

RUMBA - Guidelines for Sustainable Building Site Management



SHORT REPORT

RUMBA

StaDt Wien
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RUMBA

Guidelines for Sustainable Building Site Management

Short Report

This report was financed to 40% with means from the EU-LIFE program and developed in the context of the project RUMBA-Guidelines for Sustainable Building Site Management.

The project was realized by a comprehensive working team, in which people from numerous institutions, enterprises and specialty departments of the city of Vienna were engaged.

Project partners:

Vienna City Administration: Office for Urban Planning, Development and Construction (Project Co-ordination Office)
 OEKOTECHNA - Entsorgungs- und Umwelttechnik Ges.m.b.H.
 Mischek Bau AG
 Vienna Land Procurement and Urban Renewal Fund (WBSF)

The project team was supported by the following consulting firms:

Rosinak & Partner ZT GmbH
 raum & kommunikation
 Austrian Institute for Applied Ecology

Furthermore the following specialty departments of the city of Vienna were involved in the realization of the RUMBA-project:

MA 22 - Environmental Protection
 MA 27 - EU Strategy and Economic Development
 MA 29 - Bridge Construction and Foundation Engineering
 MA 34 - Building and Facility Management (project executing organization)
 MA 48 - Waste Management, Street Cleaning and Vehicle Fleet

Further informations:

www.rumba-info.at

In the available version of the manual, gender-neutral formulations were not used constantly. The editorial staff is aware of this inadequacy and demands for the appreciation that the female form of person designations was omitted for reasons of better legibility. However, we would like to state explicitly that all person designations refer to both sexes.

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SUSTAINABLE BUILDING SITE MANAGEMENT

- Two thirds of the quantitative goods traffic (in tons) are building material transportations. 99% of the building site traffic are completed with trucks.
- 7% to 10% of the NO_x and particle emissions in traffic are due to building site traffic.
- A fourwheel truck (18 tons) affects the roads 17,000 times, a four-axis truck (36 tons) 30,000 times more than a passenger car.
- The building of a dwelling causes 60 truck drives and 2,500 - 3,000 truck kilometers.
- 75% of the waste arising are building remainder masses, only one third of them can be used again.
- 3% of the inhabitants feel disturbed by building noise.

These values refer to the city of Vienna, however they can be assigned without doubt to other cities equally.

In the context of the LIFE project "RUMBA-Guidelines for Sustainable Building Site Management" the city of Vienna pursued the following goals together with three partners from the building industry:

- Reduction of the building site traffic by avoidance of trips and by higher usage of trains.
- Raise of the utilization ratio of building wastes by waste separation already at the building site.
- Less noise-, air polluting-, greenhouse gas- and light emissions by the building site.
- Better city-formative integration to minimize aesthetic disturbances.

The project was organized as a Public-Private Partnership and completed by the city of Vienna with the partner companies Ökotechna, Mischek Bau AG and the Vienna Land Procurement and Urban Renewal Fund (WBSF). In addition, companies of the building, waste and transportation industry were integrated via regular RUMBA Round Tables.

In three demonstration projects at eight demonstration building sites of different types, measures for a sustainable building site management were implemented. The demonstration projects had the following topics:

- Train instead of truck: Shift of excavation and pre-fabricated part transportation to the railway.
- Ecological building site management: Waste separation at the building site, dust reduction, reduction of the disposal trips.
- RUMBA contest among the building firms: Integrated planning of a sustainable building site management in the context of a competition procedure (housing with approximately 500 dwellings).

In addition, sustainable building site management needs the correct framework. Present market conditions do not offer sufficient incentives or obligations for a sustainable building site management. A substantial part of RUMBA consisted of developing recommendations for an improvement of the basic conditions for a sustainable building site management including the obtained feedback from the demonstration projects.

The most important resulting products from RUMBA are:

- A manual for sustainable building site management.
- Recommendations for the adaptation of laws, regulations, guidelines, standards, contract awards (biddings) and promotions.
- Initiation of additional projects or supporting plans like the installation of building logistics centers.

