RECYCLING OF CONSTRUCTION & DEMOLITION WASTE IN MALTA

STRATEGY FOR SHORT-TERM IMPLEMENTATION

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Twinning Project MT05-HB-EN-01
Assistance to explore long-term projects to manage
Specific waste streams in a more sustainable manner

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SUMMARY

The main steps to introduce recycling in the construction industry would be

1. Full implementation and enforcement of EU Legislation
   - Inert landfills
   - Waste acceptance (incl. chemical analysis where necessary)
   - Waste documentation
   - Construction products

2. New National Legislation for:
   - Separation of C & D waste (incl. collection centres for large construction sites)
   - Disposal levy
   - Levy on resources ("landscaping levy")
   - Documentation of waste streams
   And
   - Enforcement of Permit Conditions for Quarries (refilling, restauration)

3. Standards and Guidelines for
   - Recycled materials from civil works
   - Recycled building materials
   - Deconstruction works

4. Develop basic economic conditions for a market of recycled products:
   - No illegal dumping
   - Product standards/requirements
   - Establishing a market under ecological conditions

5. Allocation of storage areas for
   - Mineral C & D waste
   - Recycling products

6. Introduction of Separation & Collection, that means:
   - Separation at the site (demolition, new construction)
   - Collection Centres (large construction sites)

7. Installation of a sorting plant (hand sorting)

8. Installation of a Mobile Plant or a Stationary Plant for Recycling of mineral C & D waste

9. Initiatives on Re-Use & Recovery; this could be:
   - Re-use of recycled Concrete for Aggregates (batching, blocks, pre-casting) or road construction
   - Re-use of recycled Asphalt for fresh asphalt and/or road construction
   - Softstone recovery on industrial level for reconstituted stone ("Eco block")
• Re-use of building elements (e.g. shaping of used blocks for new purposes), incl. installation of a computer based exchange market
• Refurbishment of non-used buildings

10. Development of Disposal strategies and allocation of the necessary facilities:
• Quarries for clean excavation material and quarrying residuals
• Inert waste landfill (if the material is really “inert”)
• Non hazardous waste landfill for mineral waste
• Non hazardous waste landfill for residuals
• Hazardous waste landfill
• Land reclamation at sea (for clean excavation material), if technically, economically and environmentally feasible

11. Initiatives on Public Procurement with focus on:
• Public tenders (Provision of alternatives for recycled materials)
• Preference for recycled materials in certain public construction activities (sidewalks, landscaping etc.)
• Elaboration of standardized documents for public procurement, where recycled products are included

12. Information and Public Awareness Raising:
• Teaching waste management & recycling technologies (schools, University)
• Promoting the use of recycled products in general and specified technical media
• Organize instruction courses on the use of standards and guidelines (e.g. modular training on deconstruction, proper use of recycled materials, waste acceptance at landfills etc.)

13. Improvement of the Data Management with regards to:
• Quarrying activities
• Construction activities
• Building materials
• C & D waste production
• Prices

14. Encourage and support research activities (Pilot Projects, Task Forces) for
• Reconstituted stone (“Eco Block”)
• Organised stripping of a building and separate collection
• Collection centre for a large construction site (this could done within the “Smart City” project)
• Processing of C&D waste in a test recycling facility & Re-use of recycled material at a test site (roads, buildings)
• Elaborating Standards/Guidelines & modular training system
• Possibly testing of the “diamond-wire-cutting-technique” for soft stone excavations
1 Introduction

“[…] It is widely accepted that economy and technological developments are the triggers for environmental problems. On the other hand, it is also clear that only economy and technology will be able to contribute decisive solution to these problems. The great challenge is to initiate innovations that integrate and improve all available technologies. Complex problems require holistic concepts. The aim is to make provisions for the future and not to live on the expense of future generations.

In this sense there has to be a change in objectives and mentality, because
- economy cannot develop prosperously in the long run with a damaged environment,
- environmental problems can only be solved in the framework of a well developing economy,
- social compatibility needs a healthy environment and a healthy economy.

Although modern – free market - economy has proved to be advantageous, there are certain weak points with regards to environmental issues:
- short term decisions for economic profit instead of long term sustainable decisions,
- efficiency is mainly based upon output-efficiency and not upon resource efficiency,
- “prices” as a parameter for demand and supply often fails to quantify intangible assets (natural resources, environment etc.)

The European Union’s objective to include sustainable development in all policy fields also signalizes the importance for integration of economy, technology, environment and social issues for future policies on a national and local level. […]”

(The text written above is taken from a position paper of the Austrian Business Council for Sustainable Development).

So this report will contain recommendations for short term implementation, which will promote a sustainable development of C&D waste management in Malta, but will also consider the economic framework and business opportunities on the Maltese Islands.

2 Legal background on European level

2.1 Environmental legislation

Within the Strategy for a sustainable development of Europe the European Union has set clear targets to reduce the amount of produced waste and the increasing demand for final disposal. A basic idea of this strategy is the prevention of waste within all
production activities and, if waste has been produced, a treatment with no or a minimum of impacts on human health and on the environment.

Therefore a set of regulations are issued on European level to implement the strategy.

2.1.1 Thematic Strategy on the prevention and recycling of waste (COM-2005-666)


Waste volumes continue to grow. Legislation is, in some cases, poorly implemented and there are significant differences between national approaches. The potential for waste prevention and recycling is not yet fully tapped. The emerging knowledge about the environmental impact of resource use is not yet fully reflected in waste policy.

The basic objectives of current EU waste policy - to prevent waste and promote re-use, recycling and recovery so as to reduce the negative environmental impact - are still valid and will be supported by this impact-based approach. The long-term goal is for the EU to become a recycling society that seeks to avoid waste and uses waste as a resource. With high environmental reference standards in place the internal market will facilitate recycling and recovery activities.

If organisation and promotion of recycling for all waste streams is left to the market it will not be possible to reap the full environmental benefits that recycling can deliver. While the present priority is to ensure complete implementation of the EU Recycling Directives, what is needed for the future is a complementary approach that is both more flexible and broader in its coverage. The review of this strategy will assess the need for further measures to promote recycling. In particular, it will consider moving towards a more material-based approach, possibly using producer responsibility.

2.1.2 Waste Framework Directive (2006/12/EC)


Based on Article 3 Member States shall take appropriate measures to encourage the recovery of waste by means of recycling, re-use or reclamation or any other process with a view to extracting secondary raw materials.

Article 4 asks the Member States to take the necessary measures to ensure that waste is recovered or disposed of without endangering human health and without
using processes or methods which could harm the environment, and in particular without risk to water, air, soil and plants and animals and without adversely affecting the countryside or places of special interest. Member States shall also take the necessary measures to prohibit the abandonment, dumping or uncontrolled disposal of waste.

Article 5 asks the Member States to take appropriate measures to establish an integrated and adequate network of disposal installations, taking account of the best available technology not involving excessive costs. The network must enable the Member States to move towards that aim individually, taking into account geographical circumstances or the need for specialized installations for certain types of waste. The network must also enable waste to be disposed of in one of the nearest appropriate installations, by means of the most appropriate methods and technologies in order to ensure a high level of protection for the environment and public health.

Article 7: In order to attain the objectives referred to in Article 3, 4 and 5, the competent authority or authorities shall be required to draw up as soon as possible one or more waste management plans. Such plans shall relate in particular to: the type, quantity and origin of waste to be recovered or disposed of, general technical requirements and any special arrangements for particular wastes, suitable disposal sites or installations. Member States may take the measures necessary to prevent movements of waste which are not in accordance with their waste management plans. They shall inform the Commission and the Member States of any such measures.

2.1.3 European Waste Catalogue - EWC 2002 (2000/532/EC)

The European Waste Catalogue - EWC 2002 (2000/532/EC, as amended by 2001/118/EC, 2001/119/EC and 2001/573/EC) and its Appendix A provide a list of all types of wastes. The EWC 2002 details a series of steps for identifying wastes in the catalogue and determining whether a waste is covered by a hazardous waste entry. Wastes in the catalogue are listed according to individual six-digit codes. The full description of a waste includes the two-digit and four-digit chapter headings, which identify generic sources and types of waste. Set out below are the steps to be followed when using the catalogue.

01 Wastes resulting from exploration, mining, quarrying and physical and chemical treatment of minerals
01 01 Wastes from mineral excavation
01 01 02 Wastes from mineral non-metalliferous excavation
17 Construction and demolition waste (including excavated soil from contaminated sites)
17 01 Concrete, bricks, tiles and ceramics
17 01 01 Concrete
17 01 02 bricks
17 01 03 tiles and ceramics
17 01 06 mixtures of, or separate fractions of concrete, bricks, tiles and ceramics containing dangerous substances
17 01 07 mixtures of concrete, bricks, tiles and ceramics other than those mentioned in 17 01 06
17 05 soil (including excavated soil from contaminated sites), stones and dredging spoil
17 05 03 soil and stones containing dangerous substances
17 05 04 soil and stones other than those mentioned in 17 05 03
17 05 05 dredging spoil containing dangerous substances
17 05 06 dredging spoil other than those mentioned in 17 05 05
17 05 07 track ballast containing dangerous substances
17 05 08 track ballast other than those mentioned in 17 05 07
17 06 insulation materials and asbestos-containing construction materials
17 06 01 insulation materials containing asbestos
17 06 03 other insulation materials consisting of or containing dangerous substances
17 06 04 insulation materials other than those mentioned in 17 06 01 and 17 06 03
17 06 05 construction materials containing asbestos
17 08 gypsum-based construction material
17 08 01 gypsum-based construction materials contaminated with dangerous substances
17 08 02 gypsum-based construction materials other than those mentioned in 17 08 01
17 09 other construction and demolition wastes
17 09 01 construction and demolition wastes containing mercury
17 09 02 construction and demolition wastes containing PCB (for example PCB-containing sealants, PCB-containing resin-based floorings, PCB-containing sealed glazing units, PCB-containing capacitors)
17 09 03 other construction and demolition wastes (including mixed wastes) containing dangerous substances
17 09 04 mixed construction and demolition wastes other than those mentioned in 17 09 01, 17 09 02 and 17 09 03

2.1.4 Landfill Directive (1999/31/EC)

Article 2 gives definitions for the purposes of this Directive. "Inert waste" means waste that does not undergo any significant physical, chemical or biological transformations. Inert waste will not dissolve, burn or otherwise physically or chemically react, biodegrade or adversely affect other matter with which it comes into contact in a way likely to give rise to environmental pollution or harm human health. The total leachability and pollutant content of the waste and the ecotoxicity of the leachate must be insignificant, and in particular not endanger the quality of surface water and/or groundwater;

Article 3 ("Scope"), section 2 of the landfill directive excludes the use of inert waste (which is suitable)

(1) in redevelopment/restoration and filling-in work or
(2) for construction purposes in landfills

from the scope of this Directive.

Article 3 ("Scope"), section 2 of the landfill directive also excludes

(1) the deposit of unpolluted soil,
(2) the deposit of non-hazardous inert waste from prospecting, treatment and storage of mineral resources,
(3) the deposit of non-hazardous inert waste from the operation of quarries

from the scope of this directive.

Article 3 ("Scope"), section 3 of the landfill directive clarifies that Member States may declare at their own option that the deposit of defined non-hazardous waste (e.g. wastes from the operation of quarries), other than inert waste, can be exempted from the following provisions (Annex I, sections 2, 3.1 and 3.3 of this directive):

(3) the water control and leachate management
(4) the requirement for a geological barrier and a bottom liner and
(5) the requirement for a leachate collection and sealing system

Nevertheless these wastes as well as inert wastes have to be deposited in a manner that prevents environmental pollution or harm to human health. Therefore, in accordance with section 3.4 of Annex I of this directive, the competent authority has to establish on the basis of an environmental risks assessment taking into account, in particular, Directive 80/68/EEC (Groundwater Directive) that the landfill poses no potential hazard to soil, groundwater or surface water.

2.1.5 Council Decision establishing criteria and procedures for the acceptance of waste at landfills (2003/33/EC)

The Council Decision 2003/33/EC of 19th December 2002 establishes criteria and procedures for the acceptance of waste at landfills distinguishing between what is
acceptable at inert waste landfills, non-hazardous waste landfills and hazardous waste landfill pursuant to Article 16 and Annex II of the Landfill Directive (1999/31/EC).

The Council Decision 2003/33/EC describes in the Annex, section 2.1.1, a list of wastes acceptable at landfills for inert waste without testing.

The list is subject to various restrictions and includes only

1. Glass (incl. glass-based fibrous materials),
2. Concrete,
3. Bricks,
4. Tiles and ceramics,
5. Soil (excl. topsoil) and stones.

These waste types are assumed to fulfil the limit values according to section 2.1.2 of the Annex of the Council Decision 2003/33/EC.

The waste must be a single stream (only one source) of a single waste type. Different wastes contained in the list may be accepted together, provided they are from the same source.

Any other waste, not appearing on this list, must be subject to testing to determine if it fulfils the criteria as set out in section 2.1.2.

Section 2.1.2 of the Annex formulates limit values for waste acceptable at landfills for inert waste, sub-divided into

1. leaching limit values and
2. limit values for total content of organic parameters.

Non-hazardous gypsum waste should be disposed of only in landfills for non-hazardous waste, in cells where no biodegradable waste is accepted (Annex, section 2.2).

Asbestos waste is considered as hazardous waste, but may be landfilled at landfills for non-hazardous waste without testing as long as certain requirements are fulfilled (Annex, section 2.3.3).

The Council Decision 2003/33/EC also gives an overview of landfilling options provided by the Landfill Directive (Appendix B). With regards to the landfilling of C&D waste this could mean the following landfill types:
### Compliant disposal of C&D waste (incl. waste from excavations and quarrying)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>ID (2003/33/EC)</td>
<td></td>
<td>Landfill for inorganic non-hazardous waste Landfill for organic/mixed non-hazardous waste Landfill for Hazardous waste</td>
</tr>
<tr>
<td>Accepted C&amp;D wastes</td>
<td>Use of suitable inert waste for redevelopment/restoration and filling-in work in landfills On-site deposit of unpolluted soil On-site deposit of non-hazardous inert waste from prospecting, treatment and storage of mineral resources On-site deposit of non-hazardous inert waste from the operation of quarries</td>
<td>To fulfil limit values of 2003/33/EC, Annex, 2.1.2 (leaching, organic components) Criteria for inorganic components may be set by Member State Without testing (Annex, 2.1.1): Glass, bricks, concrete, tiles/ceramics, soil/stones To fulfil limit values of 2003/33/EC, Annex, 2.2.2 (leaching) To fulfil limit values of 2003/33/EC, Annex, 2.3.2 (TOC, pH, ANC) Criteria for leaching and total content to be set by Member State Without testing (2.2.1): Pre-treated municipal waste To fulfil limit values of Decision 2003/33/EC, Annex, 2.4 (leaching, LOI, TOC, ANC) Additional criteria on content of contaminants may be set by Member State</td>
</tr>
<tr>
<td>Geological/Artificial Barrier</td>
<td>Not applicable</td>
<td>K=&lt;10⁻⁹m/s, t&gt;=1m Reduction of Requirements after risk assessment possible Reduction of Requirements after risk assessment possible K=&lt;10⁻⁹m/s, t&gt;=1m Reduction of Requirements after risk assessment possible K=&lt;10⁻⁹m/s, t&gt;=5m Reduction of Requirements after risk assessment possible</td>
</tr>
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</table>
### (Sub-)Category

<table>
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<tr>
<th>ID (2003/33/EC)</th>
<th>Exempted from Landfill Directive</th>
<th></th>
<th>Landfill for inorganic non-hazardous waste</th>
<th>Landfill for organic/mixed non-hazardous waste</th>
<th>Landfill for Hazardous waste</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
<td>B1(b)</td>
<td>B2 / B3</td>
<td>C / D_haz</td>
<td></td>
</tr>
<tr>
<td>Surface Sealing</td>
<td>Not applicable</td>
<td>No</td>
<td>Depends on consideration of potential hazards by the competent authority</td>
<td>Depends on consideration of potential hazards by the competent authority</td>
<td>Depends on consideration of potential hazards by the competent authority</td>
</tr>
<tr>
<td>Water control system</td>
<td>Not applicable</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Bottom sealing and leachate collection</td>
<td>Not applicable</td>
<td>Set of requirements by national legislation</td>
<td>Principally yes</td>
<td>Yes (Reduced requirements after risk assessment possible)</td>
<td>Yes (Reduced requirements after risk assessment possible)</td>
</tr>
<tr>
<td>Leachate treatment</td>
<td>Not applicable</td>
<td>No</td>
<td>Principally yes</td>
<td>Yes (Reduced requirements after risk assessment possible)</td>
<td>Yes (Reduced requirements after risk assessment possible)</td>
</tr>
<tr>
<td>Gas collection and treatment</td>
<td>Not applicable</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Depends on biodegradability</td>
</tr>
<tr>
<td>Waste acceptance - Basic characterisation</td>
<td>Not applicable</td>
<td>No testing for Glass, bricks, concrete, tiles/ceramics, soil/stones (2003/33/EC, Annex, 2.1.1)</td>
<td>No testing for pre-treated non-hazardous municipal waste and similar waste (2003/33/EC, Annex, 2.2.1)</td>
<td>No testing for pre-treated non-hazardous municipal waste and similar waste (2003/33/EC, Annex, 2.2.1)</td>
<td>No testing for asbestos waste (special compartment) (2003/33/EC, Annex, 2.3.3)</td>
</tr>
<tr>
<td>(Sub-)Category</td>
<td>Exempted from Landfill Directive</td>
<td>Inert Waste Landfill</td>
<td>Landfill for inorganic non-hazardous waste</td>
<td>Landfill for organic/mixed non-hazardous waste</td>
<td>Landfill for Hazardous waste</td>
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<td>-----------------------------</td>
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<tr>
<td>ID (2003/33/EC)</td>
<td>A</td>
<td>B1(b)</td>
<td>B2 / B3</td>
<td>C / D_haz</td>
<td></td>
</tr>
</tbody>
</table>
| Waste acceptance - Compliance testing | Not applicable | • No testing for Glass, bricks, concrete, tiles/ceramics, soil/stones (2003/33/EC, Annex, 2.1.1)  
• Compliance check with other basic characteristic information required | • No testing for pre-treated non-hazardous municipal waste and similar waste (2003/33/EC, Annex, 2.2.1)  
• No testing for asbestos waste (special compartment) (2003/33/EC, Annex, 2.3.3)  
• Compliance check with other basic characteristic information required | • No testing for pre-treated non-hazardous municipal waste and similar waste (2003/33/EC, Annex, 2.2.1)  
• No testing for asbestos waste (special compartment) (2003/33/EC, Annex, 2.3.3)  
• Compliance check with other basic characteristic information required | No exemption |
| Waste acceptance - On-site verification | Not applicable | • Visual inspection (verification with basic characterisation and compliance testing)  
• Sampling + sample storage | • Visual inspection (verification with basic characterisation and compliance testing)  
• Sampling + sample storage | • Visual inspection (verification with basic characterisation and compliance testing)  
• Sampling + sample storage | • Visual inspection (verification with basic characterisation and compliance testing)  
• Sampling + sample storage |
2.1.6 EIA Directive (85/337/EEC, amended by 2003/35/EC)

The Directive on the assessment of the effects of certain public and private projects on the environment (EIA Directive) shall apply to the assessment of the environmental effects of those public and private projects which are likely to have significant effects to the environment.

Article 4 in connection with Annex I of the EIA Directive determines projects which shall be made subject to an Environmental Impact Assessment in any case.

This includes among others

- landfills for hazardous waste (Annex I, point 9)
- quarries with a surface exceeding 25 hectares

Article 4 in connection with Annex II of the EIA Directive lists projects for which the Member States shall determine through

- a case-by-case extermination or
- thresholds or criteria set by the member state

whether or not the project shall be made subject to an Environmental Impact Assessment.

This includes among others

- reclamation of land from the sea (Annex II, paragraph 1g)
- installations for the disposal of waste, not included in Annex I (Annex II, paragraph 11b)

2.1.7 IPPC Directive (96/61/EC, amended by 2006/166/EC)

The IPPC Directive introduces a new integrated permitting regime for major industrial and waste sites covering air, water and land pollution. It targets industrial sectors considered to have a high potential to cause pollution and aims to provide a high level of protection for the environment as a whole and extends traditional approaches to environmental protection by including energy use, waste minimization, vibration and noise.

Sectors of industry regulated by IPPC include energy, metal production and processing, minerals, chemicals production and waste management.

The Directive applies – among others - to the following waste facilities:

- landfills receiving more than 10 tonnes per day of waste with a total capacity exceeding 25,000 tonnes (excluding inert waste)

Although the Water Framework Directive is not directly linked to the treatment and disposal of C&D waste, it should be taken into account, especially with regards to the disposal of C&D waste and the procedure of groundwater risk assessment according Annex I, paragraph 3.4 of the Landfill Directive.

The purpose of the Water Framework Directive, as laid down in Article 2 of this Directive, is to establish a framework for the protection of inland surface waters, transitional waters, coastal waters and groundwater, which – among others – ensures the progressive reduction of pollution of groundwater and prevents its further pollution.

The environmental objectives, as laid down in Article 4 of this Directive, also refer to

- the implementation of measures necessary to prevent or limit the input of pollutants to groundwater and to prevent the deterioration of the status of all bodies of groundwater and
- the implementation of measures necessary to reverse any significant and sustained upward trend in the concentration of any pollutant resulting from the impact of human activity in order progressively to reduce pollution of groundwater

Article 17 of the Water Framework Directive obliges the European Parliament and the Council to adopt specific measures to prevent and control groundwater pollution. These measures, which have to be proposed by the Commission, include in paragraph 2

- criteria for assessing good groundwater chemical status, in accordance with Annex II 2.2 (=further characterization of groundwater) and Annex V 2.3.2 (=definition of good groundwater chemical status) and 2.4.5 (=Interpretation and presentation of groundwater chemical status) of this Directive;
- criteria for the identification of significant and sustained upward trends and for the definition of starting points for trend reversals to be used in accordance with Annex V 2.4.4 (=identification of trends in pollutants) of this Directive.

Article 17 also indicates that in the absence of criteria adopted under paragraph 2 at Community level, Member States shall establish appropriate criteria at the latest five years after the date of entry into force of this Directive (that means by end of 2005).

2.1.9 Groundwater Directive (80/68/EEC and 2006/118/EC)


To prove that wastes have been deposited in a manner that prevents environmental pollution, the Landfill Directive (1999/31/EC) proposes to assess the environmental risks taking into account, in particular, Directive 80/68/EEC (the Groundwater Directive).


The Groundwater Directive (80/68/EEC) emphasizes the need for effective protection of the groundwater of the Community.

Therefore Member States shall take the necessary steps to

a) prevent the introduction into groundwater of substances in list I of the Annex of this Directive and
b) limit the introduction into groundwater of substances in list II of the Annex of this Directive

List I contains

a) special organic substances (organohalogen compounds, organophosphorus compounds and organotin compounds),
b) substances which possess carcinogenic, mutagenic or teratogenic properties,
c) special heavy metals (mercury, cadmium) and its compounds,
d) mineral oils and hydrocarbons and
e) cyanides.

List II contains

(a) 20 metalloids and metals and their compounds (Zinc, Copper, Nickel, Chrome, Lead etc.)
(b) biocides and their derivates not appearing in list (1),
(c) substances that have a deleterious effect on the taste and/or odour of groundwater [...],
(d) toxic or persistent organic compounds of silicon [...],
(e) inorganic compounds of phosphorus and elemental phosphorus,
(f) fluorides,
(g) ammonia and nitrates.

According to Article 4 of this Directive (which prohibits all “direct” discharge of substances in list I into groundwater) any disposal of substances in list I which might lead to “indirect” discharge into groundwater shall be subject to investigations prior to prohibition or authorization under defined technical precautions.

According to Article 5 of this Directive

- all “direct” discharge of substances in list II and
- any disposal of substances in list II which might lead to “indirect” discharge into groundwater

shall be subject to investigations prior to authorization under defined technical precautions.

According Article 1 of this Directive means

- “Direct” discharge the introduction into groundwater without percolation through the ground or subsoil
- “Indirect” discharge the introduction into groundwater after percolation through the ground or subsoil

2.1.10 Regulation on shipments of waste (2006/1013/EC)
The new regulation on shipments of waste has entered into force on 12th July 2007 and replaced Council Regulation 93/293/EEC. It establishes procedures and control regimes for the shipment of waste, depending on
- the origin, destination and route of the shipment,
- the type of waste shipped and
- the type of treatment to be applied to the waste at its destination.

The definition of “waste” is based upon the definition in the Waste Framework Directive.

Excluded from the scope of the Directive is, amongst others, the shipment of waste resulting from prospecting, extraction, treatment and storage of mineral resources and the working of quarries.
2.2 Product related legislation

2.2.1 Construction Products Directive (89/106/EEC)

The Council Directive of 21 December 1988 on the approximation of laws, regulations and administrative provisions of the Member States relating to construction products (89/106/EEC) asks the Member States to take all necessary measures to ensure that construction products, which are intended for use in works, may be placed on the market only if they are fit for this intended use, that is to say they have such characteristics that the works in which they are to be incorporated, assembled, applied or installed, can, if properly designed and built, satisfy the essential requirements. A CE marking indicates that the marked products satisfy all the provisions of this Directive, including the conformity assessment. It is for the manufacturer or his authorized representative established within the Community to take responsibility for affixing the CE marking on the product itself, on a label attached to it, on its packaging, or on the accompanying commercial documents. Based on the Council Directive the products must be suitable for construction works and generally concern mechanical resistance and stability, safety in case of fire, hygiene, health and the environment. Especially the requirement for the environment may have some restrictive influence on the use of recycled materials, but does not mention the positive aspects of recycling.

3 Adaptation of EU regulations to the Maltese situation (with examples of Austrian Technical Standards)

In Chapter 2 the legal background on European level is summarized.

This European frame is the same for all member states – in concrete for Malta as for Austria.

Because of the similar situation between these two small countries in a large European Committee, the following chapter try to show a way to Malta (similar to Austria) to introduce a practicable, fast to implement system for reducing the amount of mineral C&D-waste.

3.1 Clear Definitions

“Waste” shall mean any substance or object in the categories set out in Landfill Directive, Annex I, which the holder discards or intends or is required to discard.

A national law should clearly define the different waste streams together with clear instructions what to do.
Although the **European Waste Catalogue (EWC 2002)** defines all types of waste in detail, it is never-the-less necessary to declare waste streams within the C&D-waste. Such categories could be:

- Excavation works (topsoil, softstone, hardstone, …)
- Road works (construction industry) (asphalt, concrete, stone blocks, gravel, ..)
- Waste from the building industry (mixed mineral waste, iron, wood, glass, textiles, gypsum, ceramics, plastics, …)

The main waste-streams of C&D-waste should be separated by each other:

- Mixed mineral waste (e.g. stone, concrete, gravel, limestone, bricks, ceramics)
- Softstone (mainly softstone)
- Hardstone (mainly hardstone)
- Concrete (mainly concrete, e.g. from bridges, walls, foundations)
- Asphalt (mainly asphalt, e.g. from toplayer of streets)
- Wood (mainly wood, e.g. wood constructions [roof])
- Metals (mainly steel and iron, also cables)
- Earth (mainly topsoil)
- Mixed C&D-waste (others than Nr. 1, mainly textiles, paper, furnishings, panelling, plastics, some undividable mineral wastes; but no asbestos or cement bound asbestos, tar or dangerous waste)
- Dangerous materials (e.g. oil, cement asbestos, tar, heavy metals)

The waste-stream 1 to 7 could be used in a treated manner, stream 8 could be used untreated and stream 9 has to be sorted. Because of economic demands it will be necessary to implement a limit, from which on the separation has to be done in one of the above waste-streams (e.g. from 5 tons onwards for waste-stream 2 or from 2 tons for the streams 4 to 6).

Waste-stream 10 has to be completely separated and special treated.

The law is a premise to get pure material streams in Malta – this is a necessary premise for the (high level) recycling of this materials.

In Austria a similar degree (Degree for separation on C&D-waste) exists since 1991. The obliged body is the client, because he is the one, who wants to build or demolish a building.

### 3.2 **Strict definitions of types of landfill**

Council Directive 1999/31/EC and 2003/33/EC controls the landfill of waste. This Directive was transposed into National law by the Waste Management (Landfill) Regulations of 2002. There have to be strict regulations for controlling waste-streams for landfilling, e.g. controlling at the entrance of a landfill, chemical analyses in front of depositing, documentation of place of disposal in the landfill.
It must be clear, that also a filling of quarrels with waste (e.g. limestone of buildings) is inert waste, which is not allowed to be landfilled outside of declared landfills!

This legislation leads to an economic output – the price for landfilling is rising, the recycling of material becomes more economic.

Illegal dumping must be sanctioned.

In Austria the national degree on landfill distinguish four types of landfills for inert or non hazardous wastes: One is only for top soil, one is mainly for (treated) mineral C&D-waste.

### 3.3 Documentation of C&D-waste streams

Special for C&D-waste the European Waste Catalogue (EWC 2002) should be adopted: Following chapter 3.1 a declaration system for the first nine non hazardous C&D-waste streams should be implemented.

