



**Natural Stone
Council**

*The United Voice of the
Natural Stone Industry*

Best Practices of the Natural Stone Industry

Transportation

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The Natural Stone Council (NSC) is a collaboration of businesses and trade associations that have come together to promote the use of Genuine Stone in commercial and residential applications. By pooling resources, their goal is to increase the understanding of, preference for, and consumption of these natural products. Trade associations affiliated with the NSC include Allied Stone Industries, Building Stone Institute, Elberton Granite Association, Indiana Limestone Institute, Marble Institute of America, National Building Granite Quarries Association, National Slate Association, New York State Bluestone Association, Pennsylvania Bluestone Association, and the Natural Stone Alliance.

The Natural Stone Council is committed to supporting sustainable initiatives and innovations at all levels of the production of Genuine Stone® products. As such, the NSC has established a Sustainability Committee made up of key industry members to elevate the issue of sustainability within the industry and provide a body responsible for planning and implementing relevant initiatives. In 2007, the NSC Sustainability Committee engaged in a partnership with the Center for Clean Products (CCP) at the University of Tennessee to assess current industry operations relating to dimensional stone production. In 2011, the NSC Sub-committee further reviewed and updated this document. The best practice identified and presented in this document is a direct result of the NSC and CCP's efforts to identify and improve the environmental profile of the natural stone industry.

This document is intended to establish guiding principles for the stakeholders as “Best Practices” in our industry and IS NOT intended to serve as a reference standard.

A Need for Strategic Transportation

Well-planned transportation is a critical component in the natural stone industry because of four facets that set natural stone apart from many other building products:

1. The raw material is also the final product (sometimes with the exception of a small amount of resin or adhesive).
2. The location of raw material production is uncontrollable.
3. Each deposit is unique, offering specific aesthetic and physical properties.
4. Stone is incredibly dense.

Although the first is a positive characteristic on its own as it eliminates transportation of additional ingredients to the fabrication site, coupling it with the second and third characteristics causes transport to play a significant role in the stone industry worldwide. Since quarries must be located where the geologic deposit has formed, and projects may call for a very particular appearance, shipment across the globe may be unavoidable. Adding the fact that stone is relatively heavy, transportation of the material can quickly become expensive economically, as well as environmentally.

Implementing transportation management promotes shipment efficiency, ultimately minimizing negative impacts to the environment and reducing costs. A comprehensive and proactive transport strategy can also improve carrier-shipper relations and enhance the quarry or processing facility's reputation for social responsibility. In fact, a FedEx transportation benchmark study demonstrated that higher customer service level and lower transport expenses were seen in companies with a strategic transportation plan (Younkin 2006). This document provides guidance to develop and implement such practices.

Benefits of Strategic Transport

Well-considered transportation of natural stone products creates an array of advantages for a quarry, processing facility, or supplier. These benefits span the following:

- Mitigated environmental impacts
- Improved health and safety
- Cost control
- Generation of revenue
- Increased efficiency
- Shortened lead time
- Reduced inventory
- Enhancement of company reputation
- Improved shipper-carrier relationships

Transportation is a highly complex and dynamic element of the natural stone industry. As such, it provides great opportunity for continuous improvement that result in cost savings, a reduced environmental footprint, and more efficient shipment overall. This document offers practices that can lead to the realization of these benefits.

Movement of Stone

Transportation in the stone industry is unique to each company and even to products within a company. The simplest route a product can take is directly from the quarry to the processing plant to a customer. Some companies' quarry and fabrication facility are located at the same site, while others can be miles apart. Alternatively, a quarry may sell blocks or slabs to a separate company for processing and sale as

a finished product. Moreover, with fabrication businesses located across the globe, the potential exists for stone to travel between continents.

Stone quarried in North America is sometimes sent to countries with low labor costs, particularly China, for processing. The product is then sold back to the United States or Canada, sometimes being marketed as imported stone, although the quarry from which it came actually resides in North America. Even considering the transportation expenses to process abroad, stone industry members indicate that the incredibly low labor costs can render this fabrication approach significantly less expensive than if the same stone was processed in North America.

