

Reuse of Secondary Building Materials in Road Constructions

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Summary

Slags, asphalt and coal-ash, have long been used as secondary building materials. They are released when roads are reconstructed. Their reuse is presently prescribed in the Provincial Rules 'Working with Secondary Building Materials'. Mid-1998, a new national decree will become effective: the 'Building Materials Decree'. It lays down the guidelines for design, realisation and maintenance of constructions, aiming at avoiding contamination of the soil by secondary building materials.

The implementation of this policy requires road constructors to adopt a new approach. They have to do environmental research, and pay attention to design, isolation measures, maintenance and possible monitoring measures. In practice this means that adhering to a schedule concerning environmental research is essential. The civil engineer needs to implement environmental aspects into his basic planning, design and realization process.

The Environmental Engineering Division of Public Works Rotterdam has developed a working model which incorporates the Building Materials Decree into the current engineering planning process. This working model is an instrument used by the Port of Rotterdam.

1. INTRODUCTION

The city of Rotterdam produces large quantities of waste. Limited space, not only in Rotterdam but also in the rest of the Netherlands, prohibits waste material landfilling. So when secondary building materials, such as slags, asphalt, coal-ash and fly-ash, are released, they are usually reused. The municipality of Rotterdam also stimulates the reuse of building materials, because it saves on new raw materials and on the increasing tariffs for landfilling. Project leaders ought to keep in mind this economic benefit.

Technical road reconstructions will confront engineers and workers with secondary building materials from the past, both in foundations and asphalt layers. Handling of these materials is outlined in rules and regulations, such as the 'Building Materials Decree' and the memorandum 'Working with Secondary Building Materials'.

In this paper special attention will be paid to secondary building materials because nearly 10 % of road foundations in the city and port of Rotterdam contain secondary building materials, a quantity large enough to deserve special attention.

2. PROBLEM ANALYSIS

How to put into practice the policy of reusing secondary building materials when reconstructing roads? When we studied the rules and regulations in view of the practice, we found a few bottlenecks.

The most obvious one is that the quality of the secondary building materials released during road reconstructions is unknown. Furthermore, the necessary contamination- and leaching tests take a lot of time and cause stagnations, and in some cases involve unexpectedly high costs of extra measures.

Another problem is how to deal with small-scale projects, in which the reuse of secondary building materials is not financially interesting. To make sure that the reuse of secondary building materials is successful in the whole region, it is important to set up a good organization with a good infrastructure and knowledge of the market.

The Public Works Department in Rotterdam is aware of these problems. Therefore, in order to avoid the bottlenecks, its Environmental Engineering Division developed a working model called: Pragmatic application of secondary building materials in road constructions.

3. STARTING POINTS

As starting points for this working model two aspects have been studied.

In the first place the applicable rules and regulations and in the second place the current practice of road constructions in Rotterdam. The working model described in this paper integrates these two aspects.

4. RULES AND REGULATIONS

Five official decrees form the basis of the working model. The three most important are: (1) the Building Materials Decree, (2) the Project Decision Building Materials Decree, and (3) the memorandum Working with Secondary Building Materials. Less important are (4) the Waste Dumping Ban and (5) the Installation and Licenses Decree.

These rules and regulations in relation with the process of road reconstructions are summarized below:

ad(1) The Building Materials Decree sets limiting conditions for using primary and secondary building materials in civil projects in land- and waterbottom. It aims at establishing a national, general protection level for soil and at stimulating the reuse of secondary building materials. It applies to granular (unmoulded)

or stony materials, such as ashes, slags, soil and matured harbour sludge, used in the open air. Wood, steel, clean soil, and materials with parameter concentrations below the prescribed leaching level are excluded

The Building Materials Decree divides building materials into three categories on the basis of composition values for organic compounds and immission values for inorganic compounds in building materials.

Category 1 are building materials that do not exceed the composition and immission values. The chance of diffusion is very low. Therefore they can be used without special conditions, such as isolation.

Category 2 are building materials exceed the composition values, but exceed the immission values without isolation. These materials need to be isolated from percolation and groundwater to minimize the risk of diffusion of chemical pollution, and are also subject to specific management and maintenance rules.