In a chain each owner of C&D-waste, beginning with the client, then e.g. the demolition company, the transport company, the landfill and so on, have to declare the amount of the different waste streams.

In Austria the “Declaration form for C&D-waste” is implemented since 1991. This proof helps the authority to control the special stream of C&D-waste from one site. Because of the “proof-chain” from the source to the end (deposit) the control can be done if necessary.

### 3.4 Taxation

A law of taxation should be initiated. The aim of the law must be the support of recycling and the avoidance of depositing.

Therefore the taxation could be

- on waste for landfiling
- on natural resources, which are used for building materials

These taxations need not make buildings more expensive; the taxes could be used for supporting better ecological buildings or energy saving constructions.

Taxation on waste could be done in accordance to the type of waste stream:

- Easily recyclable waste streams should have more tax per ton (in Malta this could be a different amount for softstone- and hardstone-waste)
- Waste with a higher amount of chemical parameters should also have more tax per ton
- The amount should be increasing yearly, so that the economy has a chance to react
In Austria the “Law for restoring old contaminated sites” defines taxes between 8€ to 84€ per ton for landfilling. There is no tax, if these materials are recycled properly!

<table>
<thead>
<tr>
<th>Table 1: Austrian taxation on waste disposal (per ton) as example</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<tr>
<td>excavated earth</td>
</tr>
<tr>
<td>contaminated material</td>
</tr>
<tr>
<td>mineral materials</td>
</tr>
<tr>
<td>other materials</td>
</tr>
<tr>
<td>changeover-landfills</td>
</tr>
</tbody>
</table>

In some parts of Austria there exist another (local) law, which forces the producer of natural materials (gravel) to pay per ton an amount up to 0,50 €.

### 3.5 Laws on building construction

The demolishing of buildings should be regulated. The authority should know at which time a building will be demolished; the company, the expected amount and types of waste should be known, especially for bigger buildings. A plan for the recovery of waste-materials should be done per law before the work begins.

The direct use of (mineral) waste without treatment and testing should be forbidden (exceptions are possible). This is necessary to get a high-level product, which can be competitive with raw material. (Otherwise the secondary material always will have a bad remembering and no price will be paid for it).

The Construction Product Directive (CPD)(Directive 89/106/EEC) allows many products for the construction to be used only with certificate (without difference between “new” materials or recycled ones).

### 4 Data on the Maltese situation – primary and secondary material streams

As stated by Dr. Eckhard Willing in the “Documentation and recommendation for C&D Waste recycling and disposal in Malta” (October 2007), the available information on the quantities and quality of C & D waste is not comprehensive.
(1)
The quantity of waste coming from C & D activities is estimated to be between 1.4 Mio to/yr, and 2 Mio to/yr. Of this, 80% is considered as excavation waste and 20% as C&D waste.

(2)
Weigh bridge data on inert waste come from the disposal facilities which are operating as contractors for WasteServ Malta Ltd. These facilities received
- in 2003:  761.883 to
- in 2004:  2.177.861 to
- in 2005:  1.185.174 to
- in 2006:  865.713 to  (Excavation: 731.396 to  C&D waste: 134.317 to)
inert/mineral C&D waste and excavation waste. According to local information, the strong differences between the annual amounts have the following reasons:
- the strong increase between 2003 and 2004 results from the ban for inert waste to be landfilled at Maghtab and the opening of disused quarries for the disposal of inert waste,
- the decrease between 2004 and 2005 results from an increase of the disposal fee for inert waste at governmental facilities.

(3)

Table 2: Sectors generating C&D waste (by BICC)

<table>
<thead>
<tr>
<th></th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mining &amp; Quarrying</td>
<td>1.094,84</td>
<td>1.167,13</td>
<td>2.187,78</td>
<td>1.196,31</td>
</tr>
<tr>
<td>Construction</td>
<td>247,97</td>
<td>171,81</td>
<td>28,17</td>
<td>9,36</td>
</tr>
<tr>
<td>Total</td>
<td>1.342,81</td>
<td>1.338,94</td>
<td>2.215,95</td>
<td>1.205,67</td>
</tr>
</tbody>
</table>

According to this report, the decrease of construction waste since 2002 is not the result of a lack of production of waste from this sector but a result of a change in disposal patterns. "In fact, disused quarries are now being used for the disposal of construction related waste, and therefore all the waste from the industry that is disposed in these quarries is recorded under the mining and quarrying sector."

(4)
Data is also available from MEPA on C&D waste, which is dumped at sea. The estimated amount of excavated rock deposited at sea would be as follows:
- March 2003 - January 2006:  513.628 tonnes
- March 2006 - October 2006:  299.000 tonnes
November 2006 - March 2007: 35,567 tonnes

Another reliable data source is the MEPA “Updated report on disused quarries 2006” (May 2007), which estimates the void space for refilling in disused quarries and quarries under operation. Following this report there should be void quarry space (operating and disused quarries)

- Malta: 37,712,433 m³
- Gozo: 2,520,960 m³

But this report also states that not all of the void space can be used for infilling of C&D waste (possible use for other purposes).

The lifespan for infilling could be estimated assuming:

- future amounts of C&D/excavation waste,
- percentages of the void space to be really available for infilling
- future quarrying activities

Summarizing this available information on quantities and qualities of C & D waste makes it difficult to draw a comprehensive plan for the recycling and the disposal of C & D waste.

For this reason reliable data on

- issued development and demolition permits (categorized into different classes of developments with estimation of an average amount of excavation waste and C&D waste for each development class)
- calculation of excavation waste and C&D waste from large construction sites (from the developer)
- amount of locally produced and imported construction materials (including quarried stone)
- amount of collected C&D waste and excavation waste (from the waste collectors)
- amount of recycled and disposed excavation waste and C&D waste (from the weighbridge data of recycling facilities, quarries and landfills)
- composition of C&D waste (waste analysis)
- void space in quarries

should be collected and processed by the competent Maltese authorities on a regular basis. Updated reports should be published every year.

As a first step a review of annual issued development and demolition permits, with categorization into different classes of developments and allocation of estimated
amounts of excavation and C&D waste to each category could produce sufficient data to improve the planning process.

5 Demolition and Deconstruction of buildings with focus on material recycling

5.1 Recycling quality depends on the quality of demolition

The quality of recycling-products depends on the input-quality of a recycling plant.

Although the quality can be made better during the recycling-process, e.g. through sorting out of fine particles, the main influence for the quality is determined through high pureness of the input-material.

Therefore the demolition of a building, a street or another construction should be done carefully as a deconstruction.

5.2 Deconstruction

Deconstruction means that buildings and building parts are to be decomposed in such a manner that the resulting materials can be supplied to utilization and/or reuse (recycling) and/or normal disposal to a large extent. Deconstruction work is to be proceeded in such a way that mixing, polluting and/or damaging the material, which can be separated, is minimized. The materials are to be stored separately.
The deconstruction should take place generally in reverse order as the establishment of the building. Before the dismantling of building parts; installations, windows, doors, floor superstructures, insulating materials, roof structures, facade constructions etc. have to be removed. The tasks are distributed as follows:

5.2.1 Tasks of the client
- Assignment of the separation and/or contractual transferring of the obligation resulting from it to the contractor
- cyclic control of the contractor regarding correct execution
- description of object and a collection
- disposal and utilization concept with larger building projects
- inducement of the investigation of the abort object by an expert person to verify whether dangerous wastes could emerge
- checking the mass proof of the building wastes

5.2.2 Tasks of the contractor
- inspection of the object
- creation of the instruction for deconstruction
- compliance with the building authority submitted and/or with the client agreed disposal conception
- compliance with the separation obligation
- applicable extent utilization of the resulting materials
- compliance with the regulations of the service taker protection
- separate storage of dangerous wastes, information of the client that dangerous wastes have been produced; delivery of the wastes only at entitled disposer.
- deposit of not usable materials only for according to granted dumps
- administrate the building daily reports
- administrate the building remainder mass proofs

5.3 Regulations for Deconstruction

Because of the technical character of a regulation for deconstruction, it seems to be useful to set a technical standard instead of a legislative step.

In Austria the technical standard ON B 2251 “Demolition works” is contracted automatically between the client and the entrepreneur, if the client is part of the public sector. So there is a force to use this technical standard, especially with long-term or bigger sites.

The appendix of the ON B 2251 contains two forms:
- A standardized form for the description of the building. This helps the entrepreneur to calculate the deconstruction because of an exact knowledge of amount, type and location of construction material.
• A standardized form “instruction for deconstruction works”, which contains safety-directions for workers and how to do with contaminations

It is highly recommended to establish a technical regulation for deconstruction in Malta.

5.4 Deconstruction and contaminations

Most C&D-waste is not hazardous. Therefore a simple treatment is in most cases successful to get a high-quality product.

The European legislation forces all member states to separate the hazardous waste. It is not allowed, to combine non hazardous and hazardous waste.

Therefore, suspicious buildings have to be controlled before deconstruction. An expert must specify areas of suspicion. These areas have to be analysed; chemical tests can give a degree of certainty.

In case of evidence of hazardous waste a separate treatment must be done. In some cases it is enough to dismantle some square meters in a separate manner. In other cases (e.g. unbound asbestos) special equipment is needed to remove it.

In some cases contaminations have to be removed before a deconstruction can be started.
• Asbestos
• Cooling Systems
• Transformers

Examples for typical contaminated sites are:
• Fuel stations
• Companies/Places for car repairing
• Chemical industry
• Petrol industry
• Places for machinery
• Textile cleaning

The most common contaminations are:
• Oil (hydrocarbon)
• PAH (e.g. tar)
• PCB (e.g. between prefabricated parts like concrete)

The recommendation for Malta is:
• In case of suspicion an expert for the absence/presence of hazardous waste has to be appointed. Deconstruction of fuel stations, car repairing, chemical industry, textile cleaning, places of accident, military bases, should always be treated as cases of suspicion.
• Buildings for demolition with more than 25,000 m³ have to be observed in any case
• The authority has to get a copy of the expert’s report, so that a control of the hazardous waste streams could be made.

6 Financial and Economic basic conditions for the reuse of C&D wastes (including possible incentives and penalties)

6.1 Establishing a market under ecological conditions

A high recycling rate cannot be forced by legislation.

The legislation has to establish a legal framework, which allows to work under commercial circumstances.

Especially in combination with environment and ecology a market has to be established, which cannot be based on pure market conditions without any legislative help.

6.2 Basic conditions for a recycling market

There are numerous conditions for a recycling market in function, the most important for the construction industry are:

1. Concerning waste:
   • No illegal dumping
   • Dumping fees, which are cost-covering
   • Controlled dumping, according to EEC-directives

2. Concerning the product:
   • Products, which can be placed on the market with profit
   • Products – especially primary products – have to fulfil Building Product Directive (CE-mark).
   • A fair commercial system, which gives secondary products the same chance as primary products
   • Same technical demands for primary and secondary materials
   • It must come into mind of the population, that recycling-products are even or better as comparable primary products
   • Technical standards and call for tenders have to consider recycling products
   • For most types of C&D-waste a recycling-product-line has to be established.
   • A subvention (or taxation on the other hand) for the compensation of the (unpaid) use of the environment, e.g. for excavating natural material
6.3 **Economical basic conditions for the recycling of C&D-waste**

The chapter “economical basic conditions” deals mainly with political economic factors.

### 6.3.1 Fair commercial system

The basic for a market is a fair commercial system. This means, no preference of an entrepreneur or a product because of friendship, corruption, oligopoly or other market-distortion. This sentence is important for all products, not only for recycling-products; but for the latter one it is more important, because they have to conquer an existing market!

### 6.3.2 Demands on products

If requirements on products are not clearly defined or not existing, it is hardly possible to substitute it through a recycling-product. For example: If a client wants only sand from the destination X, because it is “better”, than it is not possible to substitute it with any other product, also not through a recycling-product.

The base for products is the CPD and the CE-mark. If the use of primary materials is controlled on these, it is much easier to substitute them with equal secondary products.

### 6.3.3 Same technical demands on primary as on secondary products

Because of technical knowledge of some primary materials, standardisation asks for demands, which are technically not necessary, but are laid down in standards, because natural materials have these possibilities.

For an open (recycling)-market, it is necessary, that only necessary parameters are tested and laid down in standards.

### 6.3.4 Image of recycling products

Only if the image of recycling products is similar or better than of primary material, the client (or the population) will accept these products. If there is a (mental) resistance even a comparable, maybe cheaper product can not be placed on the market.
The image of recycling products must be raised. Possible instruments are specific education at schools, teaching of recycling technologies in technical schools, common public relation work.

6.3.5 Efficient product lines

Waste cannot be sold and is hardly usable.

New product lines must be established, which allow a treatment of the “waste” and in Malta the softstone- problematic must be solved. Some possibilities can be found in chapter 6. Research work will never end, because the C&D-waste always changes in its composition.

6.3.6 Call for tenders have to consider recycling products

Call for tenders have to prefer recycling-products – especially in the public sector, which is influenced through the authorities. Details see chapter 8.

6.4 Financial basic conditions for the recycling of C&D-waste

In this chapter a summary of needed conditions with financial aspects is written down:

6.4.1 Recycling-price = dumping fee + amount for primary material

If you want to sell a product sustainably, the price of the product must be
- Comparable to similar products
- Cost-covering

A client has to calculate
- dumping fee for C&D-waste
- the price for new materials

Instead of these two cost-parameters, a recycling company can calculate a combined price (instead of dumping is recycling possible?).

If the real cost-parameters of the recycling-entrepreneur (costs for employees, ground, machinery, financial costs, repair and so on) is more than the addition of the two above cost-components, an additional subvention or taxation must be established (see chapter 6.4.2)
6.4.2 Taxation / subvention

In the European Union it is not allowed to handicap foreign companies, foreign products or prefer local ones. On the other hand it is possible to set market rules, which are equal for all market participants.

Such planning measurements are allowed in the European Union.

Details see chapter 3.4.

6.4.3 Dumping fees

The European Union sets a high technical performance for the disposal of waste (see chapter 1). If these demands will be fulfilled – including analysis of waste, control of incoming waste, technical barrier-system, – the price for landfilling is high. This helps recycling to become more economically viable.

Parallel to a defined, EU-compatible depositing-system, a better control of illegal dumping is necessary. Maybe high penalties for this crime have to be established.

7 Technical basic conditions for the reuse of C&D wastes

The reuse/recycling of C&D-waste is based on technical and environmental parameters.

Demolition waste which can be reused or recycled mainly results from
- the demolition of over ground buildings
- civil engineering
- engineering constructions as well as
- demolition of circulation areas such as roads, paths, parking areas, aerodromes and railway tracks.

The materials to be processed may consist of

unbound building materials, such as for example materials for the construction of dams, filling materials, excavation materials, bases, crushed stone, hydraulically bound building materials, for example road pavements, slabs, kerbs, pipes, bricks, beams, concrete and reinforced concrete.

Bituminous bound building materials, for example bases, covering layers.

The material to be processed may exist in crushed and cut form.
In this regard the aim to be pursued is to produce pure materials by selecting. On-site sorting of demolition waste helps to improve the quality of recycled building materials. The processed demolition waste has to be almost free of impurities. If there are any impurities they have to be sorted out so that the content of impurities in recycled building materials will be lower than 1 mass percent.

If there are any contaminations suspected, for example because of the origin of the material, the respective demolition waste has to be sorted out in every case from the recycling process if the required pureness cannot be proven.

Dangerous substances must not be contained!

### 7.1 Eurocodes for all EU-member states

In the last years the EU developed Eurocodes (EN) for many fields of applications.

For example:

- EN 932-1

- EN 1744-1
  Tests for chemical properties of aggregates - Part 1: Chemical analysis; Issue July 1998

- EN 12620
  Aggregates for concrete; Issue April 2005

- EN 12697 – Part 1
  Test methods for hot mix asphalt - Part 1: Content of soluble binding agents; Issue February 2006

- EN 12697 - Part 2
  Test methods for hot mix asphalt - Part 2: Determination of particle size distribution; Issue January 2003

- EN 13043
  Aggregates for bituminous mixtures and surface treatments for roads, airfields and other trafficked areas (consolidated version); Issue October 2004

- EN 13242
  Aggregates for unbound and hydraulically bound materials for use in civil engineering work and road construction (consolidated version); Issue October 2004

- EN 13286-2
Common to all these Eurocodes is a defined, high level for the materials. The level is the same for recycled as for new aggregates.

If a use of recycling material is intended, the quality of recycling-materials has to be high.

Guidelines can help; therefore the development of such guidelines is of high priority.

### 7.2 Aims

The aim of the recycling of building materials is to reach a quality standard which meets the requirements corresponding to the future use of recycled building materials.

The guidelines and the quality regulations should regulate the requirements as well as the kind and the extent of tests provided for recycled building materials. They serve the purpose to standardize these requirements and to set a uniform system of designations and technical classifications.

The guidelines regulate the requirements and properties of products made of demolition waste, which are intended for reuse or recycling. Setting quality standards also determines the kind and the extent of assessments which have to be carried out on recycled building materials.

The quality regulations control the use of recycled building materials as mineral aggregates for bulk and filling materials and for bound and unbound bases. If recycled materials are used as aggregates for the production of asphalt or concrete, supplementary examinations according to the respective regulations have to be performed.

### 7.3 Delivery, sorting and processing

**Delivery**

At the delivery the origin and possible contaminations of the demolition waste have to be evaluated and documented in the frame of a first inspection. A first evaluation and pre-sorting of the waste regarding its usability have to be made immediately at the delivery. In particular, it has to be ensured that only appropriate and authorized materials are taken over. Moreover, in the frame of the receiving inspection mixed asphalts containing coal-tar should be sorted out. In order to detect contaminations of coal-tar in a rapid way the “paint spraying method with fluorescence under UV-light” according to the FGSV-working paper Nr 27/2(2000) may be applied. The threshold
value of this method is approximately 50 mg PAH/kg. Tar containing road demolition waste and asbestos containing cement products have to be rejected.

**Sorting**
The delivered materials have to be pre-sorted in order to classify them according to their quality. Pre-sorted materials have to be stored separately. In case of doubt, the respective material possibly has to be classified in a lower quality class or sorted out.

**Processing**
For the processing of the materials, processing plants and plant parts appropriate for the intended use of the respective product have to be applied.

**Storage**
Recycled building materials have to be stored separately according to grades and quality classes. In this regard it has to be ensured that deteriorations in quality (e.g. contaminations, mixing, de-mixing) are avoided.

**Grades – engineering classification scheme**
For a necessary compression the recycling-product must be compatible with an engineering classification scheme

Recycled building materials made of unbound and hydraulically bound materials and those with a content of granular asphalt have to be tested regarding:

- Recovering, delivery
- Processing and storage
- Resistance against fragmentation
- Purity (impurities)
- Grain-size distribution
- Content of foreign materials
- Frost susceptibility
- Frost resistance

### 7.4 Environmental framework – Quality class

In order to protect the environment, and especially ground waters, recycled building materials have to be classified in quality classes.

Recycled materials produced in recycling plants are classified according to their composition in quality classes which are defined by means of a list of parameters and respective limit values (see table 1 beneath).

**Fields of application**

In order to regulate the environmentally compatible use of recycled building materials it is necessary to determine forms of application according to hydro-geological conditions.
Fundamentally, the use of recycled building materials of quality class A\textsuperscript{+} is permitted in water-source preservation areas and in areas with frame conditions regarding water management.

The use of recycled building materials of quality class A\textsuperscript{+}, A and B is subject to defined conditions. This means that the quality of recycled building materials corresponds directly with the possible use (Table 4).

An area is to be considered less delicate in respect of hydro-geological conditions if it shows the following criteria:
- existence and sufficient efficiency of layers with low permeability or
- sufficient distance from ground waters.

The application of recycled building materials
- in water-source protection areas and
- in areas with oscillation of ground waters
is not permitted.

Because of a lack of Eurocodes for the environmental part, national regulations are allowed. In Table 1 the Austrian system of parameters and their limits are shown.

**Table 3: Classification of recycled building materials according to environmental engineering aspects (Austria)**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Unit</th>
<th>Quality class A+</th>
<th>Quality class A</th>
<th>Quality class B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eluate</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>pH-value</td>
<td></td>
<td>7,5-12,5 \textsuperscript{2)}</td>
<td>7,5-12,5 \textsuperscript{2)}</td>
<td>7,5-12,5 \textsuperscript{2)}</td>
</tr>
<tr>
<td>Electric conductivity</td>
<td>mS/m</td>
<td>150\textsuperscript{1)} \textsuperscript{2)}</td>
<td>150\textsuperscript{1)} \textsuperscript{2)}</td>
<td>150\textsuperscript{1)} \textsuperscript{2)}</td>
</tr>
<tr>
<td>Chromium total</td>
<td>mg/kg TS</td>
<td>0,3</td>
<td>0,5</td>
<td>0,5</td>
</tr>
<tr>
<td>Copper</td>
<td>mg/kg TS</td>
<td>0,5</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Ammonium-N</td>
<td>mg/kg TS</td>
<td>1</td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>Nitrite-N</td>
<td>mg/kg TS</td>
<td>0,5</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Sulphate-SO\textsubscript{4}</td>
<td>mg/kg TS</td>
<td>1.500</td>
<td>2.500</td>
<td>6.000</td>
</tr>
<tr>
<td>KW index</td>
<td>mg/kg TS</td>
<td>1</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Total content</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\Sigma$ 16 PAH according to EPO EPA</td>
<td>mg/kg TS</td>
<td>4</td>
<td>12</td>
<td>20</td>
</tr>
</tbody>
</table>

\textsuperscript{1)} If the pH-value ranges between 11.0 and 12.5 the limit value of the electric conductivity is 200 mS/m
\textsuperscript{2)} If pH-value and/or electric conductivity exceeds limit values, rapid carbonizing according Austrian Standard ON S 2116-3 has to be carried out.
Table 4: Fields of application according to environmental engineering aspects (minimum requirements)

<table>
<thead>
<tr>
<th>Form of application</th>
<th>hydro-geologically less delicate area</th>
<th>Hydro-geologically delicate area</th>
</tr>
</thead>
<tbody>
<tr>
<td>In bound form or unbound with covering layer&lt;sup&gt;1&lt;/sup&gt;</td>
<td>Quality class B</td>
<td>Quality class A</td>
</tr>
<tr>
<td>unbound without covering layer&lt;sup&gt;1&lt;/sup&gt;</td>
<td>Quality class A</td>
<td>Quality class A&lt;sup&gt;+&lt;/sup&gt;</td>
</tr>
<tr>
<td>In bound form, used as aggregate</td>
<td>Quality class B</td>
<td>Quality class B</td>
</tr>
</tbody>
</table>

<sup>1</sup> Definition of the covering layer according to Austrian Road Construction Guideline RVS 01.02.11 - Fundamentals, definitions, structural engineering (September 1984)

### 7.5 Tests and monitoring

**First examination (proof of qualification)**

The first examination serves to find out whether the control conditions (e.g. possibility of internal control within the factory or by laboratories charged with control, technical conditions, mechanical plants) and the requirements for recycled building materials can be complied with. Material samples have to be taken for the examinations which have to be performed according to the regulations regarding external control.

**Internal control**

The recycling factory is obliged to perform the internal control and to assume the responsibility for a continuous control which guarantees the complying with the determined requirements.

**External control**

The external control serves the purpose to examine whether the recycled building materials meet the determined requirements.

### 7.6 Acquiring of quality marks for recycled building materials

A supervision of the quality of recycling-material can be done by the authority or by a private association. In Austria this control is done by the GSV (Güteschutzverband):

The “Gütezeichen für Recycling-Baustoffe” - “Quality mark for recycled building materials” of the “Österreichischer Güteschutzverband Recycling- Baustoffe (ÖGSV) - “Austrian Building Materials Quality Assurance Association” may be granted for recycled building materials which comply completely with all requirements of the „Guideline for Recycled Building Materials“ and of the assessment regulations.

**Use of the quality mark**

Fundamentally, the quality mark can be used only after it has been granted by the „Güteschutzverband Recycling-Baustoffe“ – “Quality Assurance Association for
Recycled Building Materials”. Together with the quality mark the respective classification of the recycled building material has to be indicated.

For Malta it is recommended, to define technical and environmental guidelines, which will serve as objective measurements and allow competitiveness between primary and secondary products.

### 8 Technical Standards for building materials

Malta is member of the European Community.


Member States are responsible for ensuring that building and civil engineering works on their territory are designed and executed in a way that does not endanger the safety of persons, domestic animals and property, while respecting other essential requirements in the interests of general well-being.

Member States have provisions, including requirements, relating not only to building safety, but also to health, durability, energy economy, protection of the environment, aspects of economy, and other aspects important in the public interest.

These requirements, which are often the subject of national provisions laid down by law, regulation or administrative action, have a direct influence on the nature of construction products employed and are reflected in national product standards, technical approvals and other technical specifications and provisions which, by their disparity, hinder trade within the Community.

The CE mark (officially CE marking) is a mandatory conformity mark on many products – also construction products - placed on the single market in the European Economic Area (EEA). The term initially used was "EC Mark" and it was officially replaced by "CE Marking" in the Directive 93/68/EEC in 1993.

By affixing the CE marking, the manufacturer, its authorized representative, or person placing the product on the market or putting it into service asserts that the item meets all the essential requirements of all applicable EU directives – especially CPD (Construction Products Directive) and that the applicable conformity assessment procedures have been applied.

This means that combined with recycling products in the construction industry, the following European Standards (EN) has to be fulfilled:
European Standards:
- EN 12620 - Aggregates for concrete
- EN 13043 - Aggregates for bituminous mixtures and surface dressings for roads, airfields and other trafficked areas.
- EN 13242 - Aggregates for unbound and hydraulically bound materials for use in civil engineering work and road construction
- EN 13285 - Unbound mixtures - Specification

The main message is: It is not allowed to use construction products, in these fields of construction works, which need a CE-mark if the CE mark is not showing.

CE-marked products are necessary for asphalt, concrete, street layers and so on.

The CE marking...
- does not stand for any specific word, but stands for a manufacturer’s declaration, that his product meets the requirements of the applicable European Directive(s).
- is a declaration by the manufacturer that the product meets all the appropriate provisions of the relevant legislation implementing certain European Directives.
- gives companies easier access into the European market to sell their products.

This means, it is forbidden to use construction waste as a product for streets (e.g. as layer).

Therefore technical requirements, including environmental requirements, have to be established, which correspond to the relevant European Standard (EN).

The use of simple broken C&D-waste does NOT fulfil the requirements of the EN. It is not allowed to use this waste for using especially in streets.

The solution: In many member states of the EU guidelines has been established, which are conform to the relevant EN. In Austria there are two guidelines (see appendix):
- Guideline for Recycled Building Materials; Field of application: Reuse/recycling of hydraulically or bituminous bound and unbound mineral demolition waste
- Guideline for Construction Materials made from Recycled Demolition Waste from Above-ground Construction. Field of application: Unbound Materials; Cement bound Materials; Recycled sand from mineral waste

Both guidelines are conforming to EN and notified by the EU.

The recommendations for Malta is to establish a comparable system of guidelines (compare chapter 7)

Guideline for Construction Materials made from Recycled Demolition Waste from Above ground Construction
Table 5: Application and Use of Recycled Construction Materials

<table>
<thead>
<tr>
<th>Hydraulically bound construction methods</th>
<th>Bricks and hollow blocks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Concrete</td>
</tr>
<tr>
<td></td>
<td>Light-weight concrete</td>
</tr>
<tr>
<td></td>
<td>Screed and screed in bulk format</td>
</tr>
<tr>
<td></td>
<td>Ground improvement/ stabilization</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Unbound construction methods</th>
<th>Bulks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Fillings of utility trenches and covering of cables</td>
</tr>
<tr>
<td></td>
<td>Bedding material for cable areas</td>
</tr>
<tr>
<td></td>
<td>Backfilling and covering of structures</td>
</tr>
<tr>
<td></td>
<td>Cover layers and spread layers in sports structures</td>
</tr>
<tr>
<td></td>
<td>Substrates for planting purposes</td>
</tr>
<tr>
<td></td>
<td>Construction materials used for waste site constructions</td>
</tr>
<tr>
<td></td>
<td>Drainage material</td>
</tr>
</tbody>
</table>

**Application and Use**

Recycled building materials may be used in pure form or as mixed materials consisting of aggregates made of natural stone or industrial byproducts for the following purposes:

- **Unbound construction methods**, for example:
  - Bulk filling (e.g. such as noise barriers, road construction, etc.)
  - Fillings of utility trenches and covering of
    - Bedding material for cable areas
  - Backfilling and covering of structures
  - Cover layers and spread layers in sports structures
  - Substrates for planting purposes
  - Construction materials used for waste site constructions
  - Drainage material

- **Hydraulically bound construction methods**, for example:
  - Bricks, hollow blocks
  - Concrete
  - Lightweight concrete according to the standard
  - Screed
  - Subsoil improvement/ stabilization

- **Flow able self-thickening filling material** according to the guideline of the Austrian Recycled Construction Materials Association.
9 Public procurement and standardized production documents

9.1 Introduction

Reuse and recycling is only possible, if a market exists. Therefore it is necessary to establish a framework, consisting of financial conditions (compare chapter 5), technical conditions (compare chapter 6), an adapted legal background (compare chapter 2) and also a suitable public procurement:

Only if a client has the ability to order products of recycling easily, he will be willing to do so.

