made more difficult because Metropolitan Nashville and Davidson County (Metro) could not purchase all of the property and relocate all of the existing tenants at the same time. The property was therefore turned over to TSG in three phases. Phase I was the stadium footprint, Phase II included parking lots East and West of the Stadium and Phase III included parking areas South of the Stadium. The demolition of the footprint area would therefore begin approximately three months before construction on the Stadium would begin and Phase II would continue through the first year of construction.

TSG did not originally include a recycling effort in its plan. Wilmot & Associates, a Nashville based recycling consultant with extensive experience in the field, was introduced to TSG by the Mayor's office. The Metro government supported the utilization of recycling as the "right thing to do" in the community. At the same time the Mayor's office made it clear that a recycling plan should not be utilized if it cost the project more money or construction time. Through a series of meetings W&A convinced TSG that a recycling effort on the Stadium would be beneficial. In March of 1997, a contract was signed utilizing W&A's services through the entire duration of the project. The demolition phase of the project is complete and the recycling effort was a huge success. It not only saved the project money, and in turn Metro, it also gained W&A, TSG and Metro a great deal of news exposure and positive recognition, both locally and nationally. It was recognized that the project "did the right thing", while at the same time saving money and resources.

III. Project Plan

The overall plan was to salvage, reuse and/or recycle as much material from the demolition of the structures as was economically feasible. The project would benefit financially in three ways. First, it would save hauling costs and dump fees not spent for materials salvaged or recycled. Second, it would actually receive revenues from "sold" materials such as steel scrap. Third, by substituting processed concrete for stone fill, it saved the expense of purchasing fill material.

The following were planned areas for recycling on this project.

1. Process concrete, brick and block (CMU) from the demolished buildings to produce "stone" fill.
2. Collect reinforcing steel from the processed concrete to sell for steel scrap.
3. Collect structural steel and other steel products from the demolished buildings to sell for steel scrap.
4. Salvage material from buildings before demolition began. Light fixtures, toilet and bath fixtures, furniture, structural steel, wood beams and steel stairs were just a few of the types of items salvaged.
5. Collect non-ferrous metals such as copper and aluminum for recycling.

The logistics of the project dictated that the demolition, and in turn the recycling effort, would be completed in two phases with a period of down time between phases. The equipment requirements and the potential use of the recycling product were different for each phase.

The Phase I demolition included only those buildings in the actual footprint of the stadium structure. Buildings outside the footprint of the stadium had not yet been purchased and were still occupied and operated by the tenants. Due to the limited operational space special consideration had to be paid to the logistics of the processing machines. Since construction had not begun, the potential use of the recycled concrete was limited. The original plan for this phase was to construct temporary roads with the recycled concrete.

The Phase II demolition included properties away from the stadium structure in areas which would eventually be parking lots. With more area to work with, a more flexible equipment plan could be incorporated. The recycled concrete product could also be used more beneficially with construction of the facility underway.

IV. Execution of Recycling Plan

A. <u>Salvage</u>

W&A worked with numerous salvage companies to remove as much salvageable materials as possible from the buildings within the time frame available before demolition. First, W&A toured the buildings to inventory items available for salvage and reuse. Next, buyers were contacted who deal in the different varieties of materials that were found in the buildings. W&A then invited the buyers to tour the buildings and bid on the materials to get the best price for each salvageable item. The profit from this operation was returned to the project.

Many items such as electrical equipment, plumbing fixtures, structural steel, and wood beams were in high demand, and could easily be recovered and sold for a good price. Although salvage companies were interested in other items such as glass block, paneling, windows and smaller fixtures, many were not recovered due to time constraints and lower value of the materials.

B. Concrete Recycling

The restrictions and requirements of the two demolition phases were totally different and for that reason will be reported separately.

1. **Phase I**

The original plan was to use the processed concrete for constructing temporary roads on site in lieu of purchasing crushed stone for that purpose. Since construction on the stadium itself had not started, there was no immediate use for the material. This fact created a need to "store" the material.

The machine used to process the concrete was an Eagle 1000. Concrete pieces as large as 3' x 3' x 6' could be loaded into the Eagle 1000 machine and it was capable of processing 150 tons of product per hour with a three-person crew. Though the machine could produce various gradations of product, TSG and W&A chose a gradation of #57 stone for the intended purpose of the product.