Results and documents of all project parts can be found at: www.rumba.info.at



FRAMEWORK FOR SUSTAINABLE BUILDING SITE MANAGEMENT

The following changes of the general framework are recommended or have been accomplished:

- (1) Propositions concerning the change of legal regulations in the scope of the city of Vienna: Building code, waste management law, noise protection law, regulation for the avoidance of dust emissions.
- (2) Installation of the Sustainable Building Site Management as a valuation criterion for the allocation of housing promotion.
- (3) Anchorage of the Sustainable Building Site Management in the traffic master plan 2003 and in the climatic protection program of the city of Vienna.

(4) Allocation of areas for building logistics centers by the town planning department.

(5) Proposition for the legal anchorage of an environmental co-ordinator and an environmental plan similar to the safety co-ordinator and the safety and danger plan of the European Union building site guideline respectively the construction work co-ordination law in Austria.

(6) Specification of services for the rail and ship transport and for the central collecting logistics at building sites and admission into the sample texts for ecologically sound building bids of the Austrian Standardization Institute.

EFFECTS OF THE REALIZED DEMONSTRATION PROJECTS

- (1) Building site traffic

Table 1: Environmental effects concerning building site traffic with RUMBA

Type of transport	Truck - km	Concentrations (No _x)	Greenhouse Gas	Costs
Excavation (per ton)	-90% to -100%	-54% to -67%	-51% to -80%	Approx. +50% to +100%
Pre-fabricated parts (per ton)	-93%		-54% to -93%	+ / - 0%
Waste disposal (per m ²)	-10% to -35%	-10% to -35%	-10% To -35%	+ / - 0%

Despite the higher costs in the excavation transport case, the rail transport has an economically positive balance if the distance is not longer than 1,5 times (with pure diesel traction) respectively 3 times (with electric traction) the truck distance. A substantial perception of the life cycle assessment in the excavation transport case was the great importance of the handling procedures.

Conventional wheeled loaders cause 55% (CO₂) to 99% (particles) of the emissions. The use of low-polluting wheeled loaders (as in the tunnel construction) or the avoidance of additional handling procedures by ACTS-containers or conveyers is crucial for a much better life cycle assessment of the rail logistics compared to the truck.

(2) Building site wastes

It could be shown that it is possible to reduce mixed building site wastes at conventional building sites (without excavation) from 75%- 80% to 50% and lower. Thus the utilization ratio can be increased by more than 30%. Thereby

- resource consumption is reduced and
- dump volume can be saved.

Since no extra costs result, the economic balance is definitely positive.

(3) Dust

No measurements were accomplished. Still, from a qualitative estimation, one can assume a possible reduction of the dust emissions of up to 50%.

NOT REALIZED PROJECTS

Not all primarily planned demonstration projects could be realized successfully.

(1) Pre-fabricated parts logistics

The portion of the pre-fabricated parts, which are transportable by train, should be increased from 60% (standardized units) to 90% (special productions, extra-large parts). The production of rail-suited transportation containers could not be realized successfully due to technical and economical reasons.

building site did not turn out as being an appropriate solution. The creation of such a logistics chain is reasonable only with permanent building logistics centers. Solely in this case, the necessary temporal scope for the individual building sites and a cost reduction by allocation on several users are possible. An unplanned product of the project was however the establishment of such a building logistics place with railway connection of excavation-gravel-site mixed concrete logistics for several small building sites.

(2) Excavation-gravel-site mixed concrete logistics

The implementation of a combined excavation-gravel-site mixed concrete logistics by train at the

Excavation logistics by train was demonstrated instead at a large-scale building site with own railway connection.