Therefore, standardised procurement documents have to be established, that contain at least the possibility to order products of the recycling-/reuse sector. It would be even better, if there would be a binding force, for example for the public sector, to use these materials.

Standard procurement documents must be equal for all participants of the market, as well as for the Maltese market as for other companies in the EU. It is allowed to specify non discriminating calls for tenders, which forces the contractor to use ecologically preferable products, which reduce on the one hand waste, on the other hand takes care of natural resources.

For example, the “public hand” in Austria has to order ecologically preferable products. The standardised procurement documents for street building (guidelines for street works, RVS) have to be used for construction and maintenances of federal streets and are strictly recommended to the communities for their infrastructural works.

The standard procurement documents should contain

Text modules for material related tender at the following categories:

- Demolition
- Treatment
- Excavation
- Deposit
- Dispose
- Recycling
9.2 Environmental essential categories for standardisation

The following paragraphs demonstrate the most important facts, which should be considered:

**Demolishing**
- Detection of contaminations
- Treatment of contaminations
- Sorting of different kinds of materials (C&D-waste) in place
- Documentation of the amount of the sorted materials/wastes, e.g. for concrete, sandstone, wood, steel; also for the kind of treating (e.g. reuse, recycling, depositing)
- Possible use of (treated) C&D-materials directly in place

**Simple Treatment**
- In place: Use with simple methods reusable materials, e.g. screening of sand and soil, crushing of stone

**Excavation**
- Detection of contaminations
- Treatment of contaminations
- Basically Chemical Analysis
- Degree of purity (e.g. Percentage of glass, mineral waste, non mineral waste)
- Type of excavation (e.g. hardstone, softstone)
- Expected amount (e.g. cubic meters, tons)
- Possible reuse (e.g. for refilling, levelling)

**Depositing**
- Type of waste (e.g.: inert, non hazardous, hazardous)
- Expected amount
- Treatment (e.g. compacting, sorting)
- Documentation of the kind and amount of the C&D-waste (e.g.: softstone, bricks; in tons or cubic meters)

**Treatment of contaminated waste**
- Differentiation of contaminated and hazardous
- Methods of treatments (e.g. simple ones like screening and excluding of the contaminated parts, complicated ones like washing)
- Chemical analysis

**Recycling**
- Technical demands
- Environmental demands
• Grading
• Recycling on site
• Recycling in place

Reuse
• Best form of avoiding waste
• Technical demands
• Environmental demand
• Transport within the construction site

Intermediate depots
• Technical requirements
• Capacity
• Restoration after use

9.3 Examples

The following examples represent text for call for tenders:

9.3.1 Treatment of contaminated waste
Separate the dangerous wastes and waste oils from the wastes which are not dangerous, in separate suitable depots, during the demolition works, and if necessary in temporary storage facilities. The quantity removed from the building site has to be paid after confirmation by the client. The costs of the treatment and the transport of dangerous wastes are separately recompensed.

Dangerous wastes EWC- Code .........................KG

9.3.2 Recycling
Transport and build in recycling material. The recycling material has to correspond to the state of the art (in particular to the guidelines for recycling building materials or equivalent).
Recyclingmat. RH............................................................ M3
recycling above ground construction granulates of the grade....... is to be transported and built in.
Note: The granulation (e.g. 0/8) has to be specified.

9.3.3 Reuse
Reuse - soil as infilling
Excavated material as infilling insert. This is to be proceeded after the state of the art (in particular in the sense of the guideline "use of soils as infilling" or equivalent one).
A) without compression M3
B) with compression M3
compression parameter: .............................................
9.3.4 Intermediate depots

**Intermediate storage for materials on the building site. M3**
Temporary storage facilities of indicated cubature have to be established for materials on the building site. The costs of the establishment (subsoil preparation, possible measures for waterproofing etc.) and the evacuation are to be taken into account.

**Intermediate storage for materials outside of building site. M3**
Temporary storage facilities of indicated cubature have to be established for materials outside of the building site on an area indicated by the contractor to the. The costs of the establishment (subsoil preparation, possible measures for waterproofing, fence etc.) and the evacuation as well as property costs are to be taken into account.

10 Collection, re-use and recovery of C&D

10.1 Actual situation in Malta

Site visiting in Malta leads to the impression of immense construction activities on the Maltese islands. Activities include
- new developments (residential buildings, hotels, industrial estates)
- demolitions
- re-development and revitalization of old buildings
- road constructions and trenches

The main C&D waste fractions are
- soft stone excavation and soft stone demolishing material.

On the other hand, new buildings are mainly built of concrete and reinforced concrete structures and concrete blocks substitute traditional softstone blocks. Therefore an increasing amount of cuttings from concrete and concrete blocks is produced.

Separation of non used and demolished building materials at the site does actually not exist, therefore especially at construction sites for new buildings the waste material is collected as mixed fraction.

Mixed C&D waste is collected in skips (4 to 8 m3), which are transported with trucks. It is not clear, where these mixed skips are unloaded, whether it is at the engineered landfill for non-hazardous waste in Ghallis or in disused quarries.

Excavation materials and large amounts of demolition material is transported with Trailers and Semi-Trailers (15 to 30 m3).

There are also containers (20 to 30 m3) for the waste-transports in use, but mainly for commercial and industrial waste.
Recovery of metals is organized by scrap yards and scrap metal dealers. The material is exported.

During demolitions there is partly a separation of soft stone and hard stone blocks for re-use. There are also stationary, semi-mobile and mobile crushers for virgin materials in use.

The attached pictures (Annex 5) show examples from skips and containers at construction sites, which include building materials, wood, packaging waste, metals and residual waste.

The building structures, also shown on the pictures, consist of (reinforced) concrete and concrete blocks. Partly there is also a combined use of concrete blocks and soft stone blocks. Pre-cast elements, made of reinforced concrete, are also in use. “New” building materials like gypsum-board or isolation panels (mineral wool, EPS) could sometimes also be found on the visited construction sites.

The costs for disposal of C & D waste mainly consist of
- provision and transport of skips and containers
- Landfill fee

10.2 Objectives

In addition to the overall objectives
1. Protection of resources (minerals, groundwater)
2. Protection of space (no illegal dumping)
3. Protection of landscapes (holes and stockpiles, “Swiss cheese”)

there are further – more detailed – objectives, which should be reached:
1. For the re-use and recovery of C & D waste:
   a. Introduction of separate collection at the construction site
   b. Introduction of proper logistics (collection schemes, containers in various sizes in adoption of amount and specific weight)
   c. Conception of intermediate storage areas, pre-sorting areas and sorting facilities
2. Treatment for recovery of materials:
   a. Design of the recovery chain (for every material stream)
   b. Establishment of treatment-/recycling facilities
   c. Establishment of recovery techniques (e.g. production process for reconstituted stones)
3. Disposal / Landfilling in accordance with EU legislation
4. Preservation of natural resources
   a. production of reconstituted stone to preserve hard stone resources
5. Preservation of landscape and environment
a. Enforcement and penalization of dumping of C&D waste at non-dedicated areas to avoid optical pollution

The attached pictures from the study tour in Austria (Annex 5) show the results of long term public awareness raising and educational measures

10.3 Approach

10.3.1 General

The introduction of separate collection, re-use and recovery requires the simultaneous introduction of a sequence of actions. This means, that the recycled product coming from a recycling plant

- has to have a certain quality,
- can be utilized in the construction industry market,
- is competitive on the market,
- is accepted by the client
- needs a legal basis

10.3.2 Recovery options

Theoretically, also in Malta most of the C&D waste could be collected separately at the construction site.

The concerned waste fractions would be:

- excavation material
- used stones (soft stone, hard stone)
- concrete and re-inforced concrete
- concrete blocks
- asphalt
- metals
- wood
- packaging (board, plastics)
- residuals (gypsum, mixed waste, etc.)
- hazardous materials (asbestos-cement, paintings, electric pulps etc.)

These materials can be summarized in five groups:

1. recycling material (to be crushed in recycling facilities),
2. metals (to be sold to metal dealers),
3. wood (re-use, use as fuel, composting),
4. packaging waste (to be treated together with commercial packaging waste)
5. Landfill material
   a. hazardous material (to be incinerated or landfilled on hazardous waste landfill)
   b. inert residuals (to be landfilled on inert waste landfill),
   c. non-inert residuals (to be incinerated or landfilled on non-hazardous waste landfill)
Wood and metals should be separated anyway because of their value on the market. Packaging material, which is mainly biodegradable, is only allowed in small quantities on inert landfills, therefore these materials should also be sorted out at the construction site. Separated packaging materials can be introduced to the residual waste or – in higher amount – can also be utilized to contribute to the objectives of the EU packaging directive. The latter could especially be afforded with separate collection together with the Bring-In sites (“temporary” Bring-In sites).

The main part to deal with is therefore the treatment and processing of the inert materials. This could be

- **Re-Use**

Direct re-use of used stones (hard stone, soft stone). No treatment is necessary for “re-use”, the re-use of soft-stone and hard stone requires only the cleaning of the stones. During demolition works, intermediate storage, loading/unloading measures have to be taken not to damage the stones. Prerequisite for re-use is that the stones are not contaminated.

Re-use of fine-crushed or cohesive excavation materials as fillings, sub-layers and landscape structuring material (“Torba”). It has to be ensured, that only clean, virgin excavation material is used to fulfill the criteria for exemption from the EU landfill directive. If it is not possible to transfer the material from the excavation site directly to the site of infilling, it has to be stored at an intermediate storage area.

- **Recycling**

Recycling/Recovery: Recycling of mineral excavation and building materials (asphalt, concrete, stone blocks) is normally done in a recycling plant. The material is crushed and screened to produce all required grain sizes. Sand can be used as filler in trenches, as sub-layer under tiles, as sand for mortar and grout, for landscaping purposes and as aggregate for the production of reconstituted stone. Granulates in various sizes and qualities from recycled concrete and also soft stone can be used to substitute virgin hard stone, which has to be seen as limited and high-quality resource. The technical feasibility is already proven; the economic feasibility still has to be investigated. Larger blocks from demolitions as well as from excavations could be cut to smaller blocks for re-use. Again, polluted and contaminated material can not be re-used. Before instalment of logistics and production on industrial level, all effort has to be put on the establishment of a market for the recycled products. During the period of the establishment of the market for the secondary products, the raw material for crushing should be stored in intermediate storage areas.

### 10.3.3 Sorting and Logistics

Sorting at the site has to be regarded as “separate collection”. Materials which are mixed at the site and re-sorted at a sorting facility later on do not have the same quality as materials which are sorted on-site because of interactive pollution. Given a
market or an intermediate storage area for the material groups mentioned above, on-
site sorting in the described fractions is the most technically and economically
feasible option. The feasibility also relies on the amount of material per time unit.
Therefore different types of construction sites have to be distinguished:

10.3.3.1 Types of Construction sites

- **Road construction (incl. re-construction)**
  Asphalt, concrete and sub-layer material has to be processed and stored separately
  and transported to specific recycling facilities.

- **Demolition sites**
  The rather simple construction technique of buildings, which are actually demolished,
  can be regarded as an advantage for selective (recycling orientated) demolishing of
  these buildings. There is almost no composite-, gypsum- or isolation-material,
  therefore sorting and recycling of the various mineral materials should be feasible.
  Stripping of buildings, e.g. removal of furniture, electric and sanitary installations,
  doors and windows etc. has to be done before demolition and should also be feasible
  in existing buildings because of the simple construction techniques (visible electric
  installations etc.).
  Non mineral materials have to be removed and stored separately during the
demolition process for recovery/disposal purposes. If this is not possible, the material
has to be sorted later on at the construction/demolition site.
Concrete – as highest value recycling secondary building material and substitute for
virgin hard stone – has to be stored separately in any case.

- **Development sites (New buildings)**
  New developments are divided into three phases:
  - excavation
  - structural works
  - finishing works.
  During structural works mainly cuttings from stones or blocks, concrete leftovers and
  cuttings from formwork wood and reinforcing steel are accumulated. Separate
  storage and collection of these materials should not be a problem.
  Relevant for on-site sorting are mainly the finishing works. During this phase, there
are a lot of different materials, which are processed by various contractors and
manufacturers. Therefore separate collecting is rather difficult. Nevertheless there
should be separate collection of mineral materials, because they could be recycled or
at least disposed of in an inert waste landfill.
  For large construction sites with complex finishing works (residential buildings,
hotels, office buildings etc.) the installation of on-site "collection centres" is highly
recommended. These collection centres should have defined opening hours,
depending on the amount of waste. The waste received from the contractors and manufacturers has to be documented, estimated (per volume) and confirmed by deliverer and receiver (on pre-designed schedules). So it is possible to separately collect small amounts of different waste materials in containers (2 to 40 m³) for recycling or disposal.

- **Re-Development sites**

This type of construction site is a combination of

- demolition site
- construction site (development site)

The main problems on re-development sites are the small space for installation of containers or skips for collection of different waste materials. Nevertheless the following materials should be collected separately:

- concrete
- stones and blocks
- further inert materials (tiles, glass, etc.)
- wood
- metals

For all types of construction sites there has to be an obligation for separate collection and compliant disposal of hazardous waste.

### 10.3.3.2 Relevant costs

- **On-site storage**

Separate storage and delivery of C & D waste materials to the collection skips/containers is no relevant effort during construction works. However, the allocation of materials to the adequate containers has to be coordinated and monitored by responsible and trained persons on-site.

- **Transport**

Separate collected waste fractions can be transported directly to adequate recycling and disposal facilities. Wood, metals and packaging materials will be transported to facilities for further processing or export. If the material is sorted properly on-site, there is no need for additional sorting at a Material Recovery Facility (MRF). Lower costs – or even revenues – for recovery or disposal fees have to be calculated against the effort for on-site sorting and will most probably be positive.

- **Ex-post sorting**

Even ex-post sorting of mixed fractions at a C& D waste sorting facility (for recovery or before landfill) should be cost-efficient compared to landfilling of the mixed material.
• **On-site collection centres**

The operation of sorting sites leads to payroll costs for the personnel. These costs are normally low compared with costs for ex-post sorting at a C&D waste sorting facility.

### 10.4 Plants and Locations

#### 10.4.1 Sorting plants

Sorting facilities can – principally – sort and separate all kind of mixed building materials (see: waste fractions). In practice, it is recommended to sort only those fractions which can be re-used or recycled in a feasible manner. These are – because of their economic value as secondary raw material – mainly

- asphalt
- concrete
- stones and blocks (concrete, soft stone, hard stone)
- metals
- wood.

Packaging materials at construction sites are often impure and dirty and have therefore only limited recovery options. Clean packaging material (cardboard, plastics) can be put together with packaging waste from commercial entities and contribute to the national packaging waste targets.

Residuals and hazardous waste fractions have to be sorted according to the adequate disposal facility (inert, non-hazardous and hazardous waste).

Sorting plants can be equipped with different plant components and machinery. For example:

- screener,
- air separator
- inclined sorting belts
- shredder (for wood, plastics etc.)
- sorting station with conveying belt and 4 persons minimum
- etc.

But it has turned out that sorting of C & D waste can also be done as “floor sorting” with two additional machinery components (excavator with clamshell for sorting, wheel loader for loading). This has proven sufficient with the highest cost efficiency. The installation should be roofed or on sealed ground (according to Maltese legislation) to avoid soil and groundwater contamination. Also health & safety aspects for the personal have to obeyed (safety boots, adequate gloves, dust masks etc.).
10.4.2 Recycling plants

The purpose of a C & D waste recycling plant is the crushing of used inert materials and the screening of the crushed materials to different grain sizes.

To produce output of a certain quality the input must not contain impurities and contaminations (asbestos etc.).

Recycling facilities consist of

- Feeding system
- Pre-screening
- Crusher
- Metal separator (for ferrous metals)
- Output conveyer belts
- Subsequent screening facility

There are different types of crushers:

- distinction with regards to mobility (mobile, stationary)
- distinction with regards to size and plant weight
- distinction with regards to crushing technique

10.4.2.1 Mobility

Mobile crushers are available

- on wheels
- on tracks

Stationary crushers do not have a chassis frame, so they have a lower feeding height than mobile crushers. Moreover they can be supplied with electric energy, which produces less emission on-site. It also should be investigated in every particular case whether it is economically feasible with regards to energy prices and costs for infrastructure (cables, transformers etc.).

On stationary plants the process steps and health & safety aspects can be optimized better than in mobile plants.

To ensure economic feasible operation there has to be an annual throughput of approximately 120,000 to minimum (Austrian situation).

Mobile plants have the advantage to process the necessary throughput for economic feasible operation conditions on various locations. Mobile crushers on wheels have to be equipped for public traffic. They can be transported as a semi-trailer on public roads, under consideration of permitted weight limits. Mobile crushers on wheels are cheaper and less heavy but higher than comparable mobile crushers on tracks.
To feed the mobile crusher on wheels, the installation of a ramp is required, which is not needed for feeding a mobile crusher on tracks.

Mobile crushers on tracks can be moved on-site to have it as close as possible to the input material, which is not possible with the mobile crusher on wheels (because of the ramp).

Mobile crushers on tracks require a special – extra broad – flat bed trailer, whereas mobile crushers on wheels can be just docked as semi-trailers onto drawing vehicles.

Because of their heavy weight (28 - 63 tonnes) transports for both types of mobile crushers need special permissions from the transport authority.

### 10.4.2.2 Seize and weight

Distinction per weight depends on the size and type of the crusher.

The size of the crusher defines the throughput capacity and the feed material size.

Costs are related to the weight of the facility, whereas mobile crushers on wheels are generally cheaper than on tracks.

### 10.4.2.3 Crushing type

Crushing techniques are distinguished in

- jaw crusher
- impact crusher
- cone crusher

- **Jaw crusher**

  Jaw crushers compact the feed material between moving plates. This type of crusher is advantageous for very hard material (e.g. granite) or as first step to crush larger blocks of medium hard material (e.g. Maltese hard stone, concrete, and reinforced concrete). Grain size of the output can be controlled by the gap size of the impact plates.

  Jaw crushers have the lowest abrasion costs related to the material throughput, but a disadvantageous grain form of the output material.

- **Impact crusher**

  Impact crushers reduce the material size by shooting it with a rotating cylinder (which is equipped with steel bars) onto the covering cylindrical wall. Size reduction is done by virtue of impact. All kinds of material (incl. reinforced concrete) can be processed, except very hard stone (e.g. granite). Feed material size is determined by the size of
the hopper. Grain size of the output can be controlled by the gap size of the impact bars.

- **Cone crusher**
  Cone crushers reduce the material size by means of grinding. Feed material size has to be below 160 mm, the final grain size is sand 0/12 mm to 0/60 mm.

- **Application**
  Jaw crushers and impact crushers produce a variety of final grain sizes that have to be screened afterwards to get aggregates with the requested grain size distribution. Cone crushers produce sand, screening is necessary only for special purposes.

  Impact crushers are suitable for all kind of materials, whereas jaw crushers cannot be used for/ with asphalt and gravel. Cone crushers may only be used for small size input material (e.g. pre-crushed softstone).

  If only one single crushing facility is used, impact crushers are most feasible because of the huge variety of input materials that can be treated.

  For input materials larger 80/80 cm a pre-crushing facility (excavator with hydraulic bit or crushing gripper) is needed before inserting the material to the crusher.

### 10.4.2.4 Screening facilities

All kinds of screening facilities that have been seen on the Maltese Islands can be used to screen the output material of the described crushing facilities.

But it has to be kept in mind that the throughput capacity of the screeners has to be adjusted to the output capacity of the crushers to optimize the screening process.

In case of mobile crushers on tracks there should also be a mobile screener on tracks for optimized processing.

### 10.4.3 Locations

Locations should be considered for

- **Storage areas**
- **Sorting facilities**
- **Recycling plants**
10.4.3.1 Storage areas

Virgin or separated hard stone and soft stone from excavations or pre-sorted C &D waste should always be delivered to

- quarries which are equipped with crushers or
- crushing facilities

Near these quarries or crushing facilities there should be areas for intermediate storage, which don’t need to have a sealed ground.

Recycling of asphalt on the highest level means to insert the recycled granulate into the existing tarmac plants to produce new (hot) asphalt.

For mobile crushing of concrete and asphalt there has to be an area with the following requirements:

- stable and horizontal ground to bear the load of the (mobile) crusher,
- in case of asphalt recycling (which contains organic chemicals) leachate infiltration into the groundwater should be avoided (e.g. dense ground or lining with asphalt or concrete).

Recycled concrete can be used as aggregate in fresh concrete (to substitute hard stone) or for road construction. Therefore the recycled concrete granulate should be stored close at the locations of the concrete batching plants.

10.4.3.2 Sorting facilities

The largest amount of material from sorting facilities is

- inert materials
- residual waste

Therefore the sorting plant should be located either

- at the landfill for inert waste or
- at the landfill for non-hazardous waste,
- at a disused industrial building close to the inert or non-hazardous landfill
- at the location of the MBT or MRF

If the sorting station is located at the landfill for inert waste, the area of the sorting facility has to be sealed or roofed to avoid leachate infiltration into the groundwater

The advantage of having the C & D sorting facility at the location of the landfill or the MBT/MRF is that the personnel of these facilities can also do the sorting of the C &D waste.
10.4.3.3 Recycling facilities

In case of mobile recycling facilities, the location is given by the storage area (facility is moved between different storage areas)

In case of stationary recycling plants there are two preferred locations:

- Location together with the C & D waste sorting facility to optimize the use of personnel and machinery
- Location at the landfill for inert waste to separate materials for landfilling from materials for re-use or recycling directly at the landfill

Remark on the economical feasibility of a recycling plant:

If the information provided by MEPA during a meeting (9th May 2007) on the “Smart City” project is correct (e.g. 30,000 m³ = 65,000 to concrete), this amount would be the economically feasible input for a mobile recycling facility for the period of six months. The technical operation process would last approximately 3 months (given a throughput of 1,000 to/day). This would be an ideal amount to adapt existing mobile facilities (e.g. metal separation) to start concrete recycling.

The necessary incentive would be a price to be paid to the operator of the recycling plant by a concrete batching plant etc. that otherwise would have to be paid for virgin hard stone. If the costs for the production of concrete using recycled material exceed the production costs with virgin hard stone (has to be documented by the operator!!), the difference should be subsidized by Government or WasteServ.

11 Disposal of C&D Waste (Landfilling)

The existing landfills for non-hazardous waste and for hazardous waste in Malta are too precious to be used for landfilling inert waste.

However, contaminated excavation material and demolition waste should be delivered to these landfills as used for structural purposes (dams, roads inside the landfill etc.).

On the other hand, the landfilling of C & D waste has to fulfil certain requirements with regards to the EU landfill directive (groundwater protection, waste acceptance etc.)

So the following steps should be considered for construction and operation of a landfill for inert waste:

- Location (depends on geological barrier properties, kf <= 10-7 m/s)
- Operator
- Application, permission
• Construction of the landfill (baselayer, lining, leachate collection system, weighbridge)
• Operation of the landfill: Training of staff, entrance control, unloading, infilling/compaction, leachate monitoring/management, stability monitoring, infilling plan, etc.
• Closure of the landfill, top sealer, after-care, restoration
12 Annexes

Annex 1: Austrian Guideline for recycling-oriented deconstruction

Annex 2: Austrian Guideline for recycled building materials (“green” guideline – underground engineering)

Annex 3: Austrian Guideline for recycled building materials (“red” guideline – structural engineering)

Annex 4: Recycling Techniques and Machinery (Folders from MFL Ltd., Austria)

Annex 5: Photos from Malta and Austria (Study Visit 1st to 5th October 2007)
Annex 1: Austrian Guideline for recycling-oriented deconstruction
Recycling-oriented Deconstruction

A practical guideline for building owners and contracting companies

based on the Austrian Standard ÖNORM B2251 “Demolition Work”

Provided by the Austrian Ministry of Economic Affairs
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This guideline has been prepared by the Austrian Construction Material Recycling Association (BRV), Project Director Dr. Peter Maydl, at the request of the Austrian Ministry of Economic Affairs.
Preliminary Remarks

This leaflet is intended to be a good construction practice reference for the everyday use by building owners, planners and companies. As waste disposal sites are decreasing in number and the importance of saving raw material resources for the coming generations grows, it has become more necessary to reuse demolition products to the extent possible. The planning, tendering and the procedures for demolition work are of crucial importance in maximizing the economic efficiency of recycling processes. Already the recycling of construction materials is to a large extent obligatory. In the near future, there will likely be no alternative to recycling for both economic and environmental reasons.

This document, in addition to the Austrian Standard ÖNORM B2251 “Demolition work. Standards for Contracts of Work and Labour”, is meant to serve as an aid for people involved in construction in order to facilitate the planning and carrying out of demolition operations. Moreover, the regulations of the construction worker protection law (BGBI, National Law Journal Nr. 340/1995) are considered and referenced.

Deconstruction versus demolition

In the future, deconstruction will be regularly performed for the following reasons:
• Deconstruction is required by the legislative authority: recycling regulations forming part of the waste management law as well as regulations regarding waste separation and the declaration of waste
• Decreased need for waste sites
• Preservation of primary raw material resources
• Less need for the transportation of materials
• Reduced costs due to savings in deposit charges and lower contributions to be paid because of the cleanup operations, as less waste is generated and only sorted waste is deposited

Definition of terms

The following terms are drawn from the draft of the waste site regulation, the Guidelines “Proper Handling of Construction Waste” (prepared by the Austrian Industrial Construction Association) and the Austrian Standards ÖNORM B 2251 and ÖNORM B1800.

Waste Site Regulation:
Construction and demolition waste:
Waste materials produced by construction or demolition work such as excavation materials, as well as concrete, asphalt and mineral waste.

Guidelines:
Soil excavation residues:
Soil excavation and spoil materials which are excavated or removed during earthwork and structural and civil engineering work.

Concrete waste:
Reinforced and unreinforced hydraulically bound materials produced by structural and civil engineering work (e.g. road construction).

Asphalt waste:
Bituminous bound solid mineral materials primarily generated by civil engineering work (e.g. road construction)

Wood waste:
Wood waste from the construction and demolition of buildings

Metal waste:
Construction parts made from ferrous and non-ferrous metals and various alloys which may also be coated or painted

Plastic waste materials
Construction parts made from various types of plastic materials

Construction site waste
Mixed waste materials which may consist of wood, metal, cardboard, organic residues, bulk refuse and minimal amounts of mineral waste

Mineral waste:
Waste resulting from the construction or demolition of buildings, which mainly consists of mineral materials such as brick, concrete, mortar, natural stone, sand, ceramic construction materials, precast concrete blocks, and/or gaseous concrete brickwork

Harmful waste materials:
Waste materials which must be handled according to special precautionary measures and with special attention to preserve public safety and which, in general, require more precaution and attention than other waste.
Austrian Standard ÖNORM B 2251:
Recycling-oriented demolition:
Demounting of construction parts according to
the methods mentioned in the standard

Demolition:
Destruction without considering separation of
materials

Demounting:
Dismantling of construction parts via joint
separation or simply separation into smaller
parts.

Deconstruction:
Demolition carried out focusing on the separation
of construction materials

Minimal work:
Minimal work must sometimes be performed
even if not defined in the contract, but only as far
as is directly related to and necessary for the
complete, appropriate and competent
performance of the work defined in the contract.
Such work is considered to be included in the
prices stipulated in the contract.

Austrian Standard ÖNORM B1800
Total volume of content:
Total amount of product included in a
construction, floor to ceiling

Current legal situation

The following rules and regulations are of primary
importance as far as the separation and recycling
of waste materials is concerned (update: autumn
1995):
  • Cleanup operation regulation
    (ALSAG, 1989)
  • Waste management law (AWG, 1990)
  • Regulation regarding the definition of
    harmful waste (1991)
  • Waste evidence regulation (1991)
  • Regulation regarding the separation of
    materials produced by construction work
    (1991)
  • Enactment of the Austrian Ministry of
    Environment regarding the construction
    and demolition waste separation
    regulation (1993)
  • Various regulations issued at the regional
    level, e.g. waste management regulations
    and building regulations

In addition, at the national level the following
agreements have been set:
  • Voluntary agreement on the utilization of
    recycled materials (1990)
  • Agreement of the Austrian Council of
    Ministers (1992/01/09) on the utilization of
    recycled materials for the construction of
    Austrian national office buildings

Obligations of the contractor
and the contracting company

The following obligations are based on legal
regulations, standards and practical experience.