Suppliers and distributors also play a role. These industry members purchase raw pieces from quarries, or finished products from fabricators; some purchase both. The requested stone is shipped from the quarry or processing site to warehouses, which are often located at convenient distribution locations. Once a customer's order is placed, a final transport step occurs to deliver the product to the job site.

As evident, stone can be transported any number of times between the quarry and place of application. Moreover, any combination of trucking, rail, or shipping can be employed. A company can greatly benefit by managing these complexities with a holistic approach that includes maximizing efficiency, maintaining continuous communications with carriers, and ongoing evaluation of practices. Implementing such a comprehensive transportation plan will reduce costs, increase company reputation for on-time delivery, promote constructive relationships with the supply chain, and mitigate environmental impacts.

Impacts of Transportation

Truck

The most common mode of stone shipment in North America is trucking, bringing with it burdens of runoff, noise, and air pollutants. Despite the Clean Air Act's increasing stringency on motor vehicle emissions since the 1970's, heavy-duty diesel trucks have not been as tightly regulated. However, with environmental and human impacts of exhaust now better understood, the EPA has strengthened the legislation. Effective in 2007, standards for 2005 and newer heavy-duty truck models drop emissions 40% (on a mass basis) for diesel engines as compared to 2000 standards, and a second phase of this rule decreases the standards another 90% (OTAC 2000). Nevertheless, trucking is still considered less environmentally preferable than other land transportation modes (Barth and Tadi 1996; WBCSD 2001; Shaw et al. 2003; Facanha and Horvath 2007; CPW 2009).

Ship

As shipping is predominantly employed for overseas transport, its competition with regard to transportation modes is aviation. However, since stone is likely never shipped by air, the comparison is irrelevant to this document. Further, it is inappropriate to compare shipping to truck or rail, unless speaking of barge or coastal transport. As such, any comparison of waterway transport to other modes in this document is limited to such movement.

Environmental impacts associated with water vessel operation include (nonrenewable) energy consumption, displacement of ecosystem elements, discharge of oily bilge and ballast water, disposal of non-biodegradable solid waste in the ocean, and air emissions. Dumping is regulated under the Marine Protection, Research, and Sanctuaries Act, and emission standards have been promulgated for engines.

Emission standards for marine engines are based on the rated power of the engine family employed and include a standard only for the total hydrocarbon and NO_x emissions. For any engine less than 4.3kWh, a flat standard applies, while engines with a rating that equals or exceeds 4.3kWh must comply with standards that are calculated based on the particular rating. Emission limits have been steadily decreasing in magnitude since the 1998 model year, with the "hydrocarbon plus NO_x" constraint of

278g/kWh dropping to 81g/kWh for 2006 and newer engines (OAR 1997). Ideally, alternative fuels will be implemented to further mitigate these harmful emissions.

Although still unregulated, discharging ballast water can be particularly environmentally harmful. Water is taken in at one port, stored in a vessel's hull, and released at another port, bringing with it a multitude of organisms that can disrupt the new ecosystem. The invasion of the Great Lakes by zebra mussels is a prime example; effects of the species are described at <http://www.great-lakes.net/envt/flora-fauna/invasive/zebra.html>.

Rail

No conventional mode of transportation is without negative environmental consequences, but numerous studies conclude that rail has the most favorable profile, particularly with regard to CO₂ emissions (Barth and Tadi 1996; WBCSD 2001; Shaw et al. 2003; Facanha and Horvath 2007; CPW 2009). The EPA regulates locomotive emission standards based on year of manufacture; Tier 0 includes those built from 1973-1999, Tier 1 comprises 2000-2004 models, and Tier 2 applies to 2005 and later models. Tier 2 standards drop emissions 70%, 42%, and 67% for CO, NO_x, and particulate matter, respectively, as compared to Tier 0 standards (OAR 1997).

Best Practices

The natural stone industry transportation best practices center on four interconnected principles: efficiency, relationships, evaluation, and sustainability. The first concept includes all aspects related to the physical movement of natural stone from the quarry to a job site, while the second involves maintaining effective interaction between shippers, carriers, and customers. The third principle aims to identify strengths and weaknesses of the transportation process as a whole, working toward overall improvement. Finally, some additional sustainability concepts are provided to help reduce the environmental footprint of the supply chain and convey the company's status as an eco-conscious company.

