STATE PROCUREMENT OFFICE

NOTICE & REQUEST FOR SOLE SOURCE

15 MAY 28 P2:22

ADMINISTRATION
STATE PROCUREMENT OFFICE
STATE OF HAWAII

TO: Chief Procurement Officer

FROM: Transportation
Name of Requesting Department

Pursuant to HRS §103D-306 and HAR chapter 3-122, Subchapter 9, the Department requests sole source approval to purchase the following:

1. Describe the goods, services, or construction to be procured.

Refurbish/rebuild three (3) ventilation fans at the H-3 Tunnel facility by the original equipment manufacturer. The three fans are among the 32 fans that were installed and commissioned in 1995 and, after 20 years of use, only fifty percent of the fans remain in service with age, malfunctioning of hardware and corrosion issues. These two supply and one exhaust fans are among the most critical which are needed to be put back in service. Howden North America, Inc. ("Howden") is the successor to TLT-Babcock, Inc., the original manufacturer. Howden provides all the services and warranties previously done by TLT-Babcock. In addition to the cost of Howden's Base Scope (see Attachment A), a 6% contingency and GET taxes have been added for a total request of $ 3.3 million for this project.

2. Vendor/Contractor/Service Provider Name:	3. Amount of Request:
Howden North America, Inc.	$3,300,000.00
4. Term of contract (shall not exceed 12 months), if applicable:	5. Prior SPO-001, Sole Source (SS) No.:
From: ~~8/1/2015~~ 6/15/2015 To: ~~7/31/2016~~ 6/14/2016	SS15-028K

DA 5/29/15

6. Describe in detail the following:

a. The unique features, characteristics, or capabilities of the goods, service or construction.

The H-3 Tunnels are the longest vehicular tunnels in the state of Hawaii, at one-mile in length. There are two tunnel bores, one in the Halawa to Kaneohe direction and the other from the Kaneohe to Halawa direction. A ventilation system, of which the 32 fans are a key component, is required to provide safe passage for motorists who use the tunnels as well as DOT employees, who repair and maintain systems within the tunnels. Acceptable air quality levels are maintained through the use of 32 high-capacity, ventilation fans. Attachment B is a general description of the ventilation system for the H-3 Tunnels and the role of the ventilation fans.

b. How the unique features, characteristics or capabilities of the goods, service or construction are essential for the department

The DOT is responsible for the safe movement of vehicles and people traveling on state highways and roads. To ensure the safety of motorists through the H-3 Tunnels, a dependable ventilation system is required to keep noxious gases to safe levels. The rebuilding of these 3 fans is Phase 2 of a multi-year project to restore all 32 fans to last twenty years. Six fans are being rebuilt under Phase 1 and is scheduled for completion in September 2015. Less than 20 percent of the fans can be removed to continue an adequate level of service for motorists.

7. Describe the efforts and results in determining that this is the only vendor/contractor/service provider who can provide the goods, services or construction.

High-capacity industrial fans are only made world-wide by a handful of equipment manufacturers. As the original equipment manufacturer, Howden is the only company that can refurbish and rebuild these fans and provide a warranty on their service, to meet manufacturer's specifications and provide ongoing service to maintain the fans and connected devices. Howden is an international company which manufactures more than 95% of large axial fans in the USA for commercial/industrial/governmental purposes. See Attachment C.

8. Alternate source. Describe the other possible sources for the goods, services, or construction that were investigated but did not meet the department's needs.

DOT attempted to repair and restore two tunnel fans between 2011 and 2013 with some locally-based vendors; unfortunately, the local vendors were unable to restore the fans due to the exacting demands and size of the machinery, coupled with its electro-mechanical controls. This history was detailed in the previously approved sole source request, SS15-028K. Howden is committed to be a compliant vendor in the Hawaii Compliance Express system to be able to offer their services in support of this equipment.

9. Identify the primary responsible staff person(s) conducting and managing this procurement. (Appropriate delegated procurement authority and completion of mandatory training required.)
*Point of contact (Place asterisk after name of person to contact for additional information).

Name	Division/Agency	Phone Number	E-mail Address
Pratt M. Kinimaka	*HWY/HWY-O*	*831-6813-x126*	*pratt.kinimaka@hawaii.gov*
*Clyde Morita**	*HWY/HWY-OT*	*485-6208*	*clyde.morita@hawaii.gov*

Department shall ensure adherence to applicable administrative and statutory requirements, including HAR chapter 3-122, Subchapter 15, Cost or Pricing Data if required.

All requirements/approvals and internal controls for this expenditure is the responsibility of the department.
I certify that the information provided is to the best of my knowledge, true and correct.

Department Head Signature — Date: 5·27·15

For Chief Procurement Officer Use Only

Date Notice Posted: 5/29/2015

Submit written objection to this notice to issue a sole source contract within seven calendar days or as otherwise allowed from date notice posted to:

state.procurement.office@hawaii.gov

Chief Procurement Officer (CPO) Comments:

Approval is granted for the period 6/15/2015 to 6/14/2016 based on the department's representation that Howden North America, Inc. is the only company that can successfully rebuild/refurbish the fans to their original working order. The department is reminded that sole source contracts in excess of $100,000 require cost or pricing data and analysis for price reasonableness pursuant to HAR chapter 3-122, subchapter 15.