Obligations of the contractor
(see also regulations mentioned in chapter 1.3
of the Austrian Standard ÖNORM B2251)
  • Observance of the waste separation
    regulation and assignment of the related
    obligations to the contracting company
  • Periodical inspection of the contracting
    company, especially as far as the
    separation of construction and demolition
    waste is concerned
  • Preparation of a description of the
    building and collection of the associated
    data
  • Checking the construction and demolition
    waste evidence
  • Preparing a disposal and recycling
    protocol (in some Austrian Regions this is
    already prescribed by law)
  • Initiating an examination of the building to
    be demolished, if harmful substances are
    present, to be carried out by a qualified
    person

Obligations of the contracting company
(see also regulations mentioned in chapter 1.3
and 2 of the Austrian Standard ÖNORM B2251)
  • Checking of the building
  • Preparing instructions regarding how to
    carry out the demolition work
  • Following the waste disposal protocols
    stipulated in the contract and submitted to
    the building authority
  • Following the waste separation regulation
  • Recycling of the waste materials to the
    extent possible
  • Observing the worker protection
    regulations (safety at work)
  • Separate storing of harmful waste,
    informing the contractor and assigning
    disposal only to authorized companies
• Depositing non-recyclable materials only in appropriate and authorized waste sites
• Preparing daily construction records
• Preparing construction waste evidence

Tendering Procedure

General and special conditions regarding the awarding of a contract

a) General conditions
• Submission of a building description, including information on former utilization, by the contractor
• Obligatory inspections of the building by the bidding companies
• Confirmation of the bidder of having been sufficiently informed about the building after the inspection of the building and on the basis of the building description and other supporting documents
• Reminder that the quantities mentioned in the tender documents have to be regarded as reference values which must have been checked by the bidder, and that in instances involving lump sum items no additional claims can be made in this regard
• Condition of the building to be demolished at the time of assignment: e.g. free from movable installations, furniture, stored goods, etc.
• Submission of a waste recycling concept by the bidder
• Declaration of the construction material recycling companies and waste sites the bidder intends to chose
• Submission of the required statements regarding sewage, power, gas, etc.
• Instructions regarding the water and energy supplies
• Reminder that the waste separation regulation must be observed and that the obligations resulting from this regulations must be accepted by the contracting company
• Instructions regarding procedures in cases involving the unexpected presence of harmful substances according to the Austrian Waste Management Law (AWG)
• Minimal additional work to be included in the prices according to chapter 2.4 of the Austrian Standard ÖNORM B2251
• Regulations regarding the on-site reutilization of construction parts and materials

b) Special conditions
• Exact definition of the topic and extent of the contract
• Special characteristics of the building, such as connections to neighbouring buildings, connecting fire-proof walls, etc.
• Possible measures to be taken in order to secure evidence regarding the condition of neighbouring objects
• Conditions set by the authorities
• Declaration of difficulties influencing the calculations
• Security and protection measures
• Measures regarding supply and sewage conduits
• Measures regarding the foundation (e.g. demolition extending to the bottom of the foundation, etc.)
• Requirements for bulk material (e.g. eluate category)
• Reminder regarding harmful wastes and stored goods
• Restrictions due to neighbouring objects, e.g. special sensitivity to vibration, dust, noise, etc.
• Accesses to the neighbouring properties (if necessary)
• Possibilities for intermediate storage of sorted materials
• Possibilities for mobile on-site recycling
• Regulations regarding required exploration measures and examinations in terms of materials and engineering as well as in terms of chemical composition
• Special requirements regarding partial demolitions, such as gutting
• Special measures intended to limit harmful emissions
• Instructions regarding the level of demolition to take place
• Description of the final state after deconstruction

Information confirming the competence, capacity and reliability of the bidding company, such as information about reference objects, technical equipment, etc. should be requested.
Types of bills of quantities
According to the Austrian Standard ÖNORM B2251 the Bill of quantities should include separate items for each of the following job aspects:

- Disposal of harmful waste found on site (NOTE: harmful waste is defined in the Regulations on Harmful Waste, BGBl. (Federal Law Journal) 49/1991)
- Disposal of materials requiring separate disposal
- Support for exploration work, such as digging and/or taking material samples from the building, etc.
- Special protection and safety measures exceeding the normal measures defined in chapter 2.4(1), e.g. fencing, lighting, protective scaffolding, covering
- Safety measures regarding stability of the remaining part of the building in case of partial demolition and gutting
- Protection of nearby spaces and buildings
- Severing of mechanical connections with neighbouring buildings

In addition, the Bill of Quantities for Structural Engineering Work (LB-H) contains appropriate items for partial demolitions which are also to be considered.

Bill of Quantities
Fundamentally, there are two possibilities for the preparation of specifications (Bill of Quantities):

1. Bill of Quantities containing individual items
The bill of quantities is prepared by defining separate items for all demolition, sorting and transportation work, e.g. according to the Bill of Quantities for Structural Engineering Work (LB-H). The work must be defined in detail to such an extent that the price calculation, especially in regard to recycling-oriented sorting, can be referenced and checked.

2. Bill of Quantities containing lump sum items
Defining in detail the extent of work to be done as a basis for the calculation of a lump sum price.

The work must be defined in a clear and detailed way, such that all bidders understand it in the same way and are able to calculate the prices easily and without extensive preparatory work. The contracting company should not be saddled with unacceptable hazards due to situations and events which are not under its influence and the effects of which on the prices and working times cannot be estimated in advance. The work should be described defining the deconstruction task (work description), if necessary also including detailed diagrams.
Checklist for contractors and contracting companies

1. Preparatory work
   - Collecting all available planning documents
   - Collecting available information about the building to be demolished (utilization, structural modifications, etc.)
   - Restrictions due to neighbouring buildings
   - Building description
   - Collecting documents to serve as a basis for the calculation of estimated quantities
   - Discovery and declaration of possible contaminations, harmful waste and stored goods
   - Checking the building to be demolished (checking of planning documents, determination if harmful waste are present)
   - Checking for possibilities of on-site reutilization of demolition waste if the construction of a new building is planned
   - Checking the potential for reutilization of demolition waste
   - Checking the potential for the usability of whole construction parts
   - Preparation of a disposal and recycling concept (if required)
   - Clearing the building or determining what should be the condition at the time of consignment for demolition
   - Description of the final state after deconstruction
   - Securing evidence regarding the condition neighbouring properties before starting and after having finished demolition work (if not assigned to the contracting company)

2. Tendering Procedure
   - Instructions regarding procedures in cases involving the unexpected presence of harmful substances
   - Prerequisites to be included in the prices
   - Regulations regarding the transfer of title of the materials resulting from demolition
   - Measures specific to supply and sewage conduits
   - Measures specific to the foundation and the cellar walls
   - Requirements for bulk material and installations

3. Bidding for the contract
   - Inspection of the building
   - Checking spaces, accessibility, possibilities for intermediate storage and installing a mobile on-site recycling plant
   - Checking the quantities defined by the contractor
   - Choosing the appropriate demolition method
   - Checking the possibilities for and conditions of consignment of recycling plants and waste disposal sites
   - Preparation of a disposal and recycling concept
   - Instructions regarding procedures in cases involving the unexpected presence of harmful substances
   - Minimal work to be included in the prices
   - Declaration regarding water and power supplies
   - Special characteristics of the building, e.g. connections with neighbouring buildings
   - Checking the conditions imposed by the authorities
   - Security and protection measures
   - Measures regarding supply and sewage conduits
   - Measures regarding the foundation (reuse, complete demolition, etc.)
   - Required exploration measures, material examinations, etc.
   - Special measures intended to limit harmful emissions

Initiation of the permission for demolition
Award of the contract

4. Preparatory work to be carried out after contract award
   - Securing evidence of the condition of neighbouring buildings if necessary
   - Preparation of a site mobilization protocol
   - Preparation of a deconstruction process protocol
   - Appointment of the site manager
   - Announcing the beginning of the demolition process
   - Severing of the connections (anchorings, supply conduits, etc.)

5. Deconstruction process
   - Carrying out the deconstruction work according to the deconstruction process protocol
   - Recycling and disposal of demolition waste according to the related concept
   - Observance of worker protection regulation (safety at work)
   - Filling out the form accounting for demolition waste evidence
   - Preparation of daily deconstruction reports
   - Announcement of the end of the deconstruction work
   - Securing evidence regarding the condition after the deconstruction

6. Deconstruction process
   - Checking the construction waste evidence prepared by the contracting company
   - Securing evidence of the conditions after deconstruction (if not assigned to the contracting company)
### Appendix A (standardised): Building Description by the Contractor

<table>
<thead>
<tr>
<th></th>
<th>Building address:</th>
<th>Contractor:</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td><strong>Building materials</strong></td>
<td>cellar</td>
</tr>
<tr>
<td>2.1</td>
<td>Load-bearing construction parts</td>
<td></td>
</tr>
<tr>
<td>2.2</td>
<td>Non-load bearing construction parts</td>
<td></td>
</tr>
<tr>
<td>2.3</td>
<td>Ceilings</td>
<td></td>
</tr>
<tr>
<td>2.4</td>
<td>Roof construction</td>
<td></td>
</tr>
<tr>
<td>2.5</td>
<td>Roof covering</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td><strong>Dimensions of the construction</strong></td>
<td></td>
</tr>
<tr>
<td>3.1</td>
<td>Total volume (in m³)</td>
<td>Age of the building/year of construction:</td>
</tr>
<tr>
<td>3.2</td>
<td>Number of floors</td>
<td></td>
</tr>
<tr>
<td>3.3</td>
<td>Floor height (from floor top edge to floor top edge)</td>
<td></td>
</tr>
<tr>
<td>3.4</td>
<td>Type(s) of utilization:</td>
<td>Most recent:</td>
</tr>
<tr>
<td>4</td>
<td>Remodelling measures (if known by the contractor):</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Harmful substances</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Possible restrictions due to neighbouring buildings, etc.</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Particular aspects of the site (possibilities for on-site storage of sorted demolition material, etc.):</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Installations, conduits, special equipment of the building</td>
<td></td>
</tr>
</tbody>
</table>

**Date**  
**Signature**
# Appendix B (standardised): Request for Demolition (according to § 110 BauV)

## Request for Demolition

### Address of the building to be demolished

<table>
<thead>
<tr>
<th>Street/postcode:</th>
<th></th>
</tr>
</thead>
</table>

### Building owner

<table>
<thead>
<tr>
<th>Name:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Phone/fax/e-mail:</td>
<td></td>
</tr>
</tbody>
</table>

### Demolition company

<table>
<thead>
<tr>
<th>Name:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Street/postcode:</td>
<td>Phone/fax/e-mail:</td>
</tr>
<tr>
<td>Supervisor: name, phone/fax/e-mail:</td>
<td></td>
</tr>
<tr>
<td>Back-up supervisor: name, phone/fax/e-mail:</td>
<td></td>
</tr>
</tbody>
</table>

### Additional building description (additional to Appendix A)

In addition to “Appendix A, Object description by the contractor” the following examinations must be performed by the demolition company:

| Type of utilization: most recent and former: |   |
| Remodelling works performed: |   |
| Harmful substances present in the building: |   |
| Installations and conduits within the building: |   |
| Further information regarding point ...(according to appendix A) |   |

### Demolition works

- [ ] Demolition
- [ ] Demounting
- [ ] Deconstruction

| Level of demolition |   |
| Sequence for demolition in cases involving special requirements |   |
### Stability prior to the demolition of the building to be demolished of the neighbouring buildings

<table>
<thead>
<tr>
<th>Required measures</th>
<th>Required measures</th>
</tr>
</thead>
</table>

### Stability during demolition of the building to be demolished of the neighbouring buildings

<table>
<thead>
<tr>
<th>Required measures</th>
<th>Required measures</th>
</tr>
</thead>
</table>

### Protection measures against falling construction parts

<table>
<thead>
<tr>
<th>Safety scaffoldings</th>
<th>Shelter</th>
<th>Avoidance of dangerous areas</th>
</tr>
</thead>
</table>

### Measures required for installation of exposed work places and the related access points

<table>
<thead>
<tr>
<th>Ascents, accesses to the work areas, required tools and supplies for work (scaffoldings, lifting platforms, etc.)</th>
</tr>
</thead>
</table>

### Protection measures in place to avoid worker falls

<table>
<thead>
<tr>
<th>Front scaffolding</th>
<th>Roof safety scaffolding</th>
<th>Roof safety board</th>
<th>Safety scaffolding</th>
<th>Barriers</th>
<th>Covers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Other fall protection systems</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Protection measures for harmful substances

### Protection measures for installations, conduits, open wires, etc.

### Other protection measures
Annex 2: Austrian Guideline for recycled building materials ("green" guideline – underground engineering)
## Guideline for Recycled Building Materials

**Green Guideline, 7th edition, January 2007**

**Field of application:**
Reuse/recycling of hydraulically or bituminous bound and unbound mineral demolition waste

<table>
<thead>
<tr>
<th>Material Type</th>
<th>Image</th>
</tr>
</thead>
<tbody>
<tr>
<td>granular asphalt</td>
<td><img src="RA.jpg" alt="Image" /></td>
</tr>
<tr>
<td>granular concrete</td>
<td><img src="RB.jpg" alt="Image" /></td>
</tr>
<tr>
<td>granular asphalt/concrete mix</td>
<td><img src="RAB.jpg" alt="Image" /></td>
</tr>
<tr>
<td>mixed granular concrete/asphalt - stone</td>
<td><img src="RM.jpg" alt="Image" /></td>
</tr>
<tr>
<td>mixed granular stone-concrete-asphalt</td>
<td><img src="RG.jpg" alt="Image" /></td>
</tr>
</tbody>
</table>

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*Österreichischer Baustoff-Recycling Verband*
*Österreichischer Güteschutzverband Recycling-Baustoffe*
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**Preamble**

Austrian Recycled Construction Materials Quality Insurance Association has set itself the task to guarantee the quality of recycled building materials and to identify the products the quality of which is assured by means of granting quality marks for recycled building materials.

The guidelines and the quality regulations contained regulate the requirements as well as the kind and the extent of tests provided for recycled building materials. They serve the purpose to standardize these requirements and to set a uniform system of designations and technical classifications.

The aim of the recycling of building materials is to reach a quality standard which meets the requirements corresponding to the future use of recycled building materials.

The new regulation regarding the environmental compatibility of recycled building materials which proposes the classification in quality classes has been prepared on the basis of the study “Recycled building materials; regulation regarding the environmental compatibility” (December 2002) which has been published in the 5th edition. The study has been carried out by the “Umweltbundesamt” – “Federal Office of the Environment” in accordance with the recycling industry and the “Bundesministerium für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft (BMLFUW) – “Ministry of Agriculture, Forestry, Environment and Water Management”.

The 6th edition especially contains the adaptation to the CE-marking. Moreover, adaptations have been made regarding the taking of samples and the PAH-limit values on the basis of first experiences made in the field of environmental impact statements.

The 7th edition additionally includes the recycled building material RG (granular stone concrete asphalt mix) and considers the new directives regarding frost resistance and frost susceptibility as well as the renumbering of the RVS (Code for the Planning, Construction and Maintenance of Roads). In addition, the range of grading curves has been extended and the regulations have been adapted in order to correspond with the Austrian waste management plan.

This new edition of the guideline has been prepared by the Quality Assurance Association for Recycled Building Materials in collaboration with the professional committees concerned and users of recycled building materials.

As far as products coming from other EU-member states or from EEC-contracting states are concerned the complying with the requirement(s) set in the guideline can be proved also by certificates, assessment or surveillance reports, which are based on methods corresponding to those applied in Austria. The results of the assessments and surveillances must be – perhaps at request – presented to the Quality Assurance Association. If the products meet these requirements they are considered to be equal to Austrian products.

The institutes authorized to make out certificates and assessment and surveillance reports have to furnish appropriate and satisfactory guarantees regarding their technical and professional qualifications and their independence. Such guarantees are given in every case by institutes which are authorized according to the European Norms of the series EN ISO 17025.

Rules, norms and other technical specifications of other EU-member states and EEC-contracting states are considered of equal value as far as they guarantee the same quality standard as defined in the guideline.
1 Field of application

The guideline regulates the requirements and properties of products made of demolition wastes which are intended for reuse or recycling. Setting quality standards it also determines the kind and the extent of assessments which have to be carried out on recycled building materials. The quality regulations control the use of recycled building materials as mineral aggregates for bulk and filling materials and for bound and unbound bases. If recycled materials are used as aggregates for the production of asphalt or concrete, supplementary examinations according to the respective regulations have to be performed.

The present regulations do not regard the reprocessing of industrial by-products produced by waste treatment plants (such as refuse incineration plants, pavement wash plants). The grade and quality regulations contain the requirements which recycled building materials have to comply with according to their future place and purpose of use.

2 Norms and technical guidelines

Guidelines for recycled building materials made of waste resulting from demolition of over-ground buildings
Austrian Recycled Construction Materials Quality Insurance Association; current version

RVS 01.02.11 Definitions; Structural Engineering; Issue September 1984

RVS 03.08.63 Structural engineering; details of structural engineering; design for superstructures; Issue May 2005

RVS 08.06.01 Concrete, steel reinforced concrete and brickworks; Concrete and steel reinforced concrete; Issue November 2004

RVS 08.15.01 Sub-grade and unbound sub-bases; unbound sub-bases; Issue October 2005

RVS 08.15.02 Sub-grade and unbound sub-bases; unbound granular asphalt sub-bases; Issue May 2002

RVS 08.16.06 Bituminous sub-bases and overlays; reuse of asphalt; Issue April 1987

RVS 08.17.01 Concrete overlays; cement-stabilized base courses; lime-stabilized base courses; Issue June 2002

RVS 08.17.02 Concrete overlays; cement-stabilized base courses; pavement construction; Issue October 1998

RVS 08.97.04 Construction materials; granular asphalt; Issue October 1999

RVS 08.97.05 Construction materials; requirements for asphalt mixes; Issue May 2004

RVS 11.06.21 Assessments; stone material; frost heave tests; Issue August 1999

RVS 11.06.22 Assessments; stone material; sampling; Issue August 2004

RVS 11.06.26 Assessments; stone material; Enslin; Issue November 1987

RVS 11.06.27 Assessments; stone material; permeability in laboratory; Issue September 2000

RVS 11.06.28 Assessments; stone material; drusy stone; Issue January 1991

RVS 11.06.29 Assessments; stone material; on-site permeability; Issue 1997

ÖNORM B 2251 Demolition Work; Works contract; Issue August 2006

ÖNORM B 3130 Aggregates for bituminous mixtures and surface dressings for roads, airfields and other trafficked areas - Rules for the implementation of ÖNORM EN 13043; Issue October 2006

ÖNORM B 3131 Aggregates for concrete - Rules for the implementation of ÖNORM EN 12620; Issue October 2006

ÖNORM B 3132 Aggregates for unbound and hydraulically bound materials for use in civil engineering work and road construction - Rules for the implementation of ÖNORM EN 13242; Issue October 2006

ÖNORM B 4710-1 Concrete - Part 1: Specification, production, use and verification of conformity; Issue April 2004

ÖNORM B 4810 Test methods for mechanical and physical properties of aggregates - Frost susceptibility of
mixtures for unbound bases for road and airfield construction; Issue October 2006

ÖNORM B 4811
Aggregates for unbound bases for road and airfield construction - Evaluation of frost susceptibility; Issue October 2006

ÖNORM L 1200
Determination of polycyclic aromatic hydrocarbons (PAH) in soils, sewage sludges and composts; Issue January 2003

ÖNORM EN 932-1

ÖNORM EN 1744-1
Tests for chemical properties of aggregates - Part 1: Chemical analysis; Issue July 1998

ÖNORM EN 12620
Aggregates for concrete; Issue April 2005

ÖNORM EN 12697 – Part 1
Test methods for hot mix asphalt - Part 1: Content of soluble binding agents; Issue February 2006

ÖNORM EN 12697 - Part 2
Test methods for hot mix asphalt - Part 2: Determination of particle size distribution; Issue January 2003

ÖNORM EN 13043
Aggregates for bituminous mixtures and surface treatments for roads, airfields and other trafficked areas (consolidated version); Issue October 2004

ÖNORM EN 13242
Aggregates for unbound and hydraulically bound materials for use in civil engineering work and road construction (consolidated version); Issue October 2004

ÖNORM EN 13286-2
Unbound and hydraulically bound mixtures – Part 2: Test methods for the determination of the laboratory reference density and water content – Proctor compaction; Issue October 2004

ÖNORM S 2115
Determination of the eluation capacity of waste with water; Issue July 1997

ÖNORM S 2116-3
Examination of solidified wastes – Rapid carbonizing, Issue July 2000

2.1.1 Guide for Recycling Oriented Demolition
(regarding Austrian standard ÖNORM B 2251 „Demolition Work“)
Österreichischer Baustoff-Recycling Verband
(Austrian Construction Materials Recycling Association; Issue March 1996)

3 General requirements

3.1 Recovering
Demolition waste which can be reused or recycled mainly results from the demolition of overground buildings and civil engineering and engineering constructions as well as from the demolition of circulation areas such as roads, paths, parking areas, aerodromes and railway tracks.

The materials to be processed may consist of

a) unbound building materials, such as for example materials for the construction of dams, filling materials, excavation materials, bases, crushed stone for railway tracks
b) hydraulically bound building materials, for example road pavements, slabs, kerbs, pipes, bricks, beams, concrete and reinforced concrete.
c) bituminous bound building materials, for example bases, covering layers.

The material to be processed may exist in crushed and cut form.

In this regard fundamentally it has to be pursued the aim to produce pure materials by selecting, for example according to ÖNORM B 2251. On-site sorting of demolition waste helps to improve the quality of recycled building materials. The processed demolition waste has to be almost free of impurities. If there are any impurities they have to be sorted out so that the content of impurities in recycled building materials will be lower than 1 mass percent.

If there are any contaminations suspected, for example because of the origin of the material, the respective demolition waste has to be sorted out in every case from the recycling process if the required pureness cannot be proven.

Dangerous substances must not be contained!

3.2 Delivery, sorting and processing

3.2.1 Delivery
At the delivery the origin and possible contaminations of the demolition waste have to be evaluated and documented in the frame of a first inspection. A first evaluation and pre-sorting of the waste regarding its usability have to be made immediately at the delivery. In particular, it has to be ensured that only appropriate and authorized materials are taken over. Moreover, in the frame of the receiving inspection mixed asphalts containing coal-tar should be sorted out. In order
to detect contaminations of coal-tar in a rapid way
the “paint spraying method with fluorescence under UV-light” according to the FGSV-working paper Nr 27/2(2000) may be applied. The threshold value of this method is approximately 50 mg PAH/kg. Tar containing road demolition waste and asbestos containing cement products have to be rejected.

3.2.2 Sorting
The delivered materials have to be pre-sorted in order to classify them according to their quality. Pre-sorted materials have to be stored separately. In case of doubt, the respective material possibly has to be classified in a lower quality class or sorted out.

3.2.3 Processing
For the processing of the materials processing plants and plant parts appropriated for the intended use of the respective product have to be applied (see table 2).

Note: The recycling of waste resulting from demolition of over-ground buildings is regulated by the „Guideline for recycled building materials made of waste resulting from demolition of over-ground buildings“ for the fields of application „cement-bound masses“ and “unbound masses“. In order to win as much as possible pure wastes from the demolition of buildings the demolitions should be carried out according to the guide “Recycling-Oriented demolition” (regarding ÖNORM B 2251 Demolition works).

3.3 Storage
Recycled building materials have to be stored separately according to grades and quality classes. In this regard it has to be ensured that deteriorations in quality (e.g. contaminations, mixing, de-mixing) are avoided.

3.4 Designations of recycled building materials

3.4.1 Designation of materials

RA  Recycled crushed granular asphalt
RB  Recycled crushed granular concrete
RAB Recycled crushed granular asphalt/concrete mix
RM Recycled crushed mixed granular material consisting of concrete and/or asphalt and stone (natural and/or recycled) with a maximum percentage not exceeding 50 percent.
RG Recycled mixed granular material consisting of stone (natural and/or recycled) with a minimum percentage higher than 50 percent and concrete and/or asphalt

3.4.2 Grades – engineering classification scheme

According to the field of application indicated in table 2 recycled building materials are classified in:

Grade I
Frost-proof and frost resistant building materials for unbound base courses and sub-base courses (according to RVS 08.97.04, RVS 08.15.01) and for the construction of hydraulically and bituminous bound bases (according to RVS 08.17.01).

Grade II
Frost-proof and frost resistant building materials for unbound sub-bases (according to RVS 08.15.01) and hydraulically bound base courses (according to RVS 08.17.01)

Grade III, IV
Building materials for hydraulically bound base courses, agricultural and forestry road constructions, parking areas, noise protection embankment, fillings, filling materials for roadside ditches, subsoil improvement.

3.4.3 Quality classes – environmental compatibility

In order to protect the environment, and especially ground waters, recycled building materials are classified in the quality classes A+, A and B according to the fields of application indicated in tables 2 and 3.

Quality class A+
Building materials which can be used in unbound form without covering layer in hydro-geologically delicate areas.

Quality class A
Building materials which can be used in hydro-geologically delicate areas in bound form or in unbound form with covering layer or in hydro-geologically less delicate areas in unbound form without covering layer.

Quality class B
Building materials which can be used in hydro-geologically less delicate areas in bound form or in unbound form with covering layer or as
aggregates in unbound form also in hydro-
geologically delicate areas.

3.4.4 Composition of the
designation of recycled
building materials
The designation of recycled building materials
produced according to this guideline consists of:

Material designation, grade, grading curve field,
quality class.

Example: RB II 0/32 A+

4 Engineering properties –
grading regulations

The requirements which have to be complied with
by recycled building materials are laid down in the
grading regulations. The properties which have to
be examined according to the grades I, II, III, IV
are indicated in table 1.

Recycled building materials made of unbound and
hydraulically bound materials and those with a
content of granular asphalt not exceeding 50 %
have to be tested regarding:
• Recovering, delivery
• Processing and storage
• Resistance against fragmentation
• Purity (impurities)
• Grain-size distribution
• Content of foreign materials
• Frost susceptibility
• Frost resistance

As far as RA (recycled crushed granular asphalt)
is concerned the respective material has to be
tested regarding:
• Recovering, delivery
• Processing and storage
• Grain-size distribution
• Particle-size distribution
• Frost susceptibility
• Content of foreign materials
• Purity (impurities)
• Content of binding agents

4.1 Engineering properties and
material composition of
recycled building materials

The requirements regarding engineering proper-
ties and material composition are regulated
according to table 1.

4.1.1 Grain-size distribution

Figures 1 – 14 show the grading curve fields. They
apply to materials as they are on their
delivery. If the grading curves of the tested
material do not correspond to the indicated curve, the
required compressibility and soil bearing
capacity of the respective material have to be
proved in the frame of a test field.

4.1.2 Grading curves of grade I

The grading curve of grade I corresponds to the
RVS 08.15.01

4.1.3 Grading curves of grade II

See figures 5 - 9.

4.1.4 Grading curves of grade III

See figures 10 – 14

4.1.5 Content of foreign materials

Foreign materials are bitumens and materials of
mineral origin which are not included in the
definition of the respective recycled building
material according to point 3.4.1. Principally, the
use of asbestos cement is not permitted.

Foreign materials are:
• with regard to RA: materials which cannot
  be classified as bituminous bound
  materials and associated aggregates (e.g.
  brick, unbound materials)
• with regard to RB: materials which cannot
  be classified as concretes and associated
  aggregates,
• with regard to RAB: materials which
  cannot be classified as bituminous bound
  materials and concretes and associated
  aggregates,
• with regard to RM: all other mineral
  materials resulting from demolition such
  as bricks, ceramic products used in
  construction
• with regard to RG: all other mineral
  materials resulting from demolition such
  as bricks, ceramic products used in
  construction

4.1.6 Impurities

Impurities may be due to:
• Ground surface (Humus)
• Plastic materials
• Wood
• Paperboard, paper
• Metals
• Gypsum
• Other harmless wastes
# Table 1: Engineering properties and material composition

<table>
<thead>
<tr>
<th>Recycled material</th>
<th>RA</th>
<th>RB</th>
<th>RAB</th>
<th>RM</th>
<th>RG</th>
<th>RA</th>
<th>RB</th>
<th>RAB</th>
<th>RM</th>
<th>RG</th>
<th>RA</th>
<th>RB</th>
<th>RAB</th>
<th>RM</th>
<th>RG</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade</td>
<td>Grade I</td>
<td>Grade II</td>
<td>Grade III</td>
<td>Grade IV</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grain-size distribution</td>
<td>must be indicated</td>
<td>According to fig. 1 - 4</td>
<td>-</td>
<td>according to fig. 5-9</td>
<td>-</td>
<td>according to fig. 10-14</td>
<td>-</td>
<td>Maximum-grain-size must be indicated</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Particle-size distribution</td>
<td>according to fig. 1 - 4</td>
<td>-</td>
<td>according to fig. 5-9</td>
<td>-</td>
<td>according to fig. 10-14</td>
<td>-</td>
<td>maximum grain-size must be indicated</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frost-susceptibility</td>
<td>-</td>
<td>(f_{3}; f_{5}^1, f_{7}^1, f_{9}^1, f_{12}^1)</td>
<td>-</td>
<td>(f_{3}; f_{5}^1, f_{7}^1, f_{9}^1, f_{12}^1)</td>
<td>-</td>
<td>(f_{NR})</td>
<td>-</td>
<td>(f_{NR})</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resistance against fragmentation</td>
<td>(LA_{NR})</td>
<td>(LA_{R0})</td>
<td>(LA_{NR})</td>
<td>(LA_{R0})</td>
<td>(LA_{NR})</td>
<td>(LA_{R0})</td>
<td>(LA_{NR})</td>
<td>(LA_{R0})</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water absorption</td>
<td>-</td>
<td>(\leq 4 \text{ M}-%)</td>
<td>(\leq 2 \text{ M}-%)</td>
<td>-</td>
<td>(\leq 4 \text{ M}-%) (2^{(3)})</td>
<td>(\leq 2 \text{ M}-%) (2^{(3)})</td>
<td>-</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frost-dew resistance</td>
<td>(F_4^{(5)})</td>
<td>(F_4^{(6)})</td>
<td>(F_4^{(4)})</td>
<td>(F_4^{(6)})</td>
<td>(F_{NR})</td>
<td>(F_{NR})</td>
<td>(F_{NR})</td>
<td>(F_{NR})</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Content of foreign materials</td>
<td>(\leq 5 \text{ M}-%) (7)</td>
<td>(\leq 5 \text{ M}-%)</td>
<td>(\leq 12 \text{ M}-%)</td>
<td>(\leq 12 \text{ M}-%)</td>
<td>(\leq 25 \text{ M}-%)</td>
<td>(\leq 33 \text{ M}-%)</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Impurities</td>
<td>(\leq 1 \text{ M}-%)</td>
<td>(\leq 1 \text{ M}-%)</td>
<td>(\leq 1 \text{ M}-%)</td>
<td>(\leq 25 \text{ M}-%)</td>
<td>(\leq 33 \text{ M}-%)</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Content of binding agents</td>
<td>(3.5 \text{ M}-%)</td>
<td>(\geq )</td>
<td>(3.0 \text{ M}-%)</td>
<td>(\geq )</td>
<td>(\geq)</td>
<td>(\geq)</td>
<td>(\geq)</td>
<td>(\geq)</td>
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<td></td>
</tr>
<tr>
<td>Mixing ratio</td>
<td>-</td>
<td>must be indicated, (\leq 50 %) asphalt content</td>
<td>-</td>
<td>must be indicated, (\leq 50 %) asphalt content</td>
<td>-</td>
<td>must be indicated</td>
<td>-</td>
<td>must be indicated</td>
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</tr>
</tbody>
</table>

1) If the content of fine particles exceeds 3 % by mass ÖNORM B 4810 has to be considered.
2) The examination of water absorption must be performed on maximum grain-size 4-32.
3) If these maximum values are not exceeded the requirement of \(F_4\) can be regarded as complied with.
4) If the concrete content exceeds 50 % by mass the requirement regarding water absorption corresponds with that of RB, if the application is not regulated by the standard ÖNORM B 3132.
5) As the starting materials for recycled building materials are frost resistant this examination can be omitted. The requirement of \(F_4\) is fulfilled as far as grades I and II are concerned.
6) Proof regarding water absorption
7) Complies with the requirement of “pureness” contained in RVS 08.97.04.