Efficiency

Efficiency refers to not only operations but economics and sustainability, which are often quite interlinked as a leaner system can generate financial and environmental benefits. Most fundamentally, optimization of mileage and fuel efficiency result in cost and emissions savings per cubic foot of stone transported.

Improving transportation steps and reducing ecological burdens without compromising delivery quality requires strategic planning and effective management. However, efficient transport of products generates customer satisfaction, positive relationships with carriers, as well as cost savings, and may lead to repeat business. Extending the courtesy of operating in a well-organized and timely fashion will be appreciated by all business partners and clients. Carriers may even be more willing to work with facilities that uphold such high quality practices. A multitude of methods are available to assist in evolving to this type of business.

- **Centralize freight management:** Particularly for multi-facility companies, merging all freight management to one location creates a unified body to assess and control transportation throughout the business. In particular, allowing a single group this oversight creates a single database of events with consistent data capture rules and business processes. These provide a plethora of advantages, including the ability to achieve the following (Murphy 2006):
 - Combine shipments across facilities (i.e., create fuller loads)
 - Identify backhaul opportunities
 - Recognize and alleviate shipping delays and redundancies, enhancing performance
 - Share shipping information conveniently across facilities
 - Provide a consistent system for communicating with carriers

Overall, centralizing freight management increases collaboration and solution strategies across the supply chain, leading to clearly defined opportunities and return on investment (ROI).

- **Consolidate freight:**

- Less than Truck Loads (LTL) and Less than Container Loads (LCL) are more costly than moving a full truck or rail car. For instance, shipping a single cubic meter crate by itself can be four times more expensive in an LCL than transporting the same crate within a consolidated load (GNLC 2006). Shipments can be consolidated by implementing multi-stop routes or using consolidation hubs and cross-docking.
- When implementing cross-docking, revisit the strategy whenever a significant change in shipping needs to occur, such as the addition or deletion of a routine stop.

- **Pay attention to equipment:**

- *Appropriate equipment:* When shipping via truck, ensure that the trailer provided by the carrier is a proper size for the load. A shipper may pay an extra 10% more for product transport when a trailer that is too small or too large for the load is employed (GNLC 2006). Avoid this expense by asking questions to determine an appropriate trailer capacity, and speak with the carrier as soon as possible if the load changes to increase the likelihood that a proper truck can be found in time for transport.
- *Equipment operation:* Employing carriers that provide trucks with fuel-efficient attributes and implement frequent maintenance may result in a lower cost for the shipper due to the smaller volume of diesel needed. These practices are also valuable for shippers moving stone around their own facilities.
 - Ask for trucks with wide-based tires, as opposed to dual tires, on the drive and trailer axles; this simple substitution reduces tare weight and drag (Ang-Olson and Schroeer 2002).
 - Ensure proper tire inflation is maintained to avoid unnecessary rolling resistance and tire wear. Automatic Tire Inflation (ATI) systems are available to assist with this.
 - Request trucks with minimal tare weight. Ang-Olson and Schroeer (2002) estimate that many trucks could lose up to 3,000lb by switching to lighter weight materials, such as aluminum frames and axle hubs, without compromising durability. This reduction drops fuel consumption by 0.11mpg at 65mph.
 - Utilize low-friction lubricants in the drivetrain and engine to mitigate friction losses and increase fuel efficiency.
 - Require carriers to implement maximum speed policies for drivers. In addition to reducing fuel consumption, this practice assists in maintaining the safety of everyone on the road. Mechanical and electronic “governors” can be installed by carriers to monitor truck speed.
 - Stipulate that drivers are trained on fuel reduction techniques, including topics of shifting methods, route selection, acceleration, idling time, number of stops, and use of accessories.