DEMONSTRATION BUILDING SITES

Demonstration building site with pre-fabricated part logistics by train at an urban multi-storey building in Vienna

A large complex of residential buildings with 204 dwellings in 26 floors was established in the 10th Viennese district. Four builders (BUWOG, BWS, House property, Mischek) are involved in the project. In May 2004, the carcassings were finished. Due to static requirements the first nine floors were established in site-mixed concrete whereas from the 10th Floor on, the pre-fabricated part construction method was applied. Altogether 1,200 pre-fabricated parts were used, among them 480 (40%, approximately 9,500 tons) railway-suited units, which means that they were not oversized and did not come from special productions (e.g. staircase houses, linked up covers).

The railway-suited pre-fabricated units were driven by train from the precasting plant of the Mischek company (with own track connection) in Gerasdorf near Vienna to the unloading place of the Viennese south railway station and brought from there by truck to the building site. However, only 352 of the 480 pre-fabricated units could effectively be taken by train because of a rail strike lasting several days (see Table 2).

Compared to truck transports, a reduction of the CO₂-emissions of around 54% to 91% depending on the traction (diesel or electric) could be reached by using rail transports (see Table 3).

Table 2: Basic data of transport logistics

Distances	Street	Railway
precasting plant - Viennese south railway station	-	18 km
Viennese south railway Station - Construction site	2 km	-
precasting plant - Construction site	24 km	-



Table 3: Environmental effects of the shift of pre-fabricated parts to the train

Indicators	Transport Handling			Change compared to truck			
	With truck	With train	³⁾	Diesel		Electric	
	¹⁾	Diesel ²⁾	Electric	absolute	%	absolute	%
Truck - km	16,896	1,408	1,408	-15,488	-93	-15,488	-93
Train - km	-	1,584	1,584	+1,584		+1,584	
Diesel usage (l)	11,830	5,400	1,000	-6,430	-54	-10,830	- 91
CO ₂ -emissions (t)	35.8	16.3	3.2	-19.5	-54	-32.6	- 91

¹⁾ 70 litres / 100 km

²⁾ With diesel traction, Usage of 100 litres/h, Driving time precasting plant - Viennese south railway station: 0,5 h

³⁾ 0.09 kg CO₂/tonkilometer

Source: Mischek ZT: Demonstrationsvorhaben Bahn statt Lkw im Rahmen des EU-LIFE-Projektes RUMBA, Wien, 2004

Demonstration building site excavation transport by train

At the former industrial site of the cable works Vienna-Meidling, a new quarter with approximately 900 dwellings, offices, a hotel and culture and leisure facilities is created. After a participation process including the neighbourhood, the use of the existing railway connecting line for the evacuation of the 170,000 tons of excavation (approximately 14,000 truck trips inclusive dead-heads) was agreed and linked to the assignment of housing promotion means.

On the basis of the received offers, a life-cycle assessment was developed (see Table 4).

The results made clear that the double-handling of the excavated material with conventional wheeled loaders charges the life-cycle balance of the railway alternative with 55% (CO₂) to 99% (particles). The use of low-polluting wheeled loaders like the ones used in the tunnel construction, could reduce the particle emissions of the wheeled loaders by 90%. Other technical solutions - like the use of the rolling-container-transport-

system (ACTS) or conveyors - could also save additional handling procedures. The evacuation by train however costs 1,5 to 2 times more.



Table 4: Environmental effects concerning the shift of excavation transports to the train

Alternative Offers	Distance to the dumpsite	Diesel / ton	CO ₂ / ton	Particles / ton
Truck to the next dumpsite	14 km	0.45 l	1.23 kg	0.41 g
Truck to the cheapest dumpsite	32.5 km	1.0 l	2.86 kg	0.96 g
Train with diesel traction	43 km	0.4 l	1.06 kg	0.83 g 0.08 g ¹⁾
Train with diesel + electric traction	5 km 49 km ²⁾	0.23 l	0.62 kg	0.76 g 0.08 g ¹⁾

¹⁾ Low-polluting wheeled loader as in the tunnel construction

²⁾ Electricity from renewable energy

Source: Mischek: *raum & kommunikation: Ökobilanz Schiene / Straße - Zur Umweltwirkung transportlogistischer Maßnahmen am Fallbeispiel des Aushubtransports der Wohnanlage Kabelwerke KDAG, Demonstrationsvorhaben Bahn statt LKW im Rahmen des EU-LIFE-Projektes, RUMBA, Wien, 2004.*

Demonstration building site excavation transport by train

In the building project EUROSHOPPING Seiersberg, the transport of already separated building site wastes according to the sorting station principle was conducted.