Note:
The content of table 1 represents the basic requirements for the granting of the quality mark for recycled building materials.
Table 2: Application and use of recycled building materials

<table>
<thead>
<tr>
<th>Building material</th>
<th>RA</th>
<th>RB</th>
<th>RAB</th>
<th>RM / RG</th>
<th>Quality class</th>
<th>Environmental compatibility</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade</td>
<td>I</td>
<td>II</td>
<td>III</td>
<td>IV</td>
<td>I</td>
<td>II</td>
<td>III</td>
</tr>
<tr>
<td>Aggregate</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>concrete</td>
<td></td>
<td></td>
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<td></td>
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<td></td>
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<tr>
<td>from C12/15</td>
<td></td>
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<tr>
<td>asphalt</td>
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<tr>
<td>Use</td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>Base course</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Unbound</td>
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<td></td>
</tr>
<tr>
<td>Cement bound</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sub-base course</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bulk</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1) according to RVS 08.15.02
2) according to RVS 08.97.04
3) asphalt content ≤ 50%
4) consent of the contractor is required

= qualified
= qualification must be proven
= additional tests have to be carried out in order to prove the qualification

m.D. = mit Deckschicht – with covering layer
o.D. = ohne Deckschicht – without covering layer
hs = hydrogeologisch sensibles Gebiet – hydrogeologically delicate area
hws = hydro-geologically less delicate area
5 Environmental compatibility – quality regulations

The regulations regarding environmental compatibility have been prepared on the basis of the study “Recycling-Baustoffe; Regelung der Umweltverträglichkeit, Dezember 2002” – “Recycled building materials; regulation regarding the environmental compatibility, December 2002” carried out by the “Umweltbundesamt” (UBA) – “Austrian Environment Protection Agency” – at the request of the “Bundesministerium für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft” (BMLFUW) - Ministry of Agriculture, Forestry, Environment and Water Management.

5.1 Quality classes

Recycled materials produced in recycling plants are classified acc. to their composition in quality classes which are defined by means of a list of parameters and respective limit values (table 3).

5.2 Fields of application

In order to regulate the environmentally compatible use of recycled building materials it is necessary to determine forms of application according to hydro-geological conditions. Fundamentally, the use of recycled building materials of quality class A+ is permitted in water-source preservation areas and in areas with frame conditions regarding water management.

The use of recycled building materials of quality class A+, A and B is subject to defined conditions. This means that the quality of recycled building materials corresponds directly with the possible use (table 4).

An area is to be considered less delicate in respect of hydro-geological conditions if it shows the following criteria:

• existence and sufficient efficiency of layers with low permeability or
• sufficient distance from ground waters.

The application of recycled building materials
• in water-source protection areas and
• in areas with oscillation of ground waters is not permitted.

Table 3: Classification of recycled building materials according to environmental engineering aspects

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Unit</th>
<th>Quality class A+</th>
<th>Quality class A</th>
<th>Quality class B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eluate</td>
<td></td>
<td>7,5-12,5 2)</td>
<td>7,5-12,5 2)</td>
<td>7,5-12,5 2)</td>
</tr>
<tr>
<td>Electric conductivity</td>
<td>mS/m</td>
<td>150 1) 2)</td>
<td>150 1) 2)</td>
<td>150 1) 2)</td>
</tr>
<tr>
<td>Chromium total</td>
<td>mg/kg TS</td>
<td>0,3</td>
<td>0,5</td>
<td>0,5</td>
</tr>
<tr>
<td>Copper</td>
<td>mg/kg TS</td>
<td>0,5</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Ammonium-N</td>
<td>mg/kg TS</td>
<td>1</td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>Nitrite-N</td>
<td>mg/kg TS</td>
<td>0,5</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Sulphate-SO4</td>
<td>mg/kg TS</td>
<td>1.500</td>
<td>2.500</td>
<td>5.000</td>
</tr>
<tr>
<td>KW index</td>
<td>mg/kg TS</td>
<td>1</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Σ16 PAH according to EPO</td>
<td>mg/kg TS</td>
<td>4</td>
<td>12</td>
<td>20</td>
</tr>
</tbody>
</table>

1) If the pH-value ranges between 11.0 and 12.5 the limit value of the electric conductivity is 200 mS/m
2) If the value is exceeded please see point 7.5.2
5.3 General quality properties

The general quality properties are laid down in the publication of the BMLFUW (Ministry of Agriculture, Forestry, Environment and Water Management) „Recycling-Baustoffe; Regelung der Umweltverträglichkeit“, Dezember 2002 – „Recycled building materials; regulation of the environmental compatibility“, December 2002 – in section 5.6 “Allgemeine Qualitätskriterien” - „General quality properties“ on page 125. Practical experiences with recycled building materials have shown that materials which comply with the quality requirements indicated in table 3 can be assumed to correspond with the general quality properties.

If there is a well-founded doubt regarding the correspondence with the general quality properties the manufacturer has to prove the correspondence of the concerned material with the respective parameters at request of the authority.

6 Applications

6.1 Application and use of recycled building materials

Recycled building materials may be used in pure form or in form of mixed materials consisting of aggregates made of natural stone or industrial by-products such as

- aggregates for unbound materials (e.g. according to RVS 08.15.01 or RVS 08.15.02)
- aggregates for hydraulically bound materials (e.g. according to RVS 08.17.01, ÖNORM B 4710-1, RVS 08.17.02 and RVS 08.06.01)
- aggregates for bituminous bound materials (e.g. according to RVS 08.97.05)

Regarding the possibilities of use according to grades see sections 3.4.2 and 4.1 or according to quality classes see sections 3.4.3 and 5.2. Table 2 shows the possibilities of application and use of recycled building materials.

6.2 Construction designs involving recycled materials

According to RVS 03.08.63 recycled building materials which meet the requirements laid down in RVS 08.15.01 or RVS 08.15.02 are considered of equal quality with natural building materials in respect of the use in unbound lower and sub-base courses. The layer designs shown in the tables 8 to 11 of the RVS 03.08.63 may be made only of recycled building materials or may be constructed by alternating layers consisting of recycled material and layers consisting of natural material. Construction designs which do not correspond with the RVS 03.08.63 must be declared and accorded as special designs.

Note: Regarding construction type 3 of the RVS 03.08.63, the unbound sub-base course – restricted to load bearing classes III to VI – has definitely to be made of RA (recycled crushed granular asphalt)

7 Grade and quality surveillance

Assessment methods and the frequency of surveillances have been determined for the respective grades and quality classes in order to prove the complying of the materials with the requirements and the required properties. On the basis of these assessments the quality mark may be acquired according to point 8 of this guideline; in order to acquire the CE-mark the general regulations according to the standard EN 13242 have to be observed additionally.

7.1 First examination (proof of qualification)

The first examination serves to find out whether the control conditions (e.g. possibility of internal control within the factory or by laboratories charged with control, technical conditions, mechanical plants) and the requirements for recycled building materials can be complied with. Material samples have to be taken for the examinations which have to be performed according to the regulations regarding external control. The process of the taking of samples has to be recorded in a document which has to be signed by the persons present at the taking of the sample. If the first examination shows a negative result a re-examination has to be carried out immediately. If the result of this second examination is again negative the respective material definitely does not comply with the requirements of the guideline.

* For regulations regarding the acquisition of the quality mark see section 8.

The first examination has to be carried out once per factory and per kind of granulate (according to section 3.4.1) and per delivered granulation. The tests to be carried out are indicated in table 5 of the assessment regulations.
Table 4: Fields of application according to environmental engineering aspects (minimum requirements)

<table>
<thead>
<tr>
<th>Form of application</th>
<th>Hydro-geologically less delicate area</th>
<th>Hydro-geologically delicate area</th>
</tr>
</thead>
<tbody>
<tr>
<td>in bound form or unbound with covering layer(^1)</td>
<td>quality class B</td>
<td>quality class A</td>
</tr>
<tr>
<td>unbound without covering layer(^1)</td>
<td>quality class A</td>
<td>quality class A*</td>
</tr>
<tr>
<td>in bound form, used as aggregate</td>
<td>quality class B</td>
<td>quality class B</td>
</tr>
</tbody>
</table>

\(^1\) Definition of the covering layer according to RVS 01.02.11, fundamentals, definitions, structural engineering (September 1984)

7.2 Internal control

The recycling factory is obliged to perform the internal control and to assume the responsibility for a continuous control which guarantees the complying with the determined requirements. If the factory has no possibilities to carry out internal control it is obliged to charge an extern laboratory with the internal control. The results of the examinations have to be recorded in documents. The respective form must contain the following data:

- denomination and origin of the material
- tests carried out
- name of the tester, place, date
- evaluation and analysis of the comparison with determined requirements
- report about defects and measures to eliminate them

If the internal control shows that the requirements determined in the grade and quality regulations are not met, the recycling factory has to take immediately all possible internal measures to eliminate the defects. If a recycled material does not correspond with the grade or quality regulations regarding its grade or class, the respective material has to be classified in another class or - if this is not possible - has to be disposed in an appropriate way. The tests to be carried out are indicated in table 6 of the assessment regulations.

The records of the taking of samples and the test results must always be available.

7.3 External control

The recycling factory charges testing institutes authorized by the Austrian Recycled Construction Materials Quality Insurance Association with performing the required external tests. These institutes carry out the tests in the frame of the external control. The external control serves the purpose to examine whether the recycled building materials meet the determined requirements.

The frequency in which the tests have to be performed is indicated in table 5. In this regard it has to be considered that the respective second test may be omitted, if the production time of the respective granulation does not exceed 20 days a calendar year.

The records of the taking of samples and the test results must always be available.

7.3.1 External control in respect of structural engineering

Samples have to be taken in order to carry out the tests according to the assessment regulations. The process of the taking of the samples has to be recorded in a document which has to be signed by all persons present at the taking of the sample. If a certain parameter does not comply with the requirements set by this guideline, the examination of the respective parameter – and not the whole examination process – has to be repeated immediately. If the result of this second examination is again negative the respective material has to be classified in another grade or class or – if this is not possible – has to be disposed appropriately. The tests to be carried out are indicated in table 5 of the assessment regulations.

7.3.2 External control of environmental compatibility

In order to perform the external control, 3 field samples are taken (definition according to ÖNORM S 2123-1; issue 1\(^{st}\) November 2003) have to be carried out. The quantity of each of this 3 field samples must not exceed 1,500 t. The examination of the first sample in every case consists in the analysis of all parameters indicated in table 3. If the examination of this sample shows that one or more parameters (except pH-value) exceed 80 % of the limit value set for the respective class, the other samples have to be
analysed regarding the respective parameters. If the examination is carried out on three samples, the respective limit value is to be considered as not exceeded if the medium value of the three examinations does not exceed the respective limit value and if the highest value measured in the three examinations does not exceed 100 % of the respective limit value. If the result of the examination is negative, the respective material has to be classified in another quality class or – if this is not possible – has to be disposed appropriately.

7.4 Obligations regarding documentation and identification

The records must guarantee the documentation of all materials used in the production of the respective material. In the same way, it has to be documented which internal and external controls are relevant for the respective material. The general obligations according to the regulations regarding waste documentation are not affected by this obligation. In any case, the identification must reveal which materials have been used in the production of the respective building material and to which grade and quality class the building material corresponds. Moreover, the quality class of the respective product must be identified.

7.5 Testing modalities

7.5.1 Testing of foreign materials, impurities and material ratio

The examination of foreign materials, impurities and material ratio has to be carried out in analogy with the Austrian standard ÖNORM EN 933-5 (point 8.2) considering samples of grain classes ranging from 4 to maximum-size grain. The results are related to grain classes 4 to maximum-size grain.

The materials are sorted by visual inspection according to
- grains representing foreign materials (see section 4.1.5),
- grains representing impurities (see section 4.1.6)

In order to analyse the mixing ratio the materials have to be additionally sorted according to
- grains classed with crushed asphalt
- grains classed with crushed concrete
- stone (natural and/or recycled)

7.5.2 Determination of pH value and electric conductivity

When determining the pH value and the electric conductivity of recycled concrete materials and associated mixes a rapid carbonizing according to the standard ON S 2116-3 has to be performed, if the determined pH value and/or the electric conductivity exceed the respective maximum permitted value. This means that the respective material (maximum-grain size 10mm, water content 10%) is fumigated with air-CO₂ mix (30 volume percent) for a time period of three days. Afterwards, another examination of the eluate has to be performed.

7.5.3 Examination of PAH (EPO)

Regarding the examination of PAH (EPO) according to ÖNORM L1200 the material has to be dried at 30°C before extraction.

7.5.4 Internal control of environmentally relevant criteria

The following parameters have to be analysed in every case in the frame of the internal control which has to be carried out on the respective building material twice a month:
- Total amount: Σ₁₆ PAH according to EPO
- Eluate: pH-value, electric conductivity, chromium, copper

7.5.5 Quality assurance

The takings of samples have to be performed according to ÖNORM EN 932-1 in the frame of the quality assurance.

7.5.6 Simplified testing modalities

Simplified testing modalities may be applied if a factory produces building materials of uniform kind, grade and quality class according to the guideline but of different granulations (e.g. RA I 0/22 A and RA I 0/45 A). In this case only the material with the smaller maximum-grain size has to be subject to the whole external examination process whereas the other material(s) has(have) to be subject only to examinations regarding grain-size or particle-size distribution and frost susceptibility.

If a building material the grade of which is assured is produced in yearly quantities lower than 10.000 tons per delivered granulation only one external examination in the first half year has to be carried out. At least one external examination has to be carried out per calendar year in any case.
8 Acquiring of quality marks for recycled building materials

The “Gütezeichen für Recycling-Baustoffe” - “Quality mark for recycled building materials” of the “Österreichischer Güteschutzverband Recycling-Baustoffe (ÖGSV) - “Austrian Recycled Construction Materials Quality Insurance Association” may be granted for recycled building materials which comply completely with all requirements of the „Guideline for Recycled Building Materials” and of the assessment regulations. In any case, the manufacturers of building materials identified by this quality mark guarantee for the complying with the above mentioned requirements regarding environmental compatibility.

8.1 Conditions for the granting of quality marks

The quality mark for recycled building materials may be granted only to members of the ÖGSV and on application.

8.2 First examination (proof of qualification)

The first examination (proof of qualification) is carried out by a laboratory which the manufacturer can choose from an updated list of laboratories authorized by the ÖGSV. It is not possible to change the institute with a calendar year.

Subsequently, the manufacturer and the chosen testing institute have to write for each factory an accordance about the first examination and the external examination (forms available from the ÖGSV) and to forward it to the ÖGSV.

At the first examination all conditions set for the chosen grade or quality class and the chosen kind of building material must be complied with. The tests to be carried out are indicated in table 5 of the assessment regulations.

The result of the positive first examination has to be documented in a standardized result report (form to be filled in) which has to be signed and stamped by the testing institute. In this report the complete complying with all important conditions has to be documented (e.g. possibility of internal control, technical conditions, plants, complying with technical requirements). The complete examination report and the related completely filled in form of the result report must be forwarded to the ÖGSV by the laboratory. If one parameter does not meet the requirements of this guideline only the respective examination has to be repeated, not the whole examination process.

The formal application for the quality mark has to be made by the declaration of commitment (form available from the ÖGSV) which has to be filled in and forwarded to the ÖGSV. Beside the respective building materials in this form have to be indicated the tester who performed the internal control and the external testing institute.

Table 5: Assessment regulations for the first examination (proof of qualification) and external control

<table>
<thead>
<tr>
<th>GRADES I and II</th>
<th>Test according to</th>
<th>1st EC</th>
<th>2nd EC</th>
<th>RA</th>
<th>RB</th>
<th>RAB</th>
<th>RM</th>
<th>RG</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grain-size distribution</td>
<td>EN 933-1</td>
<td>x</td>
<td>x</td>
<td>I, only</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Particle-size distribution</td>
<td>EN 933-1</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frost susceptibility</td>
<td>B 4810</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Frost resistance</td>
<td>EN 1097-6 / B 3132</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Resistance against fragmentation</td>
<td>EN 1097-2</td>
<td>x</td>
<td>x</td>
<td></td>
<td>x</td>
<td>x</td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>Content of foreign materials</td>
<td>see section 7.5.1</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Impurities</td>
<td>see section 7.5.1</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Content of binding agents</td>
<td>EN 12697-1</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mixing ratio</td>
<td>see section 7.5.1</td>
<td>x</td>
<td>x</td>
<td></td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Environmental compatibility</td>
<td>see section 5</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
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### GRADES III and IV

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<th>2nd EC</th>
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<th>RB</th>
<th>RAB</th>
<th>RM</th>
<th>RG</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grain-size distribution</td>
<td>EN 933-1</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Particle-size distribution</td>
<td>EN 933-1</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Content of foreign materials</td>
<td>see section 7.5.1</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
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<td>x</td>
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<td>Impurities</td>
<td>see section 7.5.1</td>
<td>x</td>
<td>x</td>
<td>x</td>
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<td>x</td>
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<td>x</td>
</tr>
<tr>
<td>Mixing ratio</td>
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<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Environmental compatibility</td>
<td>see section 5</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
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<td>x</td>
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</table>

### Table 6: Assessment regulation for internal control

<table>
<thead>
<tr>
<th>GRADES I and II</th>
<th>Test according to</th>
<th>RA</th>
<th>RB</th>
<th>RAB</th>
<th>RM</th>
<th>RG</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recovering, delivery</td>
<td>visual inspection with indication of:</td>
<td></td>
<td></td>
<td>per load</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>• waste owner</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• waste location</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• place of recovering</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• supplier</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Processing</td>
<td>visual inspection</td>
<td></td>
<td></td>
<td>daily</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Storage</td>
<td>visual inspection</td>
<td></td>
<td></td>
<td>daily</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grain-size distribution</td>
<td>EN 933-1</td>
<td></td>
<td></td>
<td>once a week</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Particle-size distribution</td>
<td>EN 933-1</td>
<td>once a week</td>
<td></td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resistance against fragmentation</td>
<td>EN 1097-2</td>
<td>-</td>
<td>twice a year</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frost resistance</td>
<td>EN 1097-6 / B3132</td>
<td>-</td>
<td>twice a month</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Content of foreign materials</td>
<td>see section 7.5.1</td>
<td>once a week</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Impurities</td>
<td>see section 7.5.1</td>
<td>once a week</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Content of binding agents</td>
<td>EN 12697-1</td>
<td>once a month</td>
<td></td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Environmental compatibility</td>
<td>see section 5</td>
<td></td>
<td></td>
<td>twice a month</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### 8.3 Granting of the quality mark

After the ÖGSV has received the accordance, the declaration of commitment and the positive result of the qualification test (examination report and result report) the request is examined by the managing board.

If the result of this examination is positive, the quality mark is granted by the president of the ÖGSV to the respective factory (not to the business as a whole) for the respective recycled building material classified with a specific grade or quality class.

### 8.4 Use of the quality mark

Fundamentally, the quality mark can be used only after it has been granted by the „Güteschutzverband Recycling-Baustoffe“ – “Austrian Recycled Construction Materials Quality Insurance Association“. Together with the quality mark the respective classification of the recycled building material has to be indicated.

According to the guidelines and regulations the quality mark may be indicated in price lists and similar documents.

Recycled building materials which are not controlled by means of grade and test regulations must be indicated separately or identified by the manufacturer.

### 8.5 Internal control

The internal control has to be carried out according to the declaration of commitment by the member factory or by a laboratory charged with the internal control.

Every manufacturer has to prepare regularly operating reports and result reports. Kinds and frequencies of the tests are indicated in table 6.

The operating reports and the result reports must be forwarded regularly to the ÖGSV (quarterly, at least half-yearly). If internal examinations need not to be carried out (production times according to table 6) because the quantity of the produced material remains under the threshold value, the operating report must in any case be presented to the ÖGSV. A possible change of the laboratory charged with the internal control has to be reported immediately.

---

<table>
<thead>
<tr>
<th>GRADES III and IV</th>
<th>Test according to</th>
<th>RA</th>
<th>RB</th>
<th>RAB</th>
<th>RM</th>
<th>RG</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recovering, delivery</td>
<td>visual inspection with indication of:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• waste owner</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• waste location</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• place of recovering</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• supplier</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>per load</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Processing</td>
<td>visual inspection</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Storage</td>
<td>visual inspection</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grain-size distribution</td>
<td>EN 933-1</td>
<td>-</td>
<td></td>
<td></td>
<td>once a week</td>
<td></td>
</tr>
<tr>
<td>Particle-size distribution</td>
<td>EN 933-1</td>
<td>once a week</td>
<td></td>
<td></td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Content of foreign materials</td>
<td>see section 7.5.1</td>
<td></td>
<td></td>
<td></td>
<td>once a week</td>
<td></td>
</tr>
<tr>
<td>Impurities</td>
<td>see section 7.5.1</td>
<td></td>
<td></td>
<td></td>
<td>once a week</td>
<td></td>
</tr>
<tr>
<td>Environmental compatibility</td>
<td>see section 5</td>
<td></td>
<td></td>
<td></td>
<td>twice a month</td>
<td></td>
</tr>
</tbody>
</table>
8.6 External control
Every member factory has to charge the laboratory indicated in the respective declaration of commitment with the performance of external examinations in the frequency indicated in table 5. The factory is obliged to ensure that the required number of tests are carried out. The laboratory concerned can determine at which time the tests are performed. The tests to be carried out are indicated in table 5.
A copy of the examination report and the related result report (filled in form) of the external examination have to be forwarded to the ÖGSV by the external laboratory. The result report must reveal the positive result of the test. Moreover, the external laboratory must document in this report whether the operating report and the result report of the internal control have been prepared regularly and correctly.
The laboratory indicated in the declaration of commitment may be changed at the end of a year or if the first indicated laboratory is cancelled from the list of the Quality Insurance Association.

8.7 Punishment of offences
If there are resulting any defects regarding the process of quality assurance the managing board takes measures of punishment according to the seriousness of the offence. Normally, these measures consist in:
• the setting of additional conditions regarding internal control
• more external control
• warning
• limited or definite deprivation of the quality mark.
The above mentioned measures may also be combined.
Users of the quality mark who violate repeatedly and seriously the correct use of the quality mark or the quality and testing regulations may be deprived of the quality mark for a limited or unlimited period.
Before a measure is taken the manufacturer concerned has to be heard.
In urgent cases, an immediate temporary deprivation of the quality mark may be performed by the president of the Austrian Recycled Construction Materials Quality Insurance Association. This procedure must be confirmed by the managing board within the following 14 days.

8.8 Complaints
Users of quality marks have the possibility to make a complaint about the punishment notice at the ÖGSV within 14 days after its delivery. The rejection of the complaint has to be substantiated.

8.9 Returning or deprivation of the quality mark
In the case of returning (termination of production, changing of grade) or deprivation of the quality mark the granting certificate has to be returned immediately.

8.10 Re-granting
If the license to use the quality mark has been deprived, an application for re-granting can be made after a period of three months. The process is regulated according to section 8.3 of the guideline. The managing board, however, can set additional conditions.

8.11 Forms
The following forms are available from the ÖGSV:
• form of application for becoming a member of the ÖGSV
• Form of accordance („control contract“)
• Declaration of commitment
• Result report (costs must be paid)
• Operating report (costs must be paid)
Grading curves

Figures referring to section 4.1.2 grading curve ranges of grade I

Figure 1: grading curve range 0/22 for base courses, grade I, RA\(^1\), RB, RAB, RM, RG

Figure 2: Grading curve range 0/32 for base courses, grade I, RA\(^1\), RB, RAB, RM, RG

\(^1\) Regarding RA this figure indicates particle-size distribution
\(^2\) Regarding RA
Figure 3: Grading curve range 0/45 for base courses, grade I, RB, RAB, RM, RG

Figure 4: Grading curve range 0/63 for base courses, grade I, RB, RAB, RM, RG
Figures referring to section 4.1.3 Grading curve ranges of grade II

Figure 5: Grading curve range 0/22 for sub-base courses, grade II, RA\textsuperscript{1)}, RB, RAB, RM, RG

![Grading curve range 0/22](image1)

Figure 6: Grading curve range 0/32 for sub-base courses, grade II, RA\textsuperscript{1)}, RB, RAB, RM, RG

![Grading curve range 0/32](image2)

\textsuperscript{1}) Regarding RA this figure indicates particle-size distribution
Figure 7: Grading curve range 0/45 for sub-base courses, grade II, RB, RAB, RM, RG

Figure 8: Grading curve range 0/63 for sub-base courses, grade II, RB, RAB, RM, RG
Figure 9: Grading curve range 0/90 for sub-base courses, grade II, RB, RAB, RM, RG

Figures referring to section 4.1.4 grading curve ranges of grade III

Figure 10: Grading curve range 0/22 for sub-base courses, grade III, RB, RAB, RM, RG
Figure 11: Grading curve range 0/32 for sub-base courses, grade III, RA, RB, RAB, RM, RG

Figure 12: Grading curve range 0/45 for sub-base courses, grade III, RB, RAB, RM, RG
Figure 13: Grading curve range 0/63 for sub-base courses, grade III, RB, RAB, RM, RG

Figure 14: Grading curve range 0/90 for sub-base courses, grade III, RB, RAB, RM, RG
Annex 3: Austrian Guideline for recycled building materials ("red" guideline – structural engineering)
Guideline for Construction Materials made from Recycled Demolition Waste from Above-ground Construction

Red Guideline, 1st issue, August 2007

Applicable fields:
Unbound Materials or Cement Bound Materials and Recycled Sand from Mineral Waste
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Preamble

The Austrian Recycled Construction Materials Quality Assurance Association has undertaken the following task: to guarantee the quality of recycled building materials and to assure their quality based on the issuance of quality certifications/marks for recycled construction materials.

The guidelines and the quality regulations contained herein are intended to set the regulatory requirements as well as to specify the kind and the extent of tests for recycled building materials. They serve to standardize these requirements and to set a uniform system of designation and technical classification.

The aim in recycling building materials is to reach a quality standard which meets the requirements corresponding to the future use of recycled building materials.

The necessity to define both CE regulations regarding the production and use of recycled construction materials and regulations regarding the environmental compatibility corresponding to the current environmental law has led to a revision of the guidelines, merging the three previous guidelines listed below into one single guideline:

- Guideline for Construction Materials made from Recycled Demolition Waste from Above-ground Construction
  Applicable field: cement bound materials
- Guideline for Construction Materials made from Recycled Demolition Waste from Above-ground Construction
  Applicable field: unbound materials
- Guideline for Recycled sand from mineral waste

The present guideline has been revised by the Austrian Recycled Construction Materials Quality Assurance Association in collaboration with committees made up of both specialists and end users.

Products coming from other EU member states, EEC states or Turkey which have not been produced according to the present guideline but according to the regulations, standards and other technical specifications valid in the respective country as well as the related assessment and surveillance procedures are regarded as equivalent to Austrian products and procedures as far as the levels of quality assurance (quality levels) are confirmed to correspond to those defined in this guideline.