- Although new vehicle technologies & trailer designs, when available, should be employed to increase efficiencies of fuel consumption, a more important aspect to consider is the continuous upkeep and maintenance of any fleet. Total environmental impact should be reviewed to consider the manufacturing of new fleet equipment against the replacement of existing fleet equipment.
- **Load wisely:**
 - When loading stone, a trailer's weight capacity will typically be reached before the bed area is filled. Be sure to carefully distribute the stone across the bed such that the trailer is properly balanced.
 - Incorporate the bed's tie-down areas into the loading plan to ensure that the stone can be secured correctly. Maintain a safe transport by always using appropriate tie-down techniques.
 - Secure the stone so that it is physically impossible for the product to slide around the bed. This process is sometimes referred to as *blocking out*.
 - Protect edge and corners of stone to prevent damage; injured pieces can result in lost money, generation of waste, and poor customer approval ratings.
 - Ensure that the loading area is always tidy, and stone can easily be moved on to the transport vehicle. Being organized will facilitate on-time pickups and promote safety in the loading area. Additionally, minimizing the amount of time a truck idles at the facility will avoid unnecessary air emissions and potential occupational exposure to diesel exhaust.
- **Package with sustainable materials:**
 - Purchase reusable packaging supplies, and reuse them if possible. Continuous expenses for the purchase of throw-away materials can be reduced or eliminated.
 - Minimize the use of plastic wrap, which is fabricated from petroleum products (a nonrenewable resource) and not able to be recycled by some communities.
 - For disposable or single use packaging, where possible, preference sustainably sourced materials such as wood that has been certified through a third party program
- **Be flexible when working with carriers/3PL's¹:** Discuss the best modes and routes of travel with carriers without prescribing every detail of the shipment. The carrier is typically very knowledgeable about means of transport, and many now have advanced modeling programs that calculate the most efficient method.
- **Employ computer programs:** Transportation management systems (TMS) and electronic data interface/exchange (EDI) make planning and sharing information easier. TMS programs select the most efficient shipment option based on user inputs of mode, transit time, and cost, while EDI facilitates communication with the carrier, offering such function as tendering shipments, scheduling and confirming pickups, and submitting transport paperwork to carriers. Computers can be effective in storing vast quantities of shipping information, but ensure that any data stored

¹ A 3PL is a third-party logistics provider, such as a warehousing and distribution company.

is copied on a device external to the computer! Due to high costs of purchasing and operating these programs, employing SaaS² and outsourcing to a 3PL may prove more economical.

- **Consider hiring a freight forwarder:** Transportation logistics can become complex and time-consuming. Hiring a third-party service provider can not only take this weight off of (perhaps less knowledgeable) company employees but can offer complete supply chain management and expertise in transport strategy. Additionally, the costs of purchasing TMS and EID programs are avoided.
- **Maximize import/export compliance:** Understanding laws of import and export can save a company from fines, penalties, and lost time for noncompliance. These regulations can become complex as a wide range of items must be considered, including customs, duties, rebates, refunds, remissions, and taxes. Freight forwarders can provide support with these issues, particularly if they have licensed customs brokers on staff.
- **Employ rail:** As previously described, rail is generally less environmentally burdensome than trucking. Transport stone by rail when possible.

Relationships

The relationship between a shipper and carrier can play a factor in the quality of service provided on either end. While the carrier holds the responsibility of transporting natural stone in a safe and reliable manner, the shipper must facilitate smooth interaction and exchange. Consideration and respect from one side can incite the same from the other, ultimately resulting in a productive and pleasant relationship.

- **Deliberate when selecting carriers:** Choosing a company to transport product should be a carefully conducted process. Taking extra time to ensure that the potential partner not only has a history of reliable performance and excellent customer service, but will likely be amenable to an interactive relationship will save the time and finances required to find another carrier later. Additionally, a worthy carrier will be agreeable—even eager—to work as a team to accomplish objectives.
- **Form a firm agreement:** Be sure to establish a sound contract with specific base rates. This proactive step will assist in controlling costs and avoiding supplemental charges later. Programs recommended for implementation by the NSC include the following:
 - Incoterms 2000 Shipping Terms, a framework developed by the International Chamber of Commerce that defines international transaction and shipping provisions, may provide assistance with this. More information can be accessed at <http://www.iccwbo.org/incoterms/id3045/index.html>.
 - Customs-Trade Partnership Against Terrorism (C-TPAT) is a voluntary U.S. government program that emphasizes transparency, education, and relationship building to improve the security of imports and exports, as well as the security of the nation, particular at the border. Details are located at http://www.cbp.gov/xp/cgov/trade/cargo_security/ctpat/what_ctpat/ctpat_overview.xml.
- **Consolidate:** A reduction in the number of companies employed to transport stone demonstrates a commitment to those carriers. In turn, closer relationship may evolve, and more favorable shipping rates perhaps can be negotiated. The carriers may also reflect the loyalty shown to

² SaaS is “software as a service”, in which a user purchases a license for an on-demand program, eliminating burdens of software maintenance and upkeep for the user. Charges are incurred by the user only when the program is employed.

them, improving service quality or offering additional assistance at low cost. As an added bonus, administrative paperwork will become less complex.