The third is a special category, such as bottom ash from waste incineration and tarry asphalt granulate. Reusing those requires more isolation constructions.

ad(2) The Project Decision Building Materials Decree (effective as per 6 December 1995) is a practical elaboration of the former. It helps you to decide on the provisions and management rules for category 2 and the special category. It deals, for instance, with determining the distance between the average highest groundwater level and the secondary building material, and with the difference between moulded and unmoulded waste. It also contains guidelines for leaching tests and isolation constructions, and a checklist for inspection and maintenance. For example, the surface of the road could function as an isolation for rain percolation. It is necessary to keep this intact by means of inspections and maintenance works.

ad(3) The Building Materials Decree will become effective in phases. Its full implementation is expected in 1998. Until then an interim policy of the associated Dutch provinces: 'Working with Secondary Building Materials' is valid. Its most important requirements are: Determine the application category by contamination- and leaching tests. Take special isolation measures (e.g. liner) and environmental control measures, in planning and realization. Registration of the nature of the materials and the exact location is essential. When the location gets another function, it is obligatory to remove the secondary building materials. In general this interim policy is quite similar to the Building Materials Decree.

ad 4) The 'Waste Dumping Ban' of 27 June 1995 lists all the building materials that are not allowed to be dumped, for example fly-ashes, building debris, sieve sand, purification sludge, contaminated soil, household and industrial waste.

The memorandum of implementation further explains the features of the parameters.

- ad 5) The 'Installation and Licences Decree' became effective on 1 March 1993. It applies to installations using more than 50 M³ building materials from outside in or at the soil. These applications are subject to a license from the competent authority, unless the building materials are directly used in a civil project in an environmentally acceptable setting.

In review: What are the requirements and duties in relation to the different categories

REQUIREMENT/DUTY	1	2	CATEGORY Bottom ash from waste incineration	TAG
duty of reporting to authorities for soil > 50 m ³	*	*	-	-
duty of reporting to authorities other than for soil	-	*	*	*
making a plan of environmental maintenance	-	*	*	*
duty of taking back	*	*	*	*
duty of removal	*	*	*	*
possible exemption of duty of removal	*	-	-	-
Water pollution act	-	*	*	*
minimum amount				
1,000 tonnes (roads)	-	*	-	*
10,000 tonnes (large civil projects)	-	*	*	-
isolation measures	-	*	2x	*
supervision and maintenance	-	*	*	*
maximum amount in surface water	-	*	*	*

5. CURRENT PRACTICE OF ROAD CONSTRUCTIONS IN THE MUNICIPALITY OF ROTTERDAM

Apart from the limiting conditions, i.e. rules and regulations, the practical feasibility also influences our model. Therefore, it is important to have insight into the road constructing process. We used the process developed by the Management and Maintenance Department of the Harbour Authority of Rotterdam, the so-called Procedure of Programmed Maintenance d.d. 2. June 1992. It outlines the different stages of road reconstructions.

The programming phase is dedicated to planning. The main task is to realize a cost prognosis expressed in an estimation. The participants will form a project team. The next step is the phase of initiative. The most important part is to collect the

necessary information and to discuss with the other participants the ingredients for the program of requirements. Also the drawings of initiative will be made, and attention can be paid to the influence on the budget because of global knowledge of the quality of the soil and the released building materials.

In the design phase the definitive design of the project will be completed.

Subactivities are: plan development, definitive program of requirements agreed with the project team, sending the technical program of requirements to all departments and people involved, make and check the concept drawings, make credit estimation and financial proposal.

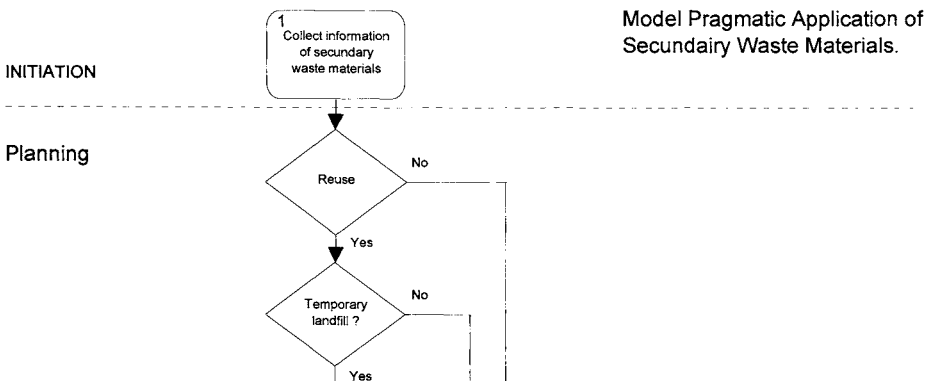
In the technical preparing phase the specification with plans will be made and submitted. The budget estimation will be prepared and the order will be placed out conform this specification.