According to this technique, in the final phase three sorting stations on approximately 70,000m² of effective area were installed, in which the wastes were taken over and documented by a trained personnel.

At "conventional" building sites - waste management at new-building construction sites - the

accumulated wastes consist of 75% - 80% mixed building site wastes or bulky waste and 20% debris and wood.

With the sorting station principle, the portion of mixed building site wastes could be reduced to under 55%. Thus the utilization ratio could be increased by approximately 30%. The disposal trips were reduced by more than 20% through the use of 10m³ containers (see Table 5).

With the sorting station, approximately 20% to 25% of the disposal costs, which arise without waste separation at the building site, could be saved. The costs of the sorting station itself (basically personnel costs) were split up by the builder on the professionals. For the professionals however, cost savings arise, (omission of individual disposal expenditure) resulting in the assumption that altogether the sorting station system is cheaper than the principle of the individual disposal of mixed building wastes by the professionals themselves.

Table 5: Reduction of the disposal trips by optimized disposal logistics

Disposal logistics	Trips
Conventional disposal with 8m ³ containers	664
With sorting stations	528



Source: ÖKOTECHNA: Demonstrationsvorhaben Ökologische Baustellenabwicklung im Rahmen des EU-LIFE Projektes RUMBA, Wien, 2003.

Demonstration building site disposal logistics at an urban new building house

At the new-building-house construction site in the Weyringergasse 10 in the 4th Viennese district, the building company Alpine Mayreder building GmbH changed from a mixed collection of building debris and bulky goods to a separate collection at an already existing building site. The building debris was furthermore collected in a container, while for bulky goods additional 1,100 l and 2,200 l roll containers were provided. The collection took place once a week with a press car and was integrated into a collecting route for building site wastes. The following effects could be realized (see Table 6).

Table 6: Decrease of the mixed building site wastes through separate collection

	Before	After
Wood	4%	20%
Bulky goods	17%	33%
Mixed wastes	79%	47%

The fraction of mixed wastes could be reduced by more than 40%. The foreman was responsible for the separate collection at the building site. After a short explication of the system, the separate collection was accepted and judged positively.



Source: ÖKOTECHNA: Demonstrationsvorhaben Ökologische Baustellenabwicklung im Rahmen des EU-LIFE Projektes RUMBA, Wien, 2003.

Demonstration building site dust avoidance during a facade repair

At an urban indoor swimming pool (Jörgerbad, 17th Viennese district) the front was renewed. The removal of the plaster and the stemming works at



the front cause strong dust emissions and large amounts of fine debris. To minimize the dust, the following measures were implemented:

- Wrapping of the front with a dust proof, transparent foil
- Installation of a close material catching area with a height of 2 to 3 meters at the pavement, as the strongest dust emissions arise during the landing of the debris material.

With these measures the dust emissions could be prevented to a very large extent.



Demonstration building site traffic avoidance at an urban revitalization building site

At the modification building site of a school in the Florian-Hedorfer-Straße 20-22 in the 11th Viennese district (HAZET building contractor GmbH & CO KG) the collection of building wastes with 8m³ containers was changed over to a collection with larger containers during the building process. Thus the disposal amount per truck trip could be increased from 8,4m³ to 14m³ and the number of trips was reduced by 40%.

Demonstration building site shop reconstruction

At a small building site with a building duration shorter than 3 months in the main business street of Vienna (Mariahilfer Straße), a separate collection of the building wastes, an arranged storage of the building materials, a minimization of the dust emissions and a better integration into the cityscape was achieved. At the beginning of the building activity a training of the responsible building foreman took place.