- **Be driver-friendly:** Provide convenient on-line scheduling for pick-ups and self-invoicing where the shipper approves payment upon notification of delivery. Be prepared for pickup at the set time, and ask for feedback to understand the improvements that can be made.
- **Communicate with carriers:** Maintain an interactive relationship with the carrier to ascertain the transmission of critical information, understand the needs of both parties, and gain—as well as offer—constructive feedback. Proactive management of the supply chain will decrease the occurrence of delayed and damaged deliveries. In particular, make sure to provide advance notice of load volume changes in order to increase the chance that the carrier will be able to transport the stone. Web-based communications, such as TMS and EDI programs, will aid this effort.
- **Communicate with customers:** Ensuring customer satisfaction can only be accomplished through interaction with clients. Ask for feedback with respect to minimum expectations—being on schedule, having sufficient packaging, arriving without damage—as well as items that go above and beyond, such as ease of ordering and friendliness of both the shipper and carrier. These questions can be assessed with a quick phone or email survey upon notification of delivery. Customers will appreciate the attention to detail. Additionally, discuss transport options with the client. This will aid in strategic planning, adds value to the product, and brings customer service to a personal level. Overall, communicating with a customer will help the shipper to maintain low costs and remain competitive in the market.

Evaluation

Continuous improvement of a transportation system requires frequent assessment of current operations. Both the shipper's practices as well as the carriers' performance should be evaluated, and feedback should be collected from all supply chain partners. This allows for enhancement of transport practices and even suggestions to be made regarding how to achieve those advancements.

- **Measure performance:** A number of metrics can be employed to rate and evaluate transportation performance. At the most fundamental level, a scorecard should be developed that includes ratings for both the shipper and the carrier. Scorecards can be tailored for specific parts of the operation and also include broader questions to assess the system as a whole. Data from these documents can be applied to compute very telling information, such as transport cost as a percentage of sales, portion of delivery deadlines attained, percentage of shipments transported on the planned route or mode, or number/cost of claims as compared to transportation expenses.
- **Monitor shipments:** Tracking loads of stone once they leave the shipping facility can reduce paperwork and improve efficiency overall. Monitoring the shipment is the responsibility of the carrier/3PL. Make sure to establish data rules, including the information provided and method of communication. Employing devices that allow for real-time updates render tracking requests unnecessary and proof-of-delivery documentation less time-sensitive. Additionally, using computer programs can offer information storage for record-keeping purposes and future analysis.
- **Assess resources:** Evaluate the (administrative) finances spent on the transportation system, and learn about external resources that could provide assistance. Partnering with transport planners to evaluate and form an appropriate shipment strategy may save the shipper from significant expenses in the long-term. Additionally, hiring a firm to manage shipment may prove more cost friendly than dedicating internal, less knowledgeable resources to the task.

- **Evaluate freight bids & the spot market:** Complement current contracts with competitive bids from the spot market, or ask for comprehensive bids for annual freight volume. Frequently viewing such offers will allow the shipper to remain up to date about shipping prices, as well as take advantage of special one-time options and discounts (such as when a carrier has an imperative need to fill a container). The former can assist when reassessing carrier contracts, allowing the shipper to negotiate competitive rates.
- **Communicate performance:** Be sure to convey transportation performance to carriers. Improvements can be made by working through challenges together and proactively discussing upcoming shipping needs, such as seasonal fluctuations or modification to the customer list that may alter shipping patterns. The supply chain cannot improve unless it knows where improvement is needed.
- **Re-evaluate:** Changes to the transport system are particularly dynamic. Fuel costs, carrier expenses, and customers all can vary widely. Taking a second look at a previous decision, even if that decision was relatively recent, can help minimize costs resulting from system variables. Optimization programs, such as TMS, may prove valuable in this purpose.