The logistics plan was for the processing machine to move near each structure being demolished so that the demolition contractor could push the concrete pieces to the processing machine. The rock-crushing crew would then load the machine with the concrete pieces and the product was made. The demolition contractor was required to break up the concrete into pieces a maximum size of 3' x 3' x 6' to fit into the crusher. The product was conveyed into a pile, then loaded into a truck to be taken to a storage area on site for future use.

The total amount of material produced and stored during Phase I was 40,356 tons.

When the time came to construct temporary roads it was found that the gradation of product chosen was not suitable to stand up to heavy construction traffic. The product, however, did prove to be beneficial for structural fill. The first month of construction (June 1997) was extremely wet and dry fill dirt could not be found. We were able to utilize our concrete product in structural fill situations to help dry the compacted structural fill areas and keep the project on schedule.

2. **Phase II**

The site conditions, the status of construction on the stadium, and the lessons we learned in Phase I, helped Phase II to be a much more beneficial operation to the project.

We had room to operate and did not have to move the processing machinery. In Phase II, we set up equipment in one spot and required

the demolition contractor to transport the concrete pieces to the "on site" processing location.

We had an immediate need for the processed material. The basement walls were being completed and structural fill was needed to backfill the walls. Crushed stone was required because suitable soil was not available and the expected wet winter conditions prevented proper compaction. Specifications were prepared in advance for producing a rock product (Grade D) suitable to backfill the foundation walls. The processed material was tested and certified by the project-testing lab, Law Engineering, and passed all requirements with an "excellent" rating. The processed recycled concrete proved to be a perfect material for that purpose, in lieu of purchasing crushed stone. It also did not have to be stored. It was immediately used when produced.

The machine used to process the concrete for Phase II was an Eagle 500. Concrete pieces as large as 2' x 2' x 6' could be loaded into the machine and it was capable of processing 100 tons of product per hour. TSG and W&A learned from Phase I and decided on a different gradation of product for Phase II. A gradation of "D" was utilized.

The total amount of material produced in Phase II was 23,849 tons. It was all used as structural backfill against the basement walls.

C. Steel Recycling

During demolition, W&A worked with TSG and the demolition contractors to salvage steel from the demolished buildings. Most of the buildings and industrial structures contained large amounts of steel. W&A, in cooperation with Philip Environmental, a local scrap metal processor, provided containers and transportation services at each structure as it was demolished. A total of 1,054 tons of steel, worth over $78,000 was collected, processed and recycled. This profit was returned to the project.

D. Office Recycling

TSG also incorporated recycling in the offices of the trailer complex. Materials recycled included corrugated cardboard, office paper, and used beverage cans. By offering personnel inside the trailers the opportunity to recycle their materials, it gave a sense of community to the project. Although the construction workers outside the trailers were recycling a great deal more material, all people on the job site were encouraged to recycle as much material as possible, no matter how small their contribution. Personnel were also apprised of the amounts of materials recycled and informed that by recycling they were saving money that would have normally been spent to haul and landfill the waste.

V. Financial Results

The following is a summary of the cost of producing a suitable backfill or fill material using the concrete from demolished buildings and the money saved by not having to haul that demolished debris to a landfill and purchase crushed stone backfill or fill material.

Cost

- Cost of processing including production, on-site hauling and supervision (W&A)

Phase I	39,689 tons	$394,427
Phase II	23,849 tons	$200,149
Total	63,538 tons	$594,576

Total Production Cost *$594,576*

- W&A Overhead and Fee During Demolition Phases I and II

Total This Cost *$231,300*

Total Cost **$825,876**

Savings

- Hauling Costs and Dump Fees Saved by Recycling

Phase I	39,689 tons	$240,539
Phase II	23,849 tons	$180,000
Total	63,538 tons	$420,539

Total Haul and Dump Savings *$420,539*

- Savings generated by not purchasing crushed stone

63,538 @ $8/ton *$508,304*

- Salvage revenue to project

Total Revenue *$119,694**

Savings Generated **$1,048,537**

TOTAL SAVINGS TO PROJECT, SAVINGS GENERATED LESS COST **$222,661**

**It should be noted that there was a delay between the date the original owner of the buildings moved out of the facility and the date TSG acquired the facility. During this time the buildings were open to scavengers who concentrated on copper wiring, copper pipes, electrical equipment and the fixtures which had value. It is estimated another $60,000 to $80,000 could have been salvaged by TSG and W&A if access could have been controlled during that period of time.*

In addition, approximately $11,000 worth of hotel fixtures were salvaged by the city before that facility was turned over to TSG and W&A. The total savings could have been over $300,000 if that situation could have been controlled (see Lessons Learned).