Building site Mariahilfer Straße, Vienna

Source: ÖKOTECHNA: *Demonstrationsvorhaben Ökologische Baustellenabwicklung im Rahmen des EU-LIFE Projektes RUMBA, Wien, 2004.*

Demonstration building site dust and noise avoidance at an urban building-construction-redevelopment building site (base redevelopment)

During the base reorganization (overall renovation) of the Generali house in the Praterstraße 66 in the 2nd Viennese district (building firm HAZET, waste management company ÖKOTECHNA) the following dust avoidance measures were implemented:

- No free storage of sand and debris by the use of Big Bag's and small containers
- Evacuation of the containers with a net coverage
- Coverage of the containers with nets outside the operation hours of the building site
- Installation of blinds and dust shield nets
- Fencing and installation of overhead barriers of the entire building site range including pave-

ment, parking area, cycle lane and green areas

- Current cleaning of the free pavements and parking areas
- Wetting of the waste groups during the reloading procedure from the 1m³ crane container into the 10m³ debris and bulky goods container.

These measures have lead to a noticeable reduction of the dust emissions (approximately 50%).

To achieve a reduction of the noise emissions, crane containers were used instead of debris chutes. A substantial precondition for the implementation of the measures in the practical working procedures was a training and a shaping of consciousness of the foremen at the start of the project.



Source: ÖKOTECHNA: Demonstrationsvorhaben Ökologische Baustellenabwicklung im Rahmen des EU-LIFE Projektes RUMBA, Wien, 2004.

INTEGRATED PLANNING AND IMPLEMENTATION OF SUSTAINABLE BUILDING SITE MANAGEMENT

Demonstration project builder competition RUMBA for a large-scale building site in Vienna (builder selective procedure Thümlhofstrasse)

In the context of the EU-LIFE-project RUMBA, the city of Vienna established a builder competition for the construction of approximately 900 dwellings at two opposed building sites along the Thümlhofstrasse in the 11th district. Apart from the (in such procedures) usual evaluations concerning the architectural, economical and ecological aspects, the submitted building projects were also evaluated under the criterion of the environmental-friendly building completion.

The near Viennese harbour is intended as being the tri-modally logistics-center for pre-fabricated parts and building items (e.g. windows). The control should take place via a central building site access control, a payment system and a time slot management of the building site supplies. The monitoring and control is carried out for all building activities, in particular however for the heavy transportation groups excavation, pre-fabricated parts, site-mixed concrete and other carcass materials.

The carrying-out of the construction begins in the first quarter of 2005, the completion of the building is presumably 2007. The builders of the different building sites will make a contractual agreement, in which the joint building logistic completion is stated. The following measures, which are prerequisites for the acquisition of housing promotion means, are part of the building logistic and environmental management:

- Central building site access
- Payment system depending on the transport extent
- Access control and time slot management
- Documentation of the transports
- Admission of the merits of the building logistic management into the bids of the building services
- Suggestions for the precaution and elimination of building obstacles
- Appointment of an environmental co-ordinator
- Separate collection of the building wastes in collecting facilities (e.g. sorting stations)
- Support of the central building site infrastructure (e.g. building site street, rolling-tracks, tire washing plant, efficiency of the sorting station etc.)
- Information for visitors, suppliers, complaining point, re-pursuance of polluters
- Consulting for operating companies

The direct overhead costs of these measures depending on construction period and construction volume are borne proportionately by the involved builders and amount to approximately 0,5% of the building costs. A further reserve of 2% of the building costs is available for other possible auxiliary costs of an environmental-friendly building completion.

Source: WBSF: *Demonstrationsvorhaben Bauträgerwettbewerb "Umweltfreundliche Baustellenabwicklung". Im Rahmen des EU-LIFE-Projektes RUMBA, Wien, 2004 (see also www.rumba-info.at).*



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