Final Remarks

A strategically constructed and clearly communicated transport plan, can control both financial and environmental impacts. It is imperative the entire supply chain is held to meet high standards of operation, and its participants are committed to the program. Implementing the best practices described in this document can prove advantageous with respect to economics, operations, and the environment. For questions regarding the content of this brochure or to learn more about the Natural Stone Council's sustainability efforts, please visit the GenuineStone® website at www.genuinestone.com or by email at info@genuinestone.com.

Industry Example

One of the largest natural stone quarry and fabrication companies in North America, Cold Spring Granite's (CSG) strategic transportation planning has earned the corporation exceptional savings to the tune of over one million dollars.



Three key practices are responsible for the heightened efficiency of CSG's outbound shipments: establishment of a centralized logistic team, partnership with a local third party logistics (3PL) company, and implementation of a state-of-the-art freight optimization software program. The centralized logistics team allows CSG to manage the freight of all (seven) of their product lines as if they were one, while the 3PL has given the company access to a greater diversity of freight carriers. The optimization software allows CSG to choose the best carrier for the shipment, create fuller loads, and travel the least amount of miles possible to complete the transaction.

CSG's team has also implemented a zone shipping concept for two product lines, which involves shipping to one section of the United States one week and the other section the following week. "This reduces the number of shipments per week and allows our weight per shipment to be increased by consolidating orders," explains Konop.

Since the inception of the three-pronged management system in January of 2008, CSG has seen a 22% reduction in overall outbound freight costs, equating to over one million dollars in corporate savings.

Much of CSG's inbound volumes are tied to steamship lines and ocean containers from foreign granite suppliers in India, China, Brazil or Italy. A small percentage of these containers are direct shipments to CSG customers, but the majority is moved via rail from the U.S. port city to Minneapolis, Minnesota (for fabrication) and then transported by a drayage company to Cold Spring, Minnesota. This process involves deconsolidating the container, building shipping schedules, loading trucks, and then re-shipping the product to customers.

Above
An organized loading deck promotes safe working conditions as well as expedited pick-ups and deliveries.

Right
Using proper tie-down equipment and techniques helps to avoid damage during transport.



Industry Example (cont.)

Historically, all of CSG’s imports arrived at ports on the West or East coast and were trucked to Minneapolis or a project site. In some cases, this resulted in the need to drive stone completely across the country. CSG decided to open a cross-docking warehouse operation four miles from the port in Pasadena, Texas in order to reduce trucking distances as well as transport duration. Pasadena was chosen because of its’ centralized location, cutting trucking for cross-country shipments in half. All monumental products are now brought into port, deconsolidated at the warehouse and then shipped directly to customers. The following tables describe the savings in mileage resulting from opening the Pasadena warehouse.

Imports from the West (e.g., China)

Former Process

Step 1: Norfolk, VA to Minneapolis, MN	1,285 miles
Step 2: Minneapolis, MN to Cold Spring, MN	78 miles
Step 3: Cold Spring, MN to Raleigh, NC	1,349 miles
TOTAL:	2,712 miles

Current Process

Step 1: Pasadena, TX to Raleigh, NC	1,218 miles
TOTAL:	1,218 miles

Imports from the East (e.g., India)

Former Process

Step 1: Los Angeles, CA to Minneapolis, MN	1,928 miles
Step 2: Minneapolis, MN to Cold Spring, MN	78 miles
Step 3: Cold Spring, MN to Phoenix, AZ	1,698 miles
TOTAL:	3,704 miles

Current Process

Step 1: Pasadena, TX to Phoenix, AZ	1,194 miles
TOTAL:	1,194 miles

Although, CSG’s import volume does not merit establishing a cross-docking warehouse on both coasts, opening the centrally-located facility has yielded excellent reductions in miles traveled, fossil fuel consumption, air emissions, and transportation expenses. In addition, establishing the warehouse has enhanced their service to certain customers.

CSG’s Director of Purchasing & Logistics, Steve Konop, asserts, “At Cold Spring Granite, the goal of the Traffic Department is to move our inbound and outbound product with the minimum amount of freight miles per truckload or shipment while simultaneously carrying the maximum amount of weight.” Although perhaps not specifically stated, this objective is also minimizing Cold Spring Granite’s environmental footprint. A little efficiency can go a long way.

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