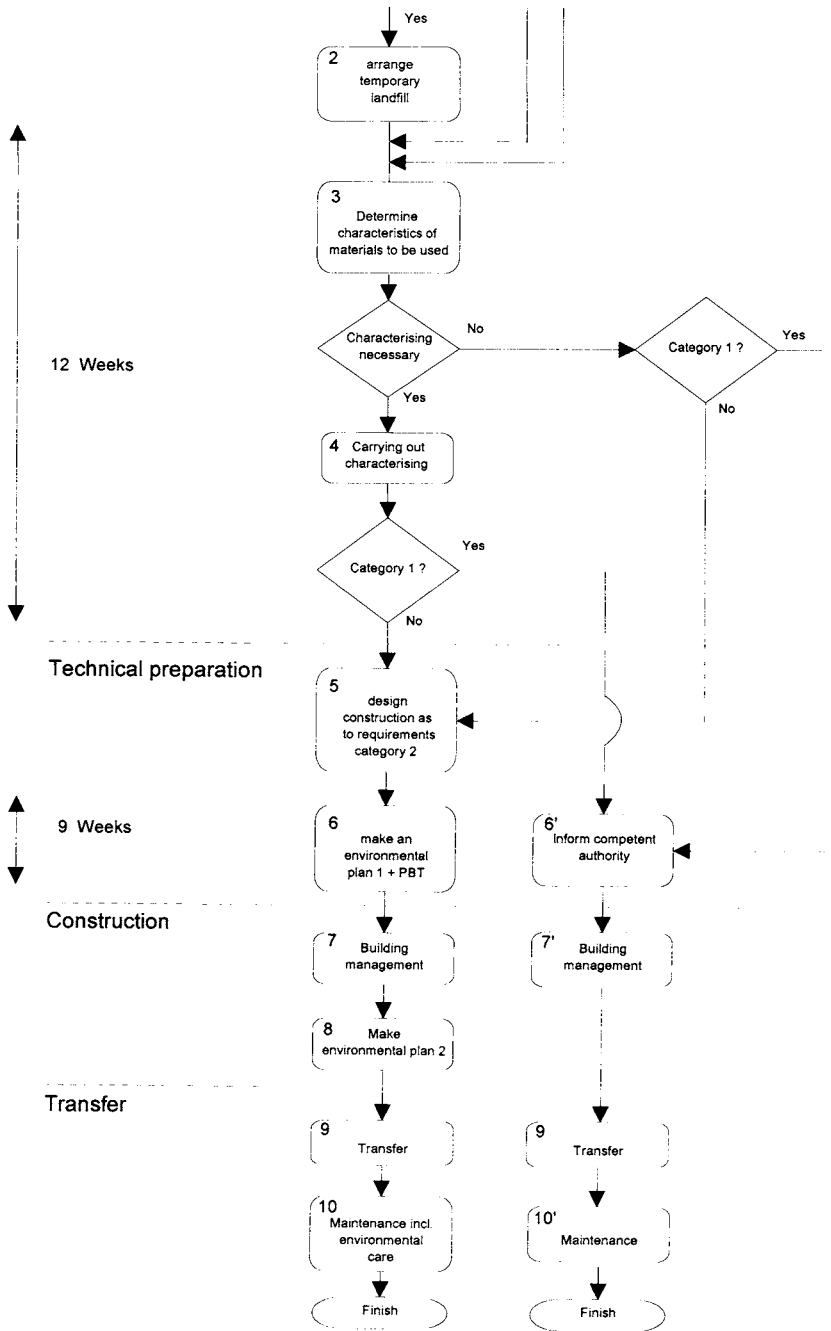
The realisation phase sees the supervision of the realisation process, and sometimes change the realisation order.

In the final phase, called transfer, the civil project will be transferred to maintenance management. Environmental maintenance can be placed under the same management, but in practice it will be done by rational road maintenance (for instance inspections of road damages). The most important activities are: inspection of the object, is everything constructed conform the plans, considering the costs by transfer, storing all information, such as drawings, into the archive or data base. These aspects determine the further amount of money, which will be involved in the maintenance of the project. A one-year intake period of transfer is advisable. An adequate transfer contract containing a liability clause for the constructor is essential.

6. IMPLEMENTATION OF RULES AND REGULATIONS IN PRACTICE: THE MODEL "PASM"

The activities within the framework of active building material management, conform the policy of reusing secondary building materials, are based on the usual working process of road reconstructions and have been condensed in a model called PASM: Pragmatical Application of Secondary building Materials. The model is a process schedule including the usual stages of programming, initiation, planning and design, technical preparation, execution, and transfer.