The entities authorized to prepare appropriate certifications and inspection and surveillance reports must give appropriate and sufficient guarantees with regard to their technical and professional qualifications as well as to their independence. Such guarantees are given for example by those entities which are accredited on the basis of the criteria set by the European Standards of the series EN 45000.
1 Applicable Field

The guideline regulates the requirements and properties of products made from above-ground demolition waste which is intended for reuse or recycling. This setting of quality standards also specifies the kind and the extent of assessments which have to be carried out on recycled construction materials. The quality standards cover the use of recycled construction materials which are mineral materials according to the following criteria:

- Recycled construction materials (RMH) 1):
  - Densified fillings 2): e.g. noise protection barriers, road construction and trenches (below frost level)
  - Loose fillings 2): e.g. back-fillings, fillings
  - Materials used for conduit zones: e.g. waste ducts, gas lines, waterlines, etc.
  - Hydraulically bound applications

- Recycled construction material (RS) 1):
  - Filling materials for electric and telecommunication conduits
  - Materials used for conduit zones: e.g. waste ducts, gas lines, waterlines, etc.
  - Other infrastructural facilities

- Recycled construction material (RZ, RHZ, RH) 1):
  - Materials used for conduit zones: e.g. waste ducts, gas lines, waterlines, etc.
  - Aggregates
  - Construction of sports facilities
  - Roof landscaping
  - Production of cement bound construction materials and construction parts (e.g. concrete, bricks, hollow blocks, screed)

1) for material designation see section 3.4.1
2) according to the precondition of what is defined in section 6

2 Norms and Technical Regulations

Guidelines for Construction Materials, Green Guideline
Austrian Recycled Construction Materials Quality Assurance Association; latest edition

Best Practice Checklist „Intermediate Storage of Mineral Demolition Waste, Asphalt and Concrete Demolition Waste“
Austrian Recycled Construction Materials Quality Assurance Association; latest edition

Best Practice Checklist „Mobile Processing of Demolition Waste“
Austrian Recycled Construction Materials Quality Assurance Association; latest edition

RVS 01.02.11
Begriffsbestimmungen; Bautechnik; Ausgabe September 1984
Definition of Terms; Civil Engineering; issue September 1984

RVS 08.03.01
Technische Vorschriften und Anleitung für Erdarbeiten; Ausgabe November 1979
Technical Regulations and Instructions for Excavation; issue November 1979

ÖNORM B 2232
Estricherarbeiten – Werkvertragsnorm; Ausgabe: Mai 2007
Screed Works – Service Contract Standards; issue May 2007

ÖNORM B 2251
Abbrucharbeiten; Werkvertragsnorm; Ausgabe August 2006
Demolition Works; Service Contract Standards; issue August 2006

ÖNORM B 2606-2
Sportplatzbeläge - Tennenbeläge; Ausgabe September 2000
Flooring Systems for Sports Fields – Barn Floors; issue September 2000

ÖNORM B 3131
Gesteinskörnungen für Beton; Regeln zur Umsetzung der ÖNORM EN 12620; Ausgabe Oktober 2006
Aggregates for Concrete Aggregates; Rules for the Implementation of the Standard ÖNORM EN 12620; issue October 2006

ÖNORM B 3132
Gesteinskörnungen für ungebundene und hydraulisch gebundene Gemische für Ingenieur- und Straßenbau – Regeln zur Umsetzung der ÖNORM EN 13242; Ausgabe Oktober 2006
Aggregates for Unbound and Hydraulically bound Mixtures used in Civil Engineering and Road Construction – Rules for the Implementation of the Standard ÖNORM EN 13242; issue October 2006
3 General Requirements

3.1 Recovery

Demolition waste from above-ground constructions which can be reused or recycled primarily results from the demolition of buildings and civil engineering structures.

The material to be processed must consist of mineral demolition waste, such as bricks, concrete, mortar, stone and building ceramics or may be a mixture of these materials.

In this regard, the production of pure materials must be seen as essential, and is achieved by observing guidelines such as the Austrian standard ÖNORM B 2251. Accurate on-site sorting of demolition waste helps to improve the quality of recycled building materials. The processed demolition waste has to be mostly free of impurities. If there are any impurities they have to be removed so that the content of impurities in recycled building materials is less than 1 percent by weight.

Dangerous substances, for example asbestos, asbestos cement, PCB-containing fill materials or tar-containing construction materials must be excluded!

If there are any contaminants suspected, for example due to the origin of the material, the respective demolition waste must be removed in every case from the recycling process if the required pureness cannot be proven.

3.2 Delivery, Sorting and Processing

3.2.1 Delivery

On delivery the origin and possible contaminations of the demolition waste have to be evaluated and documented in the course of a first inspection. A first evaluation and pre-sorting of the waste with regard to its usability must be made immediately at the time of delivery. In particular, it has to be ensured that only appropriate and authorized materials are accepted.

3.2.2 Sorting

The delivered materials have to be pre-sorted in order to classify them according to their quality. Pre-sorted materials have to be stored separately. The best practice guidelines entitled “Intermediate Storage of Mineral Demolition Waste, Asphalt and Concrete Waste” and “Mobile Processing of Demolition Waste” must be observed. If in doubt, the respective material possibly has to be classified in a lower quality class or simply removed.

3.2.3 Processing

For the processing of the materials, appropriate processing plants and plant facilities must fit the intended use of the respective product (see table 2).
Note: The recycling of waste resulting from demolition of civil and underground engineering structures is regulated by the „Guideline for Recycled Construction Materials“ for the field of application “reuse and recycling of hydraulic or bituminous bound as well as unbound mineral demolition waste”. In order to recover the maximum amount of pure waste from the demolition of above-ground constructions, the demolitions should be carried out according to the guideline “Recycling-oriented Demolition” (regarding ÖNORM B 2251 “Demolition Works”)

3.3 Storage
Recycled building materials have to be stored separately according to grade and quality class. In this regard it has to be ensured that deteriorations in quality (e.g. contaminations, mixing, separation) are avoided.

Note: In regard to the storage and processing of demolition waste as well as to recycled construction materials the criteria contained in the best practice guideline “Intermediate Storage of Demolition Waste and Asphalt and Concrete Waste” prepared by the BRV (Austrian Recycled Construction Materials Association) must be observed.

3.4 Designation of Recycled Construction Materials

3.4.1 Designation of Materials
According to this guideline, recycled construction materials are made from properly sorted waste resulting from demolition of suitable above-ground structures and construction parts or from pure materials entirely extracted from waste resulting from demolition of above-ground constructions. They mainly consist of concrete, bricks and natural stone. In processing these materials, the following recycled construction materials are produced:

- RMH Recycled mineral waste resulting from demolition of above-ground constructions
- RS Recycled sand
- RZ Recycled brick sand; recycled granular brick
- RHZ Recycled brick sand resulting from above-ground constructions; recycled granular brick resulting from above-ground constructions
- RH Recycled above-ground construction sand, recycled granular materials from above-ground construction

3.4.2 Grades – Civil Engineering Classification Scheme
According to the fields of application indicated in Table 2, recycled construction materials are classified in the following grades (according to the systematics defined in the “Green Guideline”):

- Grade III recycled construction material having the defined grading curve range (see figures 1-8)
- Grade IV recycled construction material having a defined maximum grain size

These construction materials are appropriate for usage according to point 6.

3.4.3 Quality classes – Environmental Compatibility
In order to protect the environment, and especially ground water, recycled building materials are classified into the quality based classes A⁺, A, B and C according to the fields of application indicated in Tables 3 and 4. Here it should be noted that also higher quality classes than referred to may be used for the respective purpose.

- Quality class A⁺ Building materials which can be used in unbound form without cover layer in hydro-geologically sensitive areas.
Quality class A

Building materials which can be used in hydro-geologically sensitive areas in bound form or in unbound form with cover layer or in less hydro-geologically sensitive areas in unbound form without cover layer.

Quality class B

Building materials which can be used in less hydro-geologically sensitive areas in bound form or in unbound form with cover layer or as aggregates in unbound form also in hydro-geologically sensitive areas.

Quality class C

Construction materials which are used

a) only for engineering purposes within an enclosure of a waste-site of non-harmful waste under the following conditions:
   ▪ necessary according to civil engineering demand
   ▪ fit with civil engineering criteria
   ▪ of sufficient quantity
   ▪ coverage in plans

Examples:
   ▪ planned dams
   ▪ drainage layers specified in the waste-site project
Waste-site roads and levelling layers are not considered to meet civil engineering purposes.

b) in the frame of securing or restoration measures for an existing structure or an inherited damage. Works of this type must be approved by the authorities over the course of a project.

3.4.4 Arrival at a System for Designation of Recycled Building Materials

The designation of recycled construction materials produced according to this guideline consists of:

Material designation, grade, grading curve field, quality class.

Example: RMH III 0/32 B

4 Engineering Properties – Grading Regulations

The requirements which must be complied with by recycled construction materials are specified in the grading regulations. The properties which have to be examined according to the grades III, IV are indicated in Table 1.

Recycled construction materials made from waste resulting from above-ground constructions have to be tested regarding:

- recovery, delivery
- processing and storage
- grain-size distribution
- water content
- bulk density (dry)
- specific heat resistance (dry)
- Flowability at the time of delivery
- apparent density
- content of foreign substances
- impurity (pureness)
- impurities caused by organic substances (soil content)
- content of brick material
4.1 Civil Engineering Properties and Material Composition of Recycled Construction Materials

The requirements regarding engineering properties and material composition are regulated according to Table 1.

4.1.1 Grain-size distribution

Figures 1 – 8 show the grading curve fields of the granular mixes. They apply to materials as they are at the time of their delivery. If the grading curves of the tested material do not correspond to the indicated curve, the required compressibility and soil bearing capacity of the respective materials have to be proven via a test in the field.

The grain classes are defined in Table 1.

4.1.2 Grading Curve Ranges for RS

See Figure 1.

4.1.3 Grading Curves of Grade III

See Figures 2 – 8

4.1.4 Content of Foreign Materials

Foreign materials are:
- asphalt
- gaseous concrete

Foreign materials are mainly materials of mineral origin which are not included in the definition of the respective recycled construction material according to point 3.4.1.

4.1.5 Impurities

Impurities may be due to:
- plastic materials
- wood
- cardboard, paper
- metals
- glass and glass construction parts
- gypsum plasterboards
- wood-wool slabs
- insulation materials
- other not-harmful wastes
<table>
<thead>
<tr>
<th>Civil engineering properties</th>
<th>Recycled Construction Material</th>
<th>Grade</th>
<th>Grain-size distribution</th>
<th>Water content</th>
<th>Bulk density (dry)</th>
<th>Specific heat resistance (dry)</th>
<th>Flowability at the time of delivery</th>
<th>Apparent density</th>
<th>Content of foreign materials</th>
<th>Impurities</th>
<th>Organic impurities (soil content)</th>
<th>Brick content</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>according to Fig. 1</td>
<td>5 - 12 M-%</td>
<td>-</td>
<td>≤ 6.0 Km/W (^{(1)})</td>
<td>obviously no clotting tendency</td>
<td>-</td>
<td>RA ≤ 10 M-% (^{(3)})</td>
<td>≤ 1 M-%(^{(4)})</td>
<td>-</td>
<td>≤ 85 M-%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>gem. Abb. 2-8 (D \leq 63, G_{A} 75)</td>
<td></td>
<td>-</td>
<td>Ga 80</td>
<td>Ga 80-20</td>
<td>-</td>
<td>≤ 12 M-%</td>
<td>≤ 5 M-%</td>
<td>lighter than colour reference solution(^{(5)})</td>
<td>&lt; 33 M-%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Ga 80-20</td>
<td></td>
<td>-</td>
<td>Gc 85/20 (2)</td>
<td>Gc 80-20</td>
<td>-</td>
<td></td>
<td>≤ 12 M-%</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-</td>
<td></td>
<td></td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\(^{1}\) This requirement is considered as fulfilled if the bulk density in condition \(\geq 1.15\) Mg/m³.

\(^{2}\) Must be submitted if used as aggregate according to ÖN B 3131.

\(^{3}\) RS 0/4 with a maximum RA-content of 10 M-% may be used, if there is no warming in the immediate proximity (e.g., due to cables) and if possible solidifications are accepted.

\(^{4}\) The investigation of impurities in grains of class 2/maximum grain size has to be performed analogously to the standard EN 933-5.

\(^{5}\) According to the standard ÖNORM EN 1744-1.
<table>
<thead>
<tr>
<th>construction material</th>
<th>grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>bricks and hollow blocks</td>
<td>-</td>
</tr>
<tr>
<td>concrete</td>
<td>☐</td>
</tr>
<tr>
<td>light-weight concrete</td>
<td>☐</td>
</tr>
<tr>
<td>screed and screed in bulk format</td>
<td>☐</td>
</tr>
<tr>
<td>ground improvement/stabilization</td>
<td>☐</td>
</tr>
<tr>
<td>bulks</td>
<td>☑</td>
</tr>
<tr>
<td>fillings of utility trenches and covering of cables</td>
<td>☑</td>
</tr>
<tr>
<td>bedding material for cable areas</td>
<td>☒</td>
</tr>
<tr>
<td>backfilling and covering of structures</td>
<td>☑</td>
</tr>
<tr>
<td>cover layers and spread layers in sports structures</td>
<td>☒ ³</td>
</tr>
<tr>
<td>substrates for planting purposes (aggregate)</td>
<td>☒ ³</td>
</tr>
<tr>
<td>construction materials used for waste site constructions</td>
<td>☑</td>
</tr>
<tr>
<td>drainage material</td>
<td>☐</td>
</tr>
<tr>
<td>unbound construction methods</td>
<td></td>
</tr>
<tr>
<td>flowable self-thickening filling material</td>
<td>☑</td>
</tr>
</tbody>
</table>

- ☑... suitable
- ☒... qualification must be confirmed
- ☐... additional tests are required to confirm the qualification

³ ... brick content must be submitted

Table 2: Application and Use of Recycled Construction Materials
5 Environmental Compatibility – Quality Regulations

5.1 Quality classes

Recycled materials produced in recycling plants are classified into quality classes according to their composition. The classes are defined by means of a list of parameters and associated limit values (Table 3).

5.2 Fields of Application

In order to regulate the use of environmentally sustainable recycled building materials, it is necessary to determine the type of application with regard to hydro-geological application areas. Fundamentally, the use of recycled building materials of quality class A+ is permitted in water-source preservation areas and in areas with set conditions for water management.

The use of recycled building materials of quality class A+, A and B is subject to predefined conditions. This means that the quality of recycled building materials corresponds directly with the possible use (Table 4).

An area is to be considered less fragile in respect to hydro-geological conditions if it shows either or both of the following criteria:

- existence and sufficient efficiency of layers with low permeability
- sufficient distance from ground waters

The application of recycled building materials is not permitted in the following areas

- in water-source protection areas
- in areas with changing ground water levels.

The use of recycled construction materials of quality class C is permitted only for construction purposes within the enclosure of a waste site for not-harmful waste.

Table 3: Classification of recycled building materials according to environmental engineering aspects

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Unit</th>
<th>Quality class A+</th>
<th>Quality class A</th>
<th>Quality class B</th>
<th>Quality class C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eluate</td>
<td></td>
<td>7,5-12,5(^{2})</td>
<td>7,5-12,5(^{2})</td>
<td>7,5-12,5(^{2})</td>
<td>6-13</td>
</tr>
<tr>
<td>pH-value</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electric</td>
<td>mS/m</td>
<td>150(^{1(2)})</td>
<td>150(^{1(2)})</td>
<td>150(^{1(2)})</td>
<td>300</td>
</tr>
<tr>
<td>Conductivity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chromium total</td>
<td>mg/kg TS</td>
<td>0,3</td>
<td>0,5</td>
<td>0,5</td>
<td>2</td>
</tr>
<tr>
<td>Copper</td>
<td>mg/kg TS</td>
<td>0,5</td>
<td>1</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td>Ammonium-N</td>
<td>mg/kg TS</td>
<td>1</td>
<td>4(^{3})</td>
<td>8</td>
<td>40</td>
</tr>
<tr>
<td>Nitrite-N</td>
<td>mg/kg TS</td>
<td>0,5</td>
<td>1(^{3})</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td>Sulphate-SO(_4)</td>
<td>mg/kg TS</td>
<td>1.500</td>
<td>4.500</td>
<td>6.000(^{4})</td>
<td>10.000</td>
</tr>
<tr>
<td>KW-Index</td>
<td>mg/kg TS</td>
<td>1</td>
<td>3</td>
<td>5</td>
<td>50</td>
</tr>
</tbody>
</table>

\(^{1}\) If the pH-value ranges between 11,0 and 12,5 the limit value of the electric conductivity is 200 mS/m

\(^{2}\) If the value is exceeded please see point 7.5.2

\(^{3}\) The limit value is regarded as not exceeded if all arithmetical average values resulting from all examinations performed during the last 12 months do not exceed this value and if single values are not exceeded by more than 65%.

\(^{4}\) In case of a Ca/SO\(_4\)-ratio in the eluate ≥ 0.43 the limit value is 8,000 mg/kg TS

The use of recycled construction materials instead of material excavated on-site requires the confirmation of the necessary amounts according to a project. Depending on the case, the best practice checklist "Reuse/Recycling of Excavation Material" or the respectively valid guidelines for recycled construction materials must be observed in any case.
5.3 General Quality Properties

Practical experience with recycled building materials has shown that materials which comply with the quality requirements indicated in Table 3 can be assumed to correspond with the general quality characteristics. If there is a reasonable doubt regarding the correspondence with the general quality characteristics, the values defined for the parameters concerned in the BAWP 2006 (Austrian Waste Management Plan 2006), page 152 have to be examined at the request of the authority.

The manufacturer has to take special care to observe the limit values for the eluate parameters antimony and evaporation residue and the total content of lead, copper and PAK16.

6 Application and Use

Recycled building materials may be used in pure form or as mixed materials consisting of aggregates made of natural stone or industrial by-products for the following purposes

- Unbound construction methods, for example:
  - Bulk filling 1) (e.g. according to RVS 08.03.01 such as noise barriers, road construction, etc.)
  - fillings of utility trenches and covering of cables according to RVS 08.03.01
  - bedding material for cable areas
  - backfilling and covering of structures according to RVS 08.03.01
  - cover layers and spread layers in sports structures according to the standard ÖNORM B 2606-2
  - substrates for planting purposes according to the standard ÖNORM L 1210
  - construction materials used for waste site constructions (observe ALSAG !)
  - drainage material

- Hydraulically bound construction methods, for example
  - bricks, hollow blocks
  - concrete according to the standard ÖNORM B 4710-1
  - lightweight concrete according to the standard ÖNORM B 4200-11
  - screed according to the standard ÖNORM EN 13139, ÖNORM B 3135, ÖNORM B 2232, ÖNORM B 7232
  - subsoil improvement/stabilization

- Flowable self-thickening filling material according to the guideline of the Austrian Recycled Construction Materials Association

In regard to the possibilities for use according to grades, see Table 2 according to quality classes, see point 5.2.

7 Grade and Quality Surveillance

Assessment methods and the frequency for surveillances 1 have been determined for the respective grades and quality classes in order to prove the compliance of the materials with the requirements and the required grades and quality classes.

On the basis of these assessments, the quality mark may be granted according to point 8 of this guideline. In order to acquire the CE-mark, the general regulations according to the unified European standards also have to be observed.

7.1 First Examination (Confirmation of Qualification)

The first examination serves to determine whether the control conditions (e.g. possibility of internal control within the factory or by laboratories charged with control, technical conditions, mechanical plants) and the requirements for recycled building materials can be met. Physical samples have to be taken for the examinations, which must be performed according to the regulations for external control. The sampling process must be recorded in a document which has to be signed by those present at the taking of the sample.

1For regulations regarding the acquisition of the quality mark for recycled construction materials, see chapter 8.
If the first examination shows a negative result, a re-examination must be carried out immediately. If the result of this second examination is again negative, the respective material does not comply with the requirements of the guideline.

The first examination has to be carried out once per facility and once per kind of granulate (according to point 3.4.1) and once per delivered aggregate. As far as products produced by mobile plants are concerned, a first examination has to be carried out once per place of production and once per product.

The tests to be carried out are indicated in table 5 of the assessment regulations.

7.2 Internal control

The recycling facility is obliged to independently perform an internal control and to assume the responsibility for continuous quality control which guarantees the compliance with the set requirements. If the facility cannot carry out internal quality control, it is obliged to employ an external laboratory for this control.

The results of the examinations have to be documented. The form must contain the following data:

- designation and origin of the material
- tests carried out
- name of the person testing, location, date
- evaluation and analysis of the comparison with determined requirements
- report about defects and measures to eliminate them

If the internal control shows that the requirements defined in the grade and quality regulations are not met, the recycling facility must immediately take all internal measures possible to eliminate the defects. If a recycled material does not correspond with the grade or quality regulations for its category, the respective material has to be classified into another class or - if this is not possible - has to be disposed in the appropriate way. The tests to be carried out are indicated in Table 6 of the assessment regulations.

The documentation covering the taking of samples and the test results must always be available.

7.3 External Surveillance

The recycling facility employs testing entities authorized by the Austrian Construction Materials Quality Assurance Association in performing the external tests. These entities carry out the tests as part of the external control system. The external control is in place to examine whether the recycled building materials meet the defined requirements.

The tests must be carried out twice a calendar year according to the instructions given in table 5. In this regard it has to be taken into account that the second test may be omitted if the production period of the respective granulation does not exceed 20 days per calendar year.

The documentation covering the taking of samples and the test results must always be available.

Table 4: Fields of application according to environmental engineering aspects (minimum requirements)

<table>
<thead>
<tr>
<th>Form of application</th>
<th>hydro-geologically delicate area</th>
<th>hydro-geologically less delicate area</th>
<th>within the waste site(^2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>in bound form or unbound with cover layer (^1)</td>
<td>quality class A</td>
<td>quality class B</td>
<td>quality class C</td>
</tr>
<tr>
<td>unbound without covering layer (^1)</td>
<td>quality class A+</td>
<td>quality class A</td>
<td>quality class C</td>
</tr>
<tr>
<td>as aggregate</td>
<td>quality class B</td>
<td>quality class B</td>
<td>quality class C</td>
</tr>
</tbody>
</table>

\(^1\) Definition of the cover layer according to RVS 1.112, “Fundamentals, Definitions, Structural Engineering (September 1984)

\(^2\) Only waste sites for not-harmful substances
7.3.1 External Surveillance with Respect to Structural Engineering

Samples have to be taken in order to carry out the tests according to the assessment regulations. The sampling process must be documented and has to be signed by all persons present at the taking of the sample. If a certain parameter does not comply with the requirements set by this guideline, the examination of the respective parameter – but not the whole examination process – must be immediately repeated. If the result of this second examination is again negative the respective material has to be classified in another grade or class or – if this is not possible – has to be disposed of appropriately. The tests to be carried out are indicated in Table 5 of the assessment regulations.

7.3.2 External Surveillance of Environmental Sustainability

In order to perform the external control, 3 field samples are taken (as defined by the Austrian Standard ÖNORM S 2123-1, 1st November 2003) have to be carried out. The quantity of each of these 3 field samples must not exceed 1,500t. The examination of the first sample in any case consists of the analysis of all parameters indicated in Table 3. If the examination of this sample shows that one or more parameters (except pH-value) exceed 80% of the set value limit for the respective class not exceeding, however, the limit values of the respective class, the other samples have to be analysed with regard to the concerned parameters. If the examination is carried out on three samples, the respective value limit is to be considered as not exceeded if the average value of the three tests does not exceed the respective value limit and if the highest value measured in the three tests does not exceed 100% of the respective value limit.

If the result of the test is negative, the respective material has to be placed into another quality class or – if this is not possible – has to be disposed of appropriately.

7.4 Obligations regarding Documentation and Identification

The records must guarantee the documentation of all materials used in the production of the respective material. In the same way, it has to be documented which internal and external controls are relevant for the respective material. The general obligations according to the regulations regarding waste documentation are not affected by this obligation. In any case, the identification must disclose which materials have been used in the production of the respective building material and to which grade and quality class the building material corresponds. Moreover, the grade and quality class of the respective product must be identified.

7.5 Testing Modalities

7.5.1 Testing of foreign materials, impurities and mix ratio

The examination of foreign materials, impurities and the mix ratio has to be carried out analogously to the Austrian standard ÖNORM EN 933-5 (point 8.2), considering samples of grain classes ranging from 4 to the maximum grain size.

The materials are sorted by visual inspection according to
- grains representing foreign materials (see point 4.1)
- grains representing impurities (see point 3.1)

In regard to the material RS with an apparent density ≤ 0.2 mg/m³, impurities have to be determined within the framework of the external control as defined in table 2 and in the frame of the internal control by visual inspection.

In order to determine the brick content, the nature of the grains must be determined.

7.5.2 Determination of pH value and Electrical Conductivity

When determining the pH value and the electrical conductivity of recycled concrete materials, a rapid carbonizing according to the standard ON S 2116-3 must be performed, if the pH value or the electric conductivity determined exceeds the respective maximum permitted value. This means that the material (maximum grain size 10mm, water content 10%) is aerated with air-CO₂ mix for a time period of three days. Afterwards, another examination of the eluate has to be performed.

7.5.3 Internal Control of Environmentally Relevant Criteria

The following parameters must always be analysed in regard to the internal control which has to be carried out on the respective building material twice a month:
7.5.4 Quality Assurance

The taking of samples has to be performed according to ÖNORM EN 932-1 within the quality assurance framework.

7.5.5 Simplified Testing Modalities

Simplified testing modalities may be applied if a facility produces building materials of uniform kind, grade and quality class according to the guideline which differs only in granulations (e.g. RA I 0/22 A and RA I 0/45 A). In this case, only the material with the smaller maximum grain-size is subject to the whole external examination process, whereas the other materials are subject only to examinations regarding grain-size or particle-size distribution and resistance to frost.

If a building material of the specified grade is produced in yearly quantities lower than 10,000 tons per delivered granulation, only one external examination in the first half year need be carried out. In any case, at least one external examination has to be carried out per calendar year.

8 Acquisition of Quality Marks for Recycled Construction Materials

The “Gütezeichen für Recycling-Baustoffe” - “Quality mark for recycled construction materials” of the “Österreichischer Güteschutzverband Recycling-Baustoffe (ÖGSV) - “Austrian Construction Materials Quality Assurance Association” may be granted for recycled building materials which comply completely with all requirements of the “Guideline for Recycled Construction Materials” and of the assessment regulations. In any case, the manufacturers of building materials identified by this quality certification guarantee for the compliance with the above mentioned requirements regarding environmental sustainability.

8.1 Conditions for the Granting of Quality Marks

The quality mark for recycled construction materials may be granted only to members of the ÖGSV and by application.

8.2 First Examination (Confirmation of Qualification)

The first examination (confirmation of qualification) is carried out by a laboratory chosen by the manufacturer from the updated list of laboratories authorized by the ÖGSV (Austrian Construction Materials Quality Assurance Association). It is not possible to change the institution within a calendar year.

Subsequently, the manufacturer and the chosen testing institution must write a statement of compliance about the first examination and the external examination (forms available from the ÖGSV) for each facility and forward it to the ÖGSV.

For the first examination, all conditions set for the selected grade or quality class and the selected kind of building material must be complied with. The tests to be carried out are indicated in Table 5 of the assessment regulations.

The result of the positive first examination has to be documented in a standardized result report (form to be filled in) which has to be signed and stamped by the testing institution. In this report, the complete compliance with all necessary standards has to be documented (e.g. possibility of internal control, technical conditions, plants, complying with technical requirements). The complete examination report and the related completed form for the report of the result must be forwarded to the ÖGSV by the laboratory. If one parameter does not meet the requirements of this guideline, only the respective examination has to be repeated and not the whole examination process.

The formal application for the quality mark has to be made via a declaration of commitment (form available from the ÖGSV) which has to be completed and forwarded to the ÖGSV. In addition to the respective building materials in this form the tester who performed the internal control and institution which performed the external testing must be specified.
Table 5: Assessment regulations for the first examination (confirmation of qualification) and external control

<table>
<thead>
<tr>
<th>GRADES III and IV</th>
<th>Test according to</th>
<th>RMH</th>
<th>RS</th>
<th>RZ</th>
<th>RHZ</th>
<th>RH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grain-size distribution</td>
<td>EN 933-1</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Water content</td>
<td>EN 1097-5</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bulk density (dry)</td>
<td>EN 1097-3</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Specific heat resistance (dry)</td>
<td>ÖN B 6015</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flowability at the time of delivery</td>
<td>visual inspection</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Apparent density</td>
<td>EN 1097-6</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Content of foreign materials</td>
<td>see section 7.5.1</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Impurities</td>
<td>see section 7.5.1</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Impurities caused by organic substances (soil content)</td>
<td>EN 1744-1-15.1</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brick content</td>
<td>see section 7.5.1</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Environmental sustainability</td>
<td>see section 5</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
</tbody>
</table>

Table 6: Assessment regulation for internal control

<table>
<thead>
<tr>
<th>GRADES III and IV</th>
<th>Test according to</th>
<th>RMH</th>
<th>RS</th>
<th>RZ</th>
<th>RHZ</th>
<th>RH</th>
</tr>
</thead>
</table>
| Recovery, delivery | Visual inspection with specification of:  
- waste owner  
- waste location  
- place of recovery  
- supplier | per load |
| Processing | visual inspection | daily |
| Storage | visual inspection | daily |
| Grain-size distribution | EN 933-1 | Once a week |
| Flowability at the time of delivery | visual inspection | - | once a month |
| Content of foreign materials | see section 7.5.1 | once a month<sup>2</sup> |
| Impurities | see section 7.5.1 | once a month<sup>2</sup> |
| Brick content | see section 7.5.1 | - | - | Once a month<sup>2</sup> |
| Environmental sustainability | see section 7.5.3 | twice a month |

<sup>1</sup> For grade IV only the maximum grain-size must be submitted.
<sup>2</sup> Only grain mixes and grain types d > 4mm.
8.3 Granting of the Quality Mark

After the ÖGSV has received the compliance, the declaration of commitment and the positive result of the qualification test (examination report and result report), the request is examined by the managing board.