When considering a program such as this, at other project locations, certainly many of the unit costs contained in this study will vary. Two areas can be critical:

1. Haul distances to landfills and the dumping fees can vary greatly from project to project and city to city. Dump fees in many cities will be much greater than Nashville and in some locations are almost prohibitive.

2. The cost of crushed stone fill will vary by location based upon its availability. Crushed stone in Nashville is extremely abundant, thus the low cost of $8 per ton. As the cost of crushed stone (which the recycled concrete replaces) increases, this program becomes even more beneficial. Assuming all other cost factors are the same, we offer the following examples.

    a. In Atlanta, Georgia, where crushed stone costs $12 per ton, the total savings of this program would have been $476,813.

    b. In Valdosta, Georgia, where crushed stone costs $18 per ton, the total savings of the program would have been $858,041.

VI. Lessons Learned

Few projects of any size have utilized a program such as this. Certainly no one on the TSG staff had ever been involved with one. W&A brought with them the knowledge on how to run the program and the skills to make it successful, but they too had not been involved with a project of this magnitude. We all learned a great deal as we went and the following summarizes some of the more important lessons.

A. When property is being procured for demolition three issues need to be planned carefully:

    1. The purchase agreement needs to be very clear as to what is left behind when the tenant and/or the previous owner vacates the property. When there is not clear agreement, the previous owner can strip the site of valuable salvage material, thus reducing the value to the project.

    2. The time period between the tenant/owner vacating the facility and the time it is legally turned over to a Construction Manager such as TSG is critical and needs to be carefully planned. If the building is left unattended, it will be broken into by individuals and the most valuable salvage materials stolen. It is estimated that this project lost salvageable copper wire, pipe and other fixtures valued at $60,000 to $80,000, because the buildings were left unoccupied too long. On this project, it was more of a legal issue than improper planning.

    3. When possible, implement extensive planning and control of facility to be demolished.

        a. Obtain a plan of the existing facility and inventory potential salvageable or reusable materials. Find a market far the materials in advance of taking possession of the facility.

b. Carefully plan, control and coordinate the removal of hazardous waste material with the removal of salvage material and the demolition.

B. Plan the purpose and use for the recycled product early in the project. Have the project's design engineers write a specification for the material. When the first product is produced, have it tested by the testing lab to insure it meets the specifications. By doing this, you will insure you are producing a useful product that can be utilized on the project.

C. Write tight, explicit specifications for demolition and construction subcontractors regarding recycling. As long as they understand initially what they will be required to do, they can accommodate recycling into their activities quite easily.

D. Source separation is the key to high value for recyclable materials. Work with subcontractors to help them understand the recycling program thoroughly. Also, gather information from them on their unique waste handling situation in order to design a program that will work conveniently and effectively for their particular situation.

E. Do not try to recycle everything. We found that some concrete such as beams, etc., with a larger amount of reinforcing steel was not worth trying to crush.

VII. Summary and Conclusions

Every program or project must be judged by the success it achieves, and the people who benefit from its success. The TSG and W&A program to recycle demolition material on the Tennessee NFL Stadium project has been a success in every way. The Mayor's office wanted to "do the right thing" for the environment and for the people of Metro Nashville. The "right thing" was done and it was recognized in the news media both locally and nationally. The added benefit to the Mayor's office and the citizens was that it also saved the taxpayers money.

TSG and W&A found that by working together they could overcome all obstacles in making a program work in Nashville. Some of the challenges included:

1. Construction is often a slow-to-change conservative industry, and not often open to new and untried ideas.

2. The planning and logistics, as well as techniques utilized on the project, were often new because this is not yet done very often.

3. Nashville is not an easy location to make this program work due to the abundance and low cost of the material our product is replacing, crushed stone.

4. The phased demolition of the site, which created extra cost in on-site hauling and storage of recycled product.

This successful program did its part by conserving natural resources, reducing the amount of trash going to landfills and protecting the environment. It benefited the local neighborhoods and the road infrastructure by reducing truck traffic leaving the project. The business equation, however, requires that a program be financially sound also and this program saved the project and in turn the citizens of Metro Nashville money. For the future, the program trained a whole group of management staff from TSG and W&A on how to make a recycling program successful and the importance in doing so. Hopefully, this document, a product of our program, will help others see the need, see the opportunity, see the potential and see the importance of a construction recycling program. If so, it will make this program even more successful.

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