7. EXPLANATION OF THE SCHEDULE

The activities in the schedule are further explained below. They have been arranged according to the stages of regular road reconstruction. When it is proven that the building material belongs to category 1, the shortcut on the right-hand side is applicable

Initiation

The program of requirements of the present and the desired situation is drawn up in this stage. In view of the design of the new road construction, the following is important:

1. Collect general information about the quality of the soil at the construction site, about the level of pollution, and about the categories of the building materials to be released. It is essential to have insight into the categories. Expected extra work and extra costs should be reported to your principal and your partners.

Planning/design

In this phase a program of requirements will be made and the definitive design will be agreed on.

Will material from the old construction be used? If No, continue with step 3.

2. Determine whether released materials need to be dumped temporarily. Temporary landfill on location could be arranged with the authorities.
3. Determine the need to examine secondary building materials for establishing the right category. In most cases a leaching test is necessary (furnace slag, asphalt granulate, sieve sand etc). Building materials certified by the Ministry of Housing, Physical Planning and the Environment need not be examined. In the latter case, proceed to step 6a.
4. Define the application category of the final product. Generally, cement will be added to the released secondary building materials in order to obtain a good-quality final product. This final product should be subjected to leaching tests, and its composition must be assessed in order to determine the application category.
These tests take about 12 weeks. If the result is category 1, the only required procedure is notifying the authorities.

Technical Preparation

In this phase the construction drawings will be prepared in accordance with the functional program of requirements. The technical program of requirements will be detailed in view of the project's realization.

5. Design adaptations in conformity with the application requirements for category 2 secondary building materials. These materials must be isolated from rain- and groundwater.
6. Submit licence (PBT) one month before the start of the project. Draw up the environmental maintenance plan phase 1, describing tasks and responsibilities for supervision, inspection, and maintenance.
- 6a. Report to the competent authority. For category 1 two days before starting will do. Continue to step 9.

Realization stage

In this stage the project will be realized.

7. Building management is the main task. It is important to make correct drawings of the isolation constructions and the installation.
8. Add last corrections to the environmental maintenance plan. The subsequent final plan will describe the exact location of isolation measures and the maintenance tasks.

Transfer

In this stage the object will be transferred to the manager of the technical maintenance department. In view of long-term and current road maintenance, the following is essential:

9. Transferring of the object. Final inspection, and collecting the final construction drawings and other information such as the type, location, amount, and characteristics of the secondary building materials and the isolation measures. It is important to store this information in an adequate data base and keep it for at least five years. The technical maintenance manager is responsible according to the rules and regulations.
10. This step involves environmental maintenance, such as inspections, substitution, and repairs, for which the responsibility can be transferred from the owner to the technical maintenance manager.
- 10a This step is only applicable to category 1 secondary building materials. Normal maintenance of the surface of the road is sufficient.

8. CONCLUSION

To avoid infraction of rules and regulation, as well as stagnation and high unexpected costs it is important to plan environmental research of the secondary building materials and the soil at the location at an early stage. The civil engineer needs to implement environmental aspects into his basic planning, design and realization process.

The Environmental Engineering Division of Public Works Rotterdam has developed a working model which incorporates the Building Materials Decree into the current engineering planning process. This working model is an instrument used by the Port of Rotterdam.

9. DISCUSSION

Environmental research, and particularly leaching tests, takes usually a lot of time and can be the critical path of the project. In many cases it may cause much stagnation and high unexpected costs. Another bottleneck for managers developing road constructions, is uncertain estimates if information about the building materials is lacking. As we have seen, the quality of the secondary building materials will determine the final costs of the extra measures. A third bottleneck is the situation when less than 1000 tonnes of secondary building materials becomes available. The costs of environmental research and special isolation measures are then out of balance with the total costs of the whole road construction project. Further, stagnation of small-scale road constructions in a city centre, with its many underground mains and busy traffic, should be avoided.

In the Public Works Department of Rotterdam we try to tackle these bottlenecks by using the described working model in the first place. Aiming at more accurate cost estimations we are undertaking a network research of secondary building materials by checking old archives and doing field research. For various reasons it is important to collect all this information in a data base. The main one is that the information can be used as a tool for the market: When is what and where becoming available? At the centre of collected information a special organization could function as a 'broker' in secondary building materials, and in fact is already operating in Rotterdam. Having gained much knowledge and experience about the characteristics of secondary building materials, it should be possible to come to agreements with the authorities over the necessity to speed up the procedures for small-scale applications of secondary building materials.

10. REFERENCES

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