If the result of this examination is positive, the quality mark is granted by the president of the ÖGSV to the respective facility (not to the business as a whole) for the respective recycled building material classified with the specific grade or quality class.

8.4 Use of the Quality Mark

Fundamentally, the quality mark can be used only after it has been granted by the „Güteschutzverband Recycling-Baustoffe“ – “Austrian Recycled Construction Materials Quality Assurance Association”. Together with the quality mark, the respective classification of the recycled building material has to be indicated.

According to the guidelines and regulations the quality mark may be indicated in price lists and similar documents.

Recycled building materials which are not controlled by means of grade and test regulations must be specified separately or identified as such by the manufacturer.

Figure: The quality mark for recycled construction materials

8.5 Internal Surveillance

The internal control has to be carried out according to the declaration of commitment by the member facility or by a laboratory charged with the internal control.

Every manufacturer has to regularly prepare operating reports and result reports. Types and frequencies for the tests are indicated in Table 6.

The operating reports and the result reports must be forwarded regularly to the ÖGSV (quarterly, at least every six month). If internal examinations need not be carried out (production times according to Table 6) as the quantity of the material produced remains under the threshold value, the operating report must still be presented to the ÖGSV. A change of the laboratory charged with the internal control has to be reported immediately.

8.6 External Surveillance

Every member facility has to assign the laboratory indicated in the respective declaration of commitment with the performance of regular external examinations as indicated in Table 5. The factory is obliged to ensure that the required number of tests are carried out. The laboratory concerned can determine at which time the tests are performed. The tests to be carried out are also indicated in Table 5.

A copy of the examination report and the related result report (completed form) of the external examination must be forwarded to the ÖGSV by the external laboratory. The result report must show the positive result of the test. Moreover, the external laboratory must document in this report whether the operating report and the result report of the internal control have been prepared regularly and correctly.

The laboratory indicated in the declaration of commitment may be changed at the end of a calendar year or if the first indicated laboratory is eliminated from the list of the Quality Assurance Association.
8.7 Punishment of Offences

If any offences result from the process of quality assurance, the managing board selects the level of punishment according to the seriousness of the violation. Normally, these measures consist of:

- the setting of additional conditions regarding internal control
- more external control
- warning
- limited or indefinite deprivation of the quality mark.

The measures mentioned above may also be combined.

Users of the quality mark who repeatedly and seriously violate the correct use of the quality mark or the quality and testing regulations may be deprived of the quality mark for a limited or indefinite period.

Before a measure is taken, the manufacturer concerned has a right to answer the accusation.

In urgent cases, an immediate temporary suspension of the quality mark may be instituted by the president of the Austrian Construction Materials Quality Assurance Association. This procedure must be confirmed by the managing board within 14 days.

8.8 Complaints

Users of quality marks have the possibility to make a complaint regarding the punishment notice at the ÖGSV within 14 days after its receipt. The rejection of the complaint has to be well founded.

8.9 Returning or Deprivation of the Quality Mark

In the case of returning (termination of production, changing of grade) or deprivation of the quality mark the granting certificate has to be returned immediately.

8.10 Re-granting

If the license to use the quality mark has been suspended, an application for re-granting can be made after a period of three months. The process is regulated according to section 8.3 of the guideline. The managing board, however, can set additional conditions.

8.11 Forms

The following forms are available from the ÖGSV (Austrian Recycled Construction Materials Quality Assurance Association):
- Application for becoming a member of the ÖGSV
- Form “Surveillance Agreement”
- Form “Formal Obligation”
- Result Report (free of charge for members of the ÖGSV)
- Operating Report (free of charge for members of the ÖGSV)
Appendix: Grading curve ranges

ANMERKUNG: Die Grafiken werden zur Drucklegung graphisch aufbereitet.

Figure 1: grading curve range 0/4 for RS

Figures relating to point 4.1.3, grading curve ranges for grade III

Figure 2: grading curve range 0/4 for grade III

Figure 3: grading curve range 0/8 for grade III
Figure 4: grading curve range 0/16 for grade III

Figure 5: grading curve range 0/22 for grade III
Figure 6: grading curve range 0/32 for grade III

Figure 7: grading curve range 0/45 for grade III

Figure 8: grading curve range 0/63 for grade III
Annex 4: Recycling Techniques and Machinery (Folders from MFL Ltd., Austria)
Grace to the company's traditional location Maschinenfabrik Liezen und Giesserei GesmbH disposes of more than 50 years of experience in the sectors mineral processing, mechanical engineering and foundry business activities.

Homepage: www.mfl.at Phone: +43-3612-270-0
  e-mail: geschaeftsleitung@mfl.at Fax: +43-3612-270-595

Address: MFL - Maschinenfabrik Liezen und Giesserei GesmbH
         Werkstrasse 5
         A - 8940 Liezen, Austria
New machines

Solobrecher
Relying on more than 50 years of experience in the construction and manufacture of crushing equipment MFL has been able to dispatch about 2,000 solo crushers either as mobile or stationary machines up to now. With this know-how and ongoing improvements of the crushers with regard to technology and quality MFL meets all requirements of her clients.

STE-Mobil
MFL’s mobile single toggle jaw crushers set new dimensions for an uncomplicated processing of natural rock and building debris. Wheel loaders or excavators are used to charge the crushing plants. A vibratory feeder conveys the material to be crushed from the bin via a grizzly section to the crusher itself; the broken material is transported to stockpile on the main discharge conveyor belt.

RCI-Mobil
MFL’s mobile recycling plants are mainly used to reduce reinforced concrete demolition material, building debris and asphalt fragments as well as natural rock in size. Wheel loaders or excavators charge the material to be crushed into the plants. A vibratory feeder conveys the material from the bin onto a grizzly where the small material is screened off. The prescreened material is either returned to the broken material or discharged separately on a conveyor belt.

CC-Mobil
MFL’s mobile cone crushers have been built by taking the latest developments into consideration. The cone crushers are best suited in the field of secondary and tertiary crushing of hardest rock and ores. Particular attention has been paid to mobility, robust design, easy handling, excellent throughput values and cubic final grain.
Solobrecher

STE / Single-Toggle Jaw Crushers

ST / Toggle Jaw Crusher

CC / Hydro-Cone Crusher

WB - WBL - WBS / Roll Crushers

H-CI / Hard Rock Impact Crusher

R-CI / Impact Crushers

ZS / Horizontal Crusher “Zenturbo”

SS / Reciprocating Feeder

CI / Tertiary Impact Crushers
STE / Einschwingen-Backenbrecher

Single-Toggle Jaw Crushers / STE

We offer a complete range of Single Toggle Jaw Crushers to break all types of rock. Depending on their size, the sturdy, heavy-duty machines with a swing seated in four bearings are provided with a hydraulically assisted gap adjustment. Two precisely counterbalanced flywheels ensure a smooth run. Reversible crushing jaws made of high-quality special castings developed in our workshop make sure that wear parts are utilized in the most economic way.

<table>
<thead>
<tr>
<th>Type</th>
<th>Max. Width mm</th>
<th>Gap Width mm</th>
<th>Durchsatz m³/h</th>
<th>Leistung kW</th>
<th>Gewicht kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>STE 10-17</td>
<td>300 x 175</td>
<td>5 - 60</td>
<td>1 - 7</td>
<td>11 - 15,5</td>
<td>1,100</td>
</tr>
<tr>
<td>STE 12-25</td>
<td>400 x 220</td>
<td>14 - 90</td>
<td>2 - 18</td>
<td>22 - 32</td>
<td>2,000</td>
</tr>
<tr>
<td>STE 16-31</td>
<td>500 x 300</td>
<td>15 - 150</td>
<td>3 - 38</td>
<td>35 - 37</td>
<td>4,700</td>
</tr>
<tr>
<td>STE 20-40</td>
<td>700 x 450</td>
<td>20 - 150</td>
<td>5 - 75</td>
<td>52</td>
<td>6,850</td>
</tr>
<tr>
<td>STE 30-60</td>
<td>900 x 600</td>
<td>35 - 137</td>
<td>7 - 120</td>
<td>73 - 90</td>
<td>10,000</td>
</tr>
<tr>
<td>STE 60-100</td>
<td>1100 x 850</td>
<td>63 - 153</td>
<td>15 - 195</td>
<td>90 - 130</td>
<td>16,000</td>
</tr>
<tr>
<td>STE 100-150</td>
<td>1300 x 1000</td>
<td>80 - 210</td>
<td>20 - 260</td>
<td>110 - 150</td>
<td>20,500</td>
</tr>
<tr>
<td>STE 150-200</td>
<td>1500 x 1250</td>
<td>100 - 250</td>
<td>25 - 320</td>
<td>130 - 160</td>
<td>30,500</td>
</tr>
<tr>
<td>STE 200-250</td>
<td>1700 x 1500</td>
<td>120 - 340</td>
<td>30 - 400</td>
<td>160</td>
<td>47,000</td>
</tr>
</tbody>
</table>

Toggle Jaw Crusher / ST

Due to its sturdy design and optimum stiffness of its housing, the Toggle Jaw Crusher is best suited to crush hardest and toughest materials.

Amply dimensioned flywheels are provided to balance load surges. Reversible crushing jaws made of highly wear-resistant castings are standard and economic in use. Clients can choose between 2 types up to a throughput capacity of 300 m³/h.

<table>
<thead>
<tr>
<th>Type</th>
<th>Maulweite mm</th>
<th>Spalweise mm</th>
<th>Durchsatz m³/h</th>
<th>Leistung kW</th>
<th>Gewicht kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>ST 100-80</td>
<td>1000 x 800</td>
<td>70 - 250</td>
<td>60 - 200</td>
<td>110 - 132</td>
<td>39,660</td>
</tr>
<tr>
<td>ST 125-100</td>
<td>1200 x 1000</td>
<td>100 - 300</td>
<td>90 - 300</td>
<td>132 - 160</td>
<td>63,280</td>
</tr>
</tbody>
</table>
The CC crusher has been developed according to the latest technological findings and is perfectly suited for the most efficient secondary and tertiary crushing of hardest rock and ores. Particular attention has been paid to a sturdy design, combined with simple handling, the use of most modern high-quality material, minimum maintenance, high throughput capacity and a uniform cubic final product.

<table>
<thead>
<tr>
<th>Max. Throughput Capacity (t/h)</th>
<th>Max. Throughput Capacity (t/h)</th>
<th>Max. Throughput Capacity (t/h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>90</td>
<td>110</td>
<td>130</td>
</tr>
<tr>
<td>80</td>
<td>100</td>
<td>120</td>
</tr>
<tr>
<td>70</td>
<td>90</td>
<td>110</td>
</tr>
<tr>
<td>60</td>
<td>80</td>
<td>100</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Max. Throughput Capacity (t/h)</th>
<th>Max. Throughput Capacity (t/h)</th>
<th>Max. Throughput Capacity (t/h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>90</td>
<td>110</td>
<td>130</td>
</tr>
<tr>
<td>80</td>
<td>100</td>
<td>120</td>
</tr>
<tr>
<td>70</td>
<td>90</td>
<td>110</td>
</tr>
<tr>
<td>60</td>
<td>80</td>
<td>100</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Max. Throughput Capacity (t/h)</th>
<th>Max. Throughput Capacity (t/h)</th>
<th>Max. Throughput Capacity (t/h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>90</td>
<td>110</td>
<td>130</td>
</tr>
<tr>
<td>80</td>
<td>100</td>
<td>120</td>
</tr>
<tr>
<td>70</td>
<td>90</td>
<td>110</td>
</tr>
<tr>
<td>60</td>
<td>80</td>
<td>100</td>
</tr>
</tbody>
</table>
Roll Crushers - WB/WBL/WBS

Roll crushers are designed to reduce soft to medium-hard feed material in size. Toothed roll shells are used for primary crushing, whereas fine crushing requires smooth roll shells made of wear-resistant material. The crusher consists of a base frame in welded construction, with one roll mounted in a fixed way and the movable roll in two rocker arms. Additionally, the crushers are equipped with an overload protection and separate drives for each roll. A roll turning device to calibrate and regenerate the roll shells can be offered as an option.

The capacity of a crusher depends on feed material size, gap width and possible circumferential speed and is calculated according to the following formula:

\[ Q = B \times S \times V \times \eta \times 3.600 \text{ [m}^3/\text{h]} \]

- \( Q \) = throughput \( \text{m}^3/\text{h} \)
- \( B \) = roll width [m]
- \( S \) = gap width [m]
- \( V \) = cylinder speed [between 5 and 10 m/s]
- \( \eta \) = filling coefficient [approx. 0.3]
Hard Rock Impact Crusher / H-CI

MFL-Hard Rock Impact Crushers of type series H-CI work in accordance with a recently developed kinematic principle. They are well noted for their extraordinarily favourable crushing characteristics and economic mode of operation. The large-size crushing chamber combined with MFL-H-CI-crushing elements make the operation of this crusher extremely safe compared with other crushing machines. Grace to their outstanding crushing features only one H-CI hard rock impact crusher is in most cases sufficient to produce a usable final grain size.

<table>
<thead>
<tr>
<th>Type</th>
<th>Rollbreitenmessung mm</th>
<th>Einlauföffnung Breite x Höhe mm</th>
<th>Ausbeute bis 220 oder 220 kNm/s</th>
<th>Drehzahl m/min</th>
<th>Installationsvolumen m³</th>
<th>Gewicht kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>H-CI 60-75 LS</td>
<td>900 x 750</td>
<td>780 x 450</td>
<td>300 - 850</td>
<td>70 - 90</td>
<td>6.100</td>
<td></td>
</tr>
<tr>
<td>H-CI 60-75 LT</td>
<td>900 x 750</td>
<td>780 x 450</td>
<td>300 - 850</td>
<td>70 - 90</td>
<td>6.250</td>
<td></td>
</tr>
<tr>
<td>H-CI 110-100 LS</td>
<td>1120 x 1000</td>
<td>1030 x 610</td>
<td>450 - 750</td>
<td>125 - 160</td>
<td>12.000</td>
<td></td>
</tr>
<tr>
<td>H-CI 110-100 LT</td>
<td>1120 x 1000</td>
<td>1030 x 610</td>
<td>450 - 750</td>
<td>125 - 160</td>
<td>12.000</td>
<td></td>
</tr>
<tr>
<td>H-CI 110-120 LS</td>
<td>1120 x 1200</td>
<td>1280 x 618</td>
<td>600 - 650</td>
<td>155 - 200</td>
<td>14.900</td>
<td></td>
</tr>
<tr>
<td>H-CI 110-120 LT</td>
<td>1120 x 1200</td>
<td>1280 x 618</td>
<td>600 - 650</td>
<td>155 - 200</td>
<td>14.900</td>
<td></td>
</tr>
<tr>
<td>H-CI 130-120 MS</td>
<td>1300 x 1250</td>
<td>1388 x 713</td>
<td>500 - 650</td>
<td>220 - 300</td>
<td>21.000</td>
<td></td>
</tr>
<tr>
<td>H-CI 130-120 HT</td>
<td>1380 x 1250</td>
<td>1388 x 713</td>
<td>500 - 650</td>
<td>220 - 300</td>
<td>21.000</td>
<td></td>
</tr>
<tr>
<td>H-CI 130-150 HS</td>
<td>1380 x 1500</td>
<td>1530 x 713</td>
<td>500 - 650</td>
<td>220 - 300</td>
<td>26.000</td>
<td></td>
</tr>
<tr>
<td>H-CI 130-150 HT</td>
<td>1380 x 1500</td>
<td>1530 x 713</td>
<td>500 - 650</td>
<td>220 - 300</td>
<td>26.000</td>
<td></td>
</tr>
</tbody>
</table>
Impact crushers of the series R-CI have been designed mainly to be installed in recycling plants. Such recycling plants can perfectly be used for the primary crushing of natural rock, too, where extraordinary results could have been achieved.

Advantages of R-CI impact crushers:
- Extremely sturdy design
- Easy to maintain due to hydraulic opening of housing
- Simple adjustment of impact elements
- High utilization of impact bars
- Different blow bars, qualities depend on feed material (MFL’s own foundry)
- Simple exchange of wear parts
- High throughput capacity
- High quality final product
- Best suited to crush even delicate recycling material, such as building debris, reinforced concrete and asphalt fragments.

<table>
<thead>
<tr>
<th>Type</th>
<th>Rotor-</th>
<th>Einlass-</th>
<th>Durchschlitz</th>
<th>Installationsloch</th>
<th>Gewicht</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>abmessungen mm</td>
<td>Öffnung</td>
<td>mm</td>
<td>kW</td>
<td>kg</td>
</tr>
<tr>
<td>R-CI 100-100</td>
<td>1000 x 1000</td>
<td>1000 x 750</td>
<td>100</td>
<td>90 - 110</td>
<td>9,000</td>
</tr>
<tr>
<td>R-CI 100-130</td>
<td>1000 x 1300</td>
<td>1300 x 750</td>
<td>160</td>
<td>132 - 160</td>
<td>13,500</td>
</tr>
<tr>
<td>R-CI 130-150</td>
<td>1300 x 1500</td>
<td>1500 x 850</td>
<td>160</td>
<td>160 - 200</td>
<td>18,050</td>
</tr>
</tbody>
</table>

Design variations:
- Hydraulic lifting of impact element
- Grinding path
The Zenturbo has been developed to crush hardest and abrasive rock / mainly oversize grains between 4 and 100 mm - to produce high-quality sand and fine gravel.

**Design variations:**
- HIC impact wall segments
- Hydraulic lifting device for upper part of crusher
- Material-specific rotor variants

**Technical Plus:**
- Cubic final grains, crack-free
- Improved grain shape
- Constant grain distribution of the crushing material
- Little wear due to autogenous crushing
- Few wear parts
- Easy access
- Minimum maintenance
- Simple and quick assembly
- Low investment costs
- High profitability
- Sinter-metal edges

<table>
<thead>
<tr>
<th>Type</th>
<th>Diameter</th>
<th>Feed size</th>
<th>Throughput</th>
<th>Installed Power</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>ZS 80</td>
<td>800</td>
<td>30-60</td>
<td>75-132</td>
<td>6300</td>
<td></td>
</tr>
<tr>
<td>ZS 100</td>
<td>1000</td>
<td>50-90</td>
<td>120-200</td>
<td>6800</td>
<td></td>
</tr>
<tr>
<td>ZS 100 OR</td>
<td>1000</td>
<td>85-100</td>
<td>180-200</td>
<td>7800</td>
<td></td>
</tr>
</tbody>
</table>
MFL's Reciprocating Feeders are predominantly used to uniformly charge primary crushing machines. The feed material is continuously discharged from a bin. Compared with other feeding devices, MFL's Reciprocating Feeders offer the advantage of being largely insensitive to shocks caused by big lumps of rock falling down.

<table>
<thead>
<tr>
<th>Type</th>
<th>Motor kW</th>
<th>Hublings mm</th>
<th>Hubzahl min</th>
<th>Gewicht kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>SS 100 - 400</td>
<td>15</td>
<td>1460</td>
<td>20 - 180</td>
<td>6,000</td>
</tr>
<tr>
<td>SS 130 - 400</td>
<td>16,5</td>
<td>1460</td>
<td>20 - 180</td>
<td>7,100</td>
</tr>
<tr>
<td>SS 160 - 500</td>
<td>30</td>
<td>975</td>
<td>20 - 180</td>
<td>11,350</td>
</tr>
</tbody>
</table>
CI / Tertiary Impact Crusher

Tertiary Impact Crushers of the CI series are mainly used to produce sands that are excellently suited as aggregates for concrete and asphalt producing industries.

The final product shows a close grain distribution with a high percentage of cubic grain and a low percentage of filler material.

Technical Plus:

- Extremely sturdy design
- Easy adaptation to changing operating conditions by using various rotors
- Little wear due to comminution by impact-percussion
- Easy access to wear parts (hydr. opening of housing)
- Special impact geometry

<table>
<thead>
<tr>
<th>Type / Schlusslook</th>
<th>Rotorabmessungen (Ø mm x l)</th>
<th>Aufgangsoffnung mm</th>
<th>Durchsatz ca. m³/h</th>
<th>Installierte Leistung kW</th>
<th>Gewicht kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>CI 85-60 / 2.3 SL</td>
<td>865 x 600</td>
<td>270 x 920</td>
<td>60 - 75</td>
<td>5.150</td>
<td></td>
</tr>
<tr>
<td>CI 85-60 / 3.3 SL</td>
<td>865 x 600</td>
<td>270 x 920</td>
<td>60 - 75</td>
<td>5.300</td>
<td></td>
</tr>
<tr>
<td>CI 85-90 / 2.3 SL</td>
<td>865 x 900</td>
<td>270 x 920</td>
<td>35 - 50 m³/h</td>
<td>5.400</td>
<td>5.970</td>
</tr>
<tr>
<td>CI 85-90 / 3.3 SL</td>
<td>865 x 900</td>
<td>270 x 920</td>
<td>35 - 50 m³/h</td>
<td>5.970</td>
<td></td>
</tr>
</tbody>
</table>
If frequent changing of location over short distances is required, e.g. in order to follow the place of exploitation in a quarry, this type of crusher on tracks with wireless remote control is the perfect equipment.

This plant sets new dimensions for an easy processing of even smaller quantities of road demolition material and building debris. With this plant MFL offers an economic and environment protecting solution that convinces by its well-devised comprehensive conception. This mobile crusher is also excellently suited to crush medium-hard to natural rock.

A reliable mobile crushing plant equipped with a single-toggle crushing jaw as it is more and more needed in the field of natural stone processing industry. The comprehensive conception of this plant makes it highly economical in use. Those advantages result most essentially from the following features, such as diesel-electric propulsion, minimum maintenance and control of plant by PLC.
STE 90-60/T

Mobile Crushing Plant on Tracks with Single-Toggle Jaw Crusher

STE 90-60/T

Application Data

- **Feed material:** Natural rock, building debris
- **Throat Width:** 900 x 600 mm
- **Feed material size:** 850 x 550 mm
- **Throughput capacity:** up to 150 t/h (depending on feed material and adjusted gap width)
- **Final Grain Size:** 0/50 - 0/200 mm
- **Drive:** Genset, diesel-electric, 225 kVA

**General technical data**

- **Length:** working condition approx. 12.70 m, transport condition approx. 11.50 m
- **Width:** approx. 3.60 m, approx. 2.50 m
- **Height:** approx. 3.60 m, approx. 3.10 m
- **Total weight:** approx. 30,000 kg (without options)
- **Ground pressure of tracks:** approx. 11.0 N/cm² (without options)

**Description:**

Single-Toggle Jaw Crusher STE 90-60 HBSV

- Feed opening 900 x 600 mm
- Hydraulic gap adjustment

**Feeder Bin, approx. 4 m³**
- Highly wear-resistant welded steel construction
- Bin walls can be folded down hydraulically for transport

**Vibratory Conveying Trough, 1,000 x 2,800 mm**
- 2-stage grid section, each 750 mm long, gap width 40 mm, 2 unbalance motors, electrical 2 x 2.69 kW

**Crawler-Undercarriage**
- Bridge construction, welded of steel plates and sectional steel
- Crawler undercarriage, travel speed 1.0 km/h

**Drive Unit**
- Diesel genset 225 kVA; integrated tank 400 litres; incl. filler pump, enclosed all over
- Diesel engine, type PERKINS 1306 E-87 TA; power 198 kW
- 3-phase-squirrel cage motor, 75 kW / 1,000 rpm, 50 Hz, IP 54
- Driving elements

**Hydraulic System for Crawler-Drive**
- Hydraulic components
- Double-type axial piston pump for gear pump
- Oil tank, oleo-pneumatic cooling
- Valves and filters
- Wireless remote control

**Electrical Equipment - PLC system**
- Switch cabinet
- Frequency converter
- Operation panel with Display
- Automatic start/stop operation
- Emergency-off button
- Flash-lamp and signal horn

**Wireless Remote Control – travel drive and trough control**

**Belt Conveyors**
- Main discharge belt conveyor, 1,000 x 10,000 mm, hydraulically foldable
- Belt conveyor for pre-screened material, 500 x 2,800 mm, hydraulically foldable or conveyor 500 x 4,000 mm, rigid, can be inserted laterally

**Bending Zone**

**Platforms and Access Ladders**

**Options**
- Belt scale
- Overbelt magnet separator

**Application Data**

- Feed material: Natural rock, building debris
- Throat Width: 900 x 600 mm
- Feed material size: 850 x 550 mm
- Throughput capacity: up to 150 t/h (depending on feed material and adjusted gap width)
- Final Grain Size: 0/50 - 0/200 mm
- Drive: Genset, diesel-electric, 225 kVA

**General technical data**

- Length: working condition approx. 12.70 m, transport condition approx. 11.50 m
- Width: approx. 3.60 m, approx. 2.50 m
- Height: approx. 3.60 m, approx. 3.10 m
- Total weight: approx. 30,000 kg (without options)
- Ground pressure of tracks: approx. 11.0 N/cm² (without options)

**Description:**

Single-Toggle Jaw Crusher STE 90-60 HBSV

- Feed opening 900 x 600 mm
- Hydraulic gap adjustment

**Feeder Bin, approx. 4 m³**
- Highly wear-resistant welded steel construction
- Bin walls can be folded down hydraulically for transport

**Vibratory Conveying Trough, 1,000 x 2,800 mm**
- 2-stage grid section, each 750 mm long, gap width 40 mm, 2 unbalance motors, electrical 2 x 2.69 kW

**Crawler-Undercarriage**
- Bridge construction, welded of steel plates and sectional steel
- Crawler undercarriage, travel speed 1.0 km/h

**Drive Unit**
- Diesel genset 225 kVA; integrated tank 400 litres; incl. filler pump, enclosed all over
- Diesel engine, type PERKINS 1306 E-87 TA; power 198 kW
- 3-phase-squirrel cage motor, 75 kW / 1,000 rpm, 50 Hz, IP 54
- Driving elements

**Hydraulic System for Crawler-Drive**
- Hydraulic components
- Double-type axial piston pump for gear pump
- Oil tank, oleo-pneumatic cooling
- Valves and filters
- Wireless remote control

**Electrical Equipment - PLC system**
- Switch cabinet
- Frequency converter
- Operation panel with Display
- Automatic start/stop operation
- Emergency-off button
- Flash-lamp and signal horn

**Wireless Remote Control – travel drive and trough control**

**Belt Conveyors**
- Main discharge belt conveyor, 1,000 x 10,000 mm, hydraulically foldable
- Belt conveyor for pre-screened material, 500 x 2,800 mm, hydraulically foldable or conveyor 500 x 4,000 mm, rigid, can be inserted laterally

**Bending Zone**

**Platforms and Access Ladders**

**Options**
- Belt scale
- Overbelt magnet separator
STE 100-65/T

Mobile Crushing Plant on Tracks with integrated 2-Deck-Prescreen with Single-Toggle Jaw Crusher

STE 100-65/T

Application Data

- **Feed material:** Natural rock, building debris
- **Throat Width:** 1,000 x 650 mm
- **Feed material size:** 980 x 550 mm
- **Throughput capacity:** up to 200 t/h (depending on feed material and adjusted gap width)
- **Final Grain Size:** 0/70 - 0/200 mm
- **Drive:** Genset, diesel-electric, 225 kVA

**General technical data**

<table>
<thead>
<tr>
<th></th>
<th>working</th>
<th>condition</th>
<th>transport</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Length</strong></td>
<td>approx. 13.70 m</td>
<td>approx. 13.60 m</td>
<td>approx. 13.60 m</td>
</tr>
<tr>
<td><strong>Width</strong></td>
<td>approx. 3.70 m</td>
<td>approx. 2.50 m</td>
<td>approx. 2.50 m</td>
</tr>
<tr>
<td><strong>Height</strong></td>
<td>approx. 3.80 m</td>
<td>approx. 3.50 m</td>
<td>approx. 3.50 m</td>
</tr>
<tr>
<td><strong>Total weight</strong></td>
<td>approx. 40.000 kg (without options)</td>
<td>approx. 14.000 kg (without options)</td>
<td></td>
</tr>
</tbody>
</table>

Description:

- **Single-Toggle Jaw Crusher STE 100-65 HBSV**
  - Feed opening 1,000 x 650 mm
  - Hydraulic adjustment of gap width

- **Feeder Bin, approx. 6 m³**
  - Highly wear-resistant welded steel construction
  - Bin walls can be folded down hydraulically for transport

- **Vibratory Conveying Trough, 1,100 x 3,500 mm**
  - pre-screening:
    - upper deck: 2-stage grid section, each 750 mm long, opening 40 mm
    - lower deck: finger screen, 2-stages, opening approx. 25 mm
  - 2 unbalance motors, electrical 2 x 2.69 kW

- **Crawler-Undercarriage**
  - Bridge construction, welded of steel plates and sectional steel
  - Crawler undercarriage, travel speed 1.6 km/h

- **Drive Unit**
  - Diesel genset 225 kVA; integrated tank 400 litres; incl. filler pump, enclosed all over
  - Diesel engine, type PERKINS 1308 E-87 TA; power 198 kW / 1,500 rpm
  - 3-phase-squirrel cage motor, 132 kW / 1,000 rpm, 400 V / 50 Hz, IP 54
  - Driving elements

- **Hydraulic System for Crawler-Drive**
  - Hydraulic components
  - Double-type axial piston pump for gear pump
  - Oil tank, oil-air cooling
  - Valves and filters
  - Wireless remote control

- **Electrical Equipment - SPS control system**
  - Switch cabinet
  - Frequency converter
  - Operation panel with Display
  - Automatic start/stop operation
  - Emergency-off button
  - Flash-lamp and signal horn

- **Wireless Remote Control – travel drive and trough control**

- **Belt Conveyors**
  - Main discharge belt conveyor, 1,000 x 9,800 mm
  - Pre-screened material conveyor, two alternatives available:
    - 500 x approx. 2,800 mm, hydraulically foldable, or
    - 500 x approx. 6,000 mm, rigid, to be inserted laterally

- **Bending zone**

- **Platforms and Access Ladders**

- **Options**
  - Belt scale
  - Overbelt magnet separator
STE 108-75/W

Mobile Crushing Plant on Wheels with Single-Toggle Jaw Crusher

Application Data
- Feed material: Natural rock, building debris
- Throat Width: 1.080 x 750 mm
- Feed Material Size: 1.000 x 650 mm
- Throughput: up to 300 t/h (depending on feed material and adjusted gap width)
- Final grain size: 0/80 - 0/300 mm depending on gap width
- Drive: Diesel-electric, power 250 kVA

General technical data
- Length: working condition approx. 14.70 m transport condition approx. 13.30 m
- Width: approx. 3.30 m approx. 2.50 m
- Height: approx. 4.20 m approx. 4.00 m
- Total weight: approx. 45,900 kg (without options)

Description:
Single-Toggle Jaw Crusher STE 108-75
- Feed opening 1.080 x 750 mm
Feeder Bin, approx. 7 m³
- Highly wear-resistant welded steel construction
Vibratory Conveying Trough, 1.000 x 4.250 mm
- 2-stage-grid section each 800 mm, gap width 50 mm, 2 unbalance motors, electr. 2 x 2.78 kW
Undercarriage
- Designed as welded sectional steel frame
- Axle unit, type VRS 30
- Two-line compressed-air brake system with ABS
- 24-Volt lighting equipment
Hydraulic Support System
- Hydraulic unit, solenoid valves
- 6 supporting cylinders
- Wireless remote control
Drive Unit
- Diesel genset 240 kVA; integrated tank 400 litres, enclosed all over
- Diesel engine, type IVECO 8210 SRI 15, power 221 kW as per DIN 6271
- Three-phase-squirrel cage motor, 132 kW / 1.500 rpm, 50 Hz
- Driving elements
Electrical Equipment - SPS Control System
- Switch cabinet
- Frequency converter for vibratory conveying trough
- Operation panel with display, equipped with 32 softkeys to operate each of the plant components
- Additional sockets for external consumers
- Safety circuit
- Flash lamp and signal horn
Wireless Remote Control
Belt Conveyors
- Main discharge belt conveyor, 1.200 x 9.850 mm, hydraulically foldable
- Reversible belt conveyor, 650 x 3.150 mm, laterally tittable
Platforms and Access Ladders
Options
- Overbelt magnet separator
- Belt scale
- Special painting
- Bending zone
Mobile Crushing Plant on Tracks with Single Toggle Jaw Crusher

STE 108-75/T-VR

Application Data
  - **Feed material:** Natural rock, building debris
  - **Throat Width:** 1.080 x 750 mm
  - **Feed Material Size:** 1.000 x 650 mm
  - **Throughput Capacity:** up to 450t/h (depending on feed material and adjusted gap width)
  - **Final Grain Size:** 0/80 to 0/300 mm depending on gap width
  - **Drive:** Diesel genset, 250 KVA

General technical data
  - **Length:** approx. 17.00 m
  - **Width:** approx. 4.50 m
  - **Height:** approx. 5.00 m
  - **Total Weight:** approx. 60,000 kg - without options
  - **Ground pressure of tracks:** ca. 16.40 N/cm² - without options

Description:
  - Single Toggle Jaw Crusher, STE 108-75
  - Feed opening 1.080 x 750 mm
  - Feeder Bin, approx. 9 m³
  - Highly wear-resistant welded steel construction
  - Vibratory Conveying Trough, 1.000 x 3.500 mm
  - With 2 grid sections, 2 x 650 mm, gap width 40 mm
  - 2 unbalance motors, electr. 2 x 4.7 kW
  - Vibratory Conveying Grid, 1.100 x 1.600 mm
  - Grid length: 2 x 650 mm,
    upper deck: gap width 60 mm
    lower deck: gap width 25 mm, finger screen (1-stage)
  - 2 unbalance motors, electr. 2 x 2.8 kW
  - Crawler-Undercarriage
    - Bridge construction, welded of steel plates and sectional steel
    - Crawler undercarriage, travel speed approx. 1.0 km/h
  - Drive Unit
    - Diesel genset 250 KVA; integrated tank 500 l; enclosed all-over
    - Diesel engine, Type PERKINS 1306-E87 TA; power 217 kW acc. to ISO 3046/1
    - 3-phase squirrel cage motor, 132 kW / 1.000 rpm
    - Drive elements
  - Hydraulic System for Crawler Drive
    - Hydraulic components mounted on base frame
  - Electrical Equipment - PLC
    - Switch cabinet
    - Operating panel
    - Frequency converter
  - Wireless Remote Control for travel drive and feeding trough
  - Belt Conveyors
    - Main discharge conveyor, 1.200 x 11.300 mm
    - Belt conveyor for pre-screened material, 650 x 4.000 mm (lateral discharge)
    - Reversible belt conveyor, 850 x 2.600 mm (lateral discharge resp. conveying of material to main discharge conveyor)
  - Blending Zone
  - Platforms and Access Ladders
  - Options
    - Overbelt magnet separator (permanent magnet)
    - Belt scale

Application Data
  - **Feed material:** Natural rock, building debris
  - **Throat Width:** 1.080 x 750 mm
  - **Feed Material Size:** 1.000 x 650 mm
  - **Throughput Capacity:** up to 450t/h (depending on feed material and adjusted gap width)
  - **Final Grain Size:** 0/80 to 0/300 mm depending on gap width
  - **Drive:** Diesel genset, 250 KVA

General technical data
  - **Length:** approx. 17.00 m
  - **Width:** approx. 4.50 m
  - **Height:** approx. 5.00 m
  - **Total Weight:** approx. 60,000 kg - without options
  - **Ground pressure of tracks:** ca. 16.40 N/cm² - without options

Description:
  - Single Toggle Jaw Crusher, STE 108-75
  - Feed opening 1.080 x 750 mm
  - Feeder Bin, approx. 9 m³
  - Highly wear-resistant welded steel construction
  - Vibratory Conveying Trough, 1.000 x 3.500 mm
  - With 2 grid sections, 2 x 650 mm, gap width 40 mm
  - 2 unbalance motors, electr. 2 x 4.7 kW
  - Vibratory Conveying Grid, 1.100 x 1.600 mm
  - Grid length: 2 x 650 mm,
    upper deck: gap width 60 mm
    lower deck: gap width 25 mm, finger screen (1-stage)
  - 2 unbalance motors, electr. 2 x 2.8 kW
  - Crawler-Undercarriage
    - Bridge construction, welded of steel plates and sectional steel
    - Crawler undercarriage, travel speed approx. 1.0 km/h
  - Drive Unit
    - Diesel genset 250 KVA; integrated tank 500 l; enclosed all-over
    - Diesel engine, Type PERKINS 1306-E87 TA; power 217 kW acc. to ISO 3046/1
    - 3-phase squirrel cage motor, 132 kW / 1.000 rpm
    - Drive elements
  - Hydraulic System for Crawler Drive
    - Hydraulic components mounted on base frame
  - Electrical Equipment - PLC
    - Switch cabinet
    - Operating panel
    - Frequency converter
  - Wireless Remote Control for travel drive and feeding trough
  - Belt Conveyors
    - Main discharge conveyor, 1.200 x 11.300 mm
    - Belt conveyor for pre-screened material, 650 x 4.000 mm (lateral discharge)
    - Reversible belt conveyor, 850 x 2.600 mm (lateral discharge resp. conveying of material to main discharge conveyor)
  - Blending Zone
  - Platforms and Access Ladders
  - Options
    - Overbelt magnet separator (permanent magnet)
    - Belt scale
For short-distance travelling within a quarry the track-version can be employed. Its low overall weight allows troublefree changing of locations over longer distances on a flat-bed trailer. Those plants reach that kind of flexibility that is indispensable for frequent changing of location with short set-up times.

The mobile recycling plants equipped with R-CI impact crushers are perfectly appropriate for tertiary processing of building residuals, such as asphalt demolition material, reinforced concrete of building demolition and construction rubble, but also to reduce medium-hard and hard natural rock in size. A hydraulic system to open and close the crusher housing enables easy access into the crushing chamber.

The R-CI impact crushers are wonderfully reliable in operation. Simple maintenance, excellent accessibility provided by suitable access ladders and operation platforms together with technical auxiliary equipment characterize this type of crusher.
Mobile Crushing Plant with Impact Crusher

R-CI 100-100/T

Application Data

- Feed material: Natural rock, building debris, asphalt fragments, gravel
- Throughput capacity: up to 150 t/h (depending on feed material and gap width)
- Feed material size: up to max. 520 mm edge length building debris
  max. 620 x 620 x 250 mm
- Final grain size: approx. 75 % 0/30 - 0/50 mm
  (depending on feed material and adjusted gap width)

General technical data

- Length: working condition approx. 13.50 m, transport condition approx. 12.00 m
- Width: approx. 3.70 m, approx. 2.50 m
- Height: approx. 3.60 m, approx. 3.10 m
- Total weight: approx. 30.000 kg (without options)
- Ground pressure crawlers: approx. 11.00 N/cm² (without options)

Description

Impact Crusher R-CI 100-100 (rotor with 4 impact bars)
- Inlet opening 1.000 x 670 mm
- Rotor diameter 1.000 mm, rotor width 1.000 mm

Feeder Bin approx. 4 m³
- Highly wear resistant welded steel construction, bin walls can be folded hydraulically

Vibratory Conveying Trough 1.000 x 2.800 mm
- 2-stage grid section, each 750 mm, gap width 40 mm, 2 unbalance motors, electrical, 2 x 3.05 kW

Undercarriage
- Bridge construction, welded of steel plates and sectional steel
- Crawler track unit, travel speed 1.5 km/h, admissible gradient approx. 20 %

Drive Unit
- Diesel genset 225 kVA; incl. tank 400 litres; incl. filler pump, enclosed all over
- Diesel engine, type PERKINS 1306 E-87 TA; power 198 kW
- Three-phase squirrel cage motor, 110 kW, 1.500 rpm, 400 V, 50 Hz
- Driving elements

Hydraulic unit to drive the crawler undercarriage
- Hydraulic unit completely mounted on base frame
- Wireless remote control

Electrical Equipment - SPS control system
- Switch cabinet with operation panel
- Frequency converter
- additional sockets for external consumers

Wireless Remote Control

Belt Conveyors
- Main discharge conveyor belt, 1.000 x 7.700 mm, troughed
- Discharge conveyor belt for pre-screened material available in two versions:
  * either pre-screened material conveyor, 500 x 2.800 mm, hydraulically foldable, or
  * pre-screened material conveyor, 500 x approx. 4.000 mm, rigid, to be inserted laterally

Discharge Chute, 1080 / 900 x 2.670
- Wearing plates, bolted to the chute body
- 2 unbalance motors, electr. 2 x 2.29 kW

Platforms and Access Ladders

Spraying Device

Options
- Overbelt magnet separator
- Grinding path
- Service crane, mechanical - carrying capacity 500 kg
- Belt scale
- Hydraulic system to lift the front impact element
Mobile Crushing Plant with Impact Crusher

R-CI 100-130/T

**Application Data**

- **Feed material:** Natural rock, building debris, asphalt fragments, gravel
- **Throughput capacity:** up to 250 t/h (depending on feed material and adjusted gap width)
- **Feed material size:** up to max. 550 mm edge length building debris, max. 650 x 650 x 280 mm
- **Final grain size:** approx. 75 % 0/30 - 0/50 mm (depending on feed material and gap width)
- **Drive:** diesel-electric, genset 225 kVA

**General technical data**

- **Length:** working condition approx. 14.20 m, transport condition approx. 14.10 m
- **Width:** approx. 3.70 m, approx. 3.60 m
- **Height:** approx. 3.80 m, approx. 3.60 m
- **Total weight:** approx. 36.000 kg (without options)
- **Ground pressure crawlers:** approx. 15.0 N/cm² (without options)

**Description:**

*Impact Crusher R-CI 100-130 (rotor with 4 impact bars)*
- Inlet opening 1.360 x 852 mm
- Rotor diameter 1.000 mm, rotor width 1.300 mm

*Feeder Bin approx. 6 m³*
- Highly wear resistant welded steel construction, bin walls can be folded hydraulically

*Vibratory Conveying Trough 1.100 x 3.500 mm*
- Pre-screening:
  - Upper deck: 2-stage grid section, each 750 mm long, opening 40 mm
  - Lower deck: finger screen, 2-stages, free-swinging, opening 25 mm
- 2 unbalance motors, electrical 2 x 2.69 kW

*Undercarriage*
- Bridge construction, welded of steel plates and sectional steel
- Crawler track unit, travel speed 1.6 km/h, admissible gradient approx. 20 %

*Drive Unit*
- Diesel genset 225 kVA; incl. tank 400 litres; incl. filler pump, enclosed all over
- Diesel engine, type PERKINS 1306 E87-TA; 198 kW
- Three-phase squirrel cage motor, 132 kW, 1.500 rpm, 400 V, 50 Hz
- Driving elements

*Hydraulic unit to drive the crawler undercarriage*
- Hydraulic unit completely mounted on base frame
- Wireless remote control

*Electrical Equipment - SPS control system*
- Switch cabinet with operation panel
- Frequency converter

*Wireless Remote Control*

*Belt conveyors*
- Main discharge conveyor belt, 1.000 x 7.700 mm, troughed
- Discharge conveyor belt for pre-screened material available in two versions,
  * either 500 x 2.800 mm hydraulically foldable, or
  * 500 mm x approx. 6.000 mm, rigid, can be inserted laterally

*Discharge Chute, 1.100 x 2.670*
- Wearing plates, bolted to the chute body
- 2 unbalance motors, electr. 2 x 2.29 kW

*Platforms and Access Ladders*

*Spraying Device*

*Options*
- Overbelt magnet separator
- Belt scale
- Hydraulic system to lift the front impact element
- Grinding path
- Service crane, mechanical - carrying capacity 500 kg

**Application Data**

- **Feed material:** Natural rock, building debris, asphalt fragments, gravel
- **Throughput capacity:** up to 250 t/h (depending on feed material and adjusted gap width)
- **Feed material size:** up to max. 550 mm edge length building debris, max. 650 x 650 x 280 mm
- **Final grain size:** approx. 75 % 0/30 - 0/50 mm (depending on feed material and gap width)
- **Drive:** diesel-electric, genset 225 kVA

**General technical data**

- **Length:** working condition approx. 14.20 m, transport condition approx. 14.10 m
- **Width:** approx. 3.70 m, approx. 3.60 m
- **Height:** approx. 3.80 m, approx. 3.60 m
- **Total weight:** approx. 36.000 kg (without options)
- **Ground pressure crawlers:** approx. 15.0 N/cm² (without options)
R-CI 130-130/W

Mobile Crushing Plant on Wheels with Impact Crusher

R-CI 130-130/W

Application Data
- Feed material: natural rock, building debris, asphalt fragments, gravel
- Throughput: up to 330 t/h (depending on feed material and adjusted gap width)
- Feed material size: up to max. 600 mm edge length construction debris
  max. 800 x 800 x 300 mm
- Final grain size: approx. 75 % 0/30 - 0/50 mm
  (depending on feed material and gap width)
- Drive: diesel-electric, genset 350 kVA

General technical data
- Length: approx. 15.40 m
- Width: approx. 4.90 m
- Height: approx. 4.50 m
- Total weight: approx. 42,000 kg (without options)

Description:
Impact Crusher R-CI 130-130 (rotor with 4 impact bars)
- Inlet opening 1.360 x 950 mm
- Rotor diameter 1.300 mm, rotor width 1.300 mm

Feeder Bin approx. 8 m³
- Highly wear resistant welded steel construction

Vibratory Conveying Trough 1.250 x 4.600 mm
- Grid section: 2 stages, each 650 mm long, gap width 40 mm, 2 unbalance motors, electrical 2 x 4.5 kW

Undercarriage
- Welded sectional steel frame
- 3 axles, type VRS 30, with 10 tons axle load each
- Two-line-compressed-air brake system with ABS
- Lighting, 24-Volt light installation
- Hydraulic support

Drive Unit
- Diesel genset 340 kVA; incl. tank 700 litres; enclosed all over
- Diesel engine, type IVECO 8210 SRI 27; 306 kW as per DIN 6271
- Three-phase squirrel cage motor, 160 kW, 1.500 rpm, 50 Hz
- Driving elements

Hydraulics - Basic Equipment
- Hydraulic aggregate, solenoid valves, hand valve blocks
- Hydraulic cylinders and hosing
- Wireless control: to operate legs, lift impact elements, open and close crusher housing
- Hand valves: to fold main discharge conveyor in and out, to fold bin walls

Electrical Equipment
- Switch cabinet
- Frequency converter
- Operation panel with display
- Capacity regulation of crusher
- Socket system, max. 30 kW, to operate external devices
- Flash lamp and signal horn
- Energy supply by short-time current generator

Wireless Remote Control, 7 Channels

Belt Conveyors
- Main discharge conveyor belt, 1,000 x approx. 8.600 mm, hydraulically foldable
- Discharge conveyor belt for pre-screened material, 500 x approx. 4.000 mm, troughing 15°
- Discharge chute 1,250 x 1,900 mm

Platforms and Access Ladders

Options
- Overbelt magnet separator
- Belt scale
- Spraying device
- Service crane, mechanical - carrying capacity 500 kg
- Hydraulic system to lift the front impact element

Application Data

Application Data
- Feed material: natural rock, building debris, asphalt fragments, gravel
- Throughput: up to 330 t/h (depending on feed material and adjusted gap width)
- Feed material size: up to max. 600 mm edge length construction debris
  max. 800 x 800 x 300 mm
- Final grain size: approx. 75 % 0/30 - 0/50 mm
  (depending on feed material and gap width)
- Drive: diesel-electric, genset 350 kVA

General technical data
- Length: approx. 15.40 m
- Width: approx. 4.90 m
- Height: approx. 4.50 m
- Total weight: approx. 42,000 kg (without options)

Description:
Impact Crusher R-CI 130-130 (rotor with 4 impact bars)
- Inlet opening 1.360 x 950 mm
- Rotor diameter 1.300 mm, rotor width 1.300 mm

Feeder Bin approx. 8 m³
- Highly wear resistant welded steel construction

Vibratory Conveying Trough 1.250 x 4.600 mm
- Grid section: 2 stages, each 650 mm long, gap width 40 mm, 2 unbalance motors, electrical 2 x 4.5 kW

Undercarriage
- Welded sectional steel frame
- 3 axles, type VRS 30, with 10 tons axle load each
- Two-line-compressed-air brake system with ABS
- Lighting, 24-Volt light installation
- Hydraulic support

Drive Unit
- Diesel genset 340 kVA; incl. tank 700 litres; enclosed all over
- Diesel engine, type IVECO 8210 SRI 27; 306 kW as per DIN 6271
- Three-phase squirrel cage motor, 160 kW, 1.500 rpm, 50 Hz
- Driving elements

Hydraulics - Basic Equipment
- Hydraulic aggregate, solenoid valves, hand valve blocks
- Hydraulic cylinders and hosing
- Wireless control: to operate legs, lift impact elements, open and close crusher housing
- Hand valves: to fold main discharge conveyor in and out, to fold bin walls

Electrical Equipment
- Switch cabinet
- Frequency converter
- Operation panel with display
- Capacity regulation of crusher
- Socket system, max. 30 kW, to operate external devices
- Flash lamp and signal horn
- Energy supply by short-time current generator

Wireless Remote Control, 7 Channels

Belt Conveyors
- Main discharge conveyor belt, 1,000 x approx. 8.600 mm, hydraulically foldable
- Discharge conveyor belt for pre-screened material, 500 x approx. 4.000 mm, troughing 15°
- Discharge chute 1,250 x 1,900 mm

Platforms and Access Ladders

Options
- Overbelt magnet separator
- Belt scale
- Spraying device
- Service crane, mechanical - carrying capacity 500 kg
- Hydraulic system to lift the front impact element
Mobile Crushing Plant on Tracks

R-CI 130-130/T-V

Impact Crusher R-CI 130-130 (rotor with 4 impact bars)
- Inlet opening 1,360 x 950 mm
- Rotor diameter 1,300 mm, rotor width 1,300 mm

Feeder Bin approx. 7 m³
- Highly wear resistant welded steel construction, bin walls can be folded hydraulically

Vibratory Conveying Trough 1.100 x 3.500 mm
- 2 unbalance motors, electrical, 2 x 2.78 kW

2-Deck Screen (linear resonance type)
- screen width: 1.200 mm;
- screen length: 2.300 mm;
- upper deck and lower deck electrically driven, 2 x 3.5 kW

Discharge chute
- Chute width: 1,250 mm/1,400 mm; chute length: 2,670 mm;
- electrically driven, 2 x 2.29 kW

Undercarriage
- Bridge construction, welded of steel plates and sectional steel
- Crawler track unit, travel speed 1.0 km/h, admissible gradient approx. 25 %

Drive Unit
- Diesel genset 400 kVA; incl. tank 500 litres; enclosed all over
- Diesel engine, type PERKINS 2306 C-E14 TAG 2, 320 kW
- Three-phase squirrel cage motor, 200 kW, 1,500 rpm;
- Driving elements
- Three-phase motor to drive the double-acting axial piston pumps and the geared pump for the working hydraulic

Hydraulics - Basic Equipment
- Switch cabinet
- Operating element with 2 x 40 symbol display
- Automatic start/stop operation
- Frequency converter
- Cabling and emergency-off
- Flash warning light and horn
- Wireless remote control

Electrical Equipment - SPS
- Main discharge conveyor belt, 1,400 x 9.000 mm
- Lateral discharge conveyor belt, two versions available on customer’s request
  * 650 x 6.200 mm, can be rigidly pushed in,
  * 650 x 4.200 mm, can be folded down hydraulically

Platforms and Access Ladders

Spraying Device

Options
- Overbelt magnet separator
- Belt scale
- Grinding path
- Service crane, mechanical - carrying capacity 500 kg
- Hydraulic system to lift the front impact element

Technical data

<table>
<thead>
<tr>
<th>Operating condition</th>
<th>Transport condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>L e n g t h</td>
<td>approx. 18.60 m</td>
</tr>
<tr>
<td>W i d t h</td>
<td>approx. 6.90 m</td>
</tr>
<tr>
<td>H e i g h t</td>
<td>approx. 4.70 m</td>
</tr>
<tr>
<td>T o t a l w e i g h t</td>
<td>approx. 62.000 kg</td>
</tr>
<tr>
<td></td>
<td>approx. 19.10 m (resp. 18,5 m)</td>
</tr>
<tr>
<td></td>
<td>approx. 3.20 m</td>
</tr>
<tr>
<td></td>
<td>approx. 4.10 m</td>
</tr>
</tbody>
</table>
For decades cone crushers have been part of the extensive product program of solo crushers at Maschinenfabrik Liezen und Gießerei GmbH. Not only to fulfill market requirements of today but also to contain components pointing the way ahead into the future, the mobile cone crusher CC 80 / T on tracks has been created. For planning and construction of CC 80 / T, MFL took three main characteristics into consideration:

- versatile in application
- strong, powerful and mobile
- economical and reliable in use
CC 80/T

Product Inquiry

Mobile Crushing Plant on Tracks with Cone Crusher

CC 80/T

Application Data
- Feed material: natural stone
- Throughput capacity: up to 145 t/h (depending on feed material and gap width)
- Feed material size: max. 160 mm edge length
- Final grain size: 0/12 up to 0/60 mm depending on crushing tools and adjusted gap width
- Drive: Diesel genset, power 225 kVA

General technical Data
- Length: approx. 13.80 m approx. 11.50 m
- Width: approx. 2.50 m approx. 2.50 m
- Height: approx. 4.20 m approx. 3.20 m
- Total weight: approx. 26,000 kg without option

Description
Cone Crusher, CC 80
- Cone diameter 800 mm, stroke (optional) 16, 20 or 25 mm
- Hydraulic gap adjustment
- Overload protection: electr. for crusher drive; hydraulically with bubble accumulator for crusher

Feeder Bin, approx. 4.5 m³
- Highly wear-resistant welded steel construction
- with grizzly to limit max. grain size

Crawler-Undercarriage
- Bridge construction, welded of steel plates and sectional steel
- Crawler undercarriage, travel speed 1.8 km/h

Drive Unit
- Diesel genset 225 kVA; integrated tank 400 litres; incl. filler pump, enclosed all over
- Diesel engine, type Perkins 1306 E-87 TA; 198 kW / 1.500 rpm
- 3-phase-squirrel cage motor, 90 kW / 1.500 rpm, 50 Hz, IP 54
- Drive elements

Hydraulics - Basic Equipment
- Hydraulic control unit and solenoid valves for track drive
- auxiliary hydraulic system
- particular hydraulic control unit for cone crusher
- lubricating oil circuit with automatic control and regulating system

Electrical Equipment - PLC
- Switch cabinet with canopy
- Frequency converter
- Operation panel with display
- Automatic start/stop operation
- Emergency-off button
- Flash-lamp and signal horn

Wireless Remote Control - travel drive and feed material quantity

Belt Conveyors
- Main discharge belt conveyor, 800 x about 8.200 mm, hydraulically foldable
- Material loading conveyor, 800 x 5.300 mm, hydraulically displaceable

Platforms and Access Ladders

Option
- Belt scale
Annex 5: Photos from Malta and Austria (Study Visit 1\textsuperscript{st} to 5\textsuperscript{th} October 2007)
Malta 01 – Mixed C&D waste in Skips
Twinning Project MT05-IB-EN-01
Assistance to explore long term projects to manage specific waste streams in a more sustainable manner
Recycling of Construction and Demolition Waste in Malta
Strategy for immediate implementation
Malta 02 – Excavation and demolition works
Recycling of Construction and Demolition Waste in Malta
Strategy for immediate implementation
Malta 03 – Construction works
Twinning Project MT05-IB-EN-01
Assistance to explore long term projects to manage specific waste streams in a more sustainable manner
Recycling of Construction and Demolition Waste in Malta
Strategy for immediate implementation
Recycling of Construction and Demolition Waste in Malta
Strategy for immediate implementation
Malta 04 – Re-use of (building) materials
Assistance to explore long term projects to manage specific waste streams in a more sustainable manner

Recycling of Construction and Demolition Waste in Malta

Strategy for immediate implementation
Austria 01 – Handsorting of mixed C&D waste with consecutive RDF treatment (“Oekomacher”, Vienna)
Austria 02 – Production of secondary materials for road construction
(“Contracon” and “Pittel&Brausewetter”, Vienna)
Twinning Project MT05-IB-EN-01
Assistance to explore long term projects to manage specific waste streams in a more sustainable manner
Recycling of Construction and Demolition Waste in Malta
Strategy for immediate implementation
Twinning Project MT05-IB-EN-01
Assistance to explore long term projects to manage specific waste streams in a more sustainable manner
Recycling of Construction and Demolition Waste in Malta
Strategy for immediate implementation
Austria 03 – Recycling oriented dismantling of disused industrial buildings (“Schneiberg Ltd.”, Vienna)
Twinning Project MT05-IB-EN-01
Assistance to explore long term projects to manage specific waste streams in a more sustainable manner
Recycling of Construction and Demolition Waste in Malta
Strategy for immediate implementation
Austria 04 – Mobile recycling (“Oekotechna Ltd.”, Vienna)
Austria 05 – Recycling of used bricks for the cement industry ("Prajo-Boehm Ltd.", Himberg, Lower Austria)
Austria 06 – Re-use of recycled bricks in the cement industry ("Lafarge-Perlmoser Ltd.", Mannersdorf, Lower Austria)
Austria 07 – Landfill for mineral waste and asbestos-cement waste in a disused quarry (“Oekotechna Ltd.”, Vienna)
Austria 08 – Landfill for contaminated soil ("Mineralstoff Verwertung Ltd.", Hennersdorf, Lower Austria)