This approval is for the solicitation process only. HRS section 103D-310(c) and HAR section 3-122-112 shall apply (i.e., vendor is required to provide proof of compliance and may use the Hawaii Compliance Express) and the award is required to be posted on the Awards Reporting System. Copies of the compliance, cost or pricing data certificate, and the awards posting are required to be documented in the procurement/contract file. SPO will follow up with the department to ensure the award has been posted and the cost or pricing data certificate has been obtained for both SS15-028K and SS15-081B.

If there are any questions, please contact Bonnie Kahakui at 587-4702, or bonnie.a.kahakui@hawaii.gov

☒ Approved ☐ Disapproved ☐ No Action Required

6/8/15

Chief Procurement Officer Signature *Date*

Additional Documentation in Support of SPO-001
DOT H-3 Tunnels Fan Rebuilding Project by Howden North America, Inc.

INDEX

a. Attachment A – Proposal from Howden and Quotation for Fans

b. Attachment B – Breakdown of Requested $ 3.3 million Authorization

c. Attachment C – Breakdown of $ 3.3 million Cost

d. Attachment D – Howden's Unique Qualification as Sole Source

e. Attachment E – Pricing Cost Comparison Phase 1 versus Phase 2

f. Attachment F – Cost of Rebuilding Versus Replacing Fans

5515-0818

May 15, 2015

State of Hawaii

Hawaiian Department of Transportation
H-3 Harano Tunnels
Exhaust & Supply Air Fan Refurbishment

Quote No. HNANSD. AFM 002408 SG rev 4

Reference:

TLT Three (3): Exhaust Fans Kaneohe Side and Eight (8) Exhaust Fans Honolulu Side (OEM Dwg. No. 417486-E)

OR

TLT: Threer (3) Supply Air Fans Kaneohe Side and Eight (8) Supply Fans Honolulu Side (OEM Dwg. No. 417328-E)

Dear Mr. Clyde Morita,

In regards to your request for a Turnkey price to refurbish/rebuild H-3 Harano Tunnel 3 Exhaust or 3 Supply Air Fans, Motors and Install new VFD Drives during the 2015 Fiscal Year (July 1, 2015 thru June 31, 2016), Howden North America Inc. is pleased to offer the following budgetary proposal for your review.

Howden has performed a significant number of Turnkey projects for Large Utility and Industrial Axial fans and has an impressive team of engineers, project managers, and field service personnel to support this kind of work. In performing this turnkey work Howden has an excellent safety record and we have brought every project to completion within the predicted time frame. We look forward to providing you with the same exemplary service for your fan project.

As the original equipment manufacturer of this equipment Howden is uniquely qualified to refurbish/rebuild your TLT Axial fans and perform maintenance inspections. Benefits to using Howden over other Contractors to perform this work include:

- Howden will be managing and directly supervising the work force as opposed to acting as technical advisors.
- Howden will bring this job to completion far quicker than any other contractor.
- Howden will be using local Union Craft field labor, including Howden Technical Supervisors and Construction Managers that have experience executing this type of work.
- Howden has a team of engineers, project managers, and support personnel that will be involved in the execution of this project.

- As the supplier for the design, parts and equipment manufacturer for this project, Howden has a high stake in maintaining control of the quality of the installation work, as does Hawaii DOT personnel.
- All new/refurbished parts/equipment install will be per original manufacturer drawings and specifications.
- A full work scope schedule will be contingent upon receipt of P.O.

Howden North America, Inc. will supply Turnkey services as outlined below:

HOWDEN (HNA) Scope of Work: Phase Two 2015/2016

Howden Turnkey will provide Project Manager, Howden Supt. /Engineers, local Union Craft labor, tool trailer, equipment required, consumables, materials, supervision, technical assistance and craft supervision to perform the following work scope: Howden will have a craft trailer, Consumables and materials.

Howden Turnkey group will handle all coordination with outside shops, communication between shops, field and Engineering as required. We will also handle shipping and keep the HDOT advised on a daily basis of progress on all equipment shipped off site as well as on-going work on site. We will work off a Primavera Schedule and keep this up to date on a daily basis.

Howden's technical personnel on site will assure all dimensional settings are correct and recorded.

Note: Our repair center (MRSC) is now called HNA- Medina

- Howden will mobilize equipment, tool trailer, office trailer and manpower to site.

Base Work Scope: Refurbish/Rebuild Three (Supply or Exhaust) Fans, Motors, and Install/Upgrade new VFD.s

Item No. 1: Supply Fans

- Dis-assemble Fan housing
- Dis-connect all electrical connections and remove all applicable instrumentation as required.
- Remove Motor and Fan Rotor w/Blades
- Remove Fan Blades
- Crate Fan Motor
- Crate Fan Rotor & Blades
- Ship Fan Motor & Rotor/Blades to Howden Shop (see Motor, Rotor and Blade Scopes below)
- Load and unload Fan housing sections required to be painted and transport to and from local shop for sandblasting and painting.
- Inspect Fan Housings prep and paint as required.

- Sandblast, apply one (1) coat Amercoat Zinc Primer @2.5 to 3.0 mils DFT, one (1) coat Amerlock 2 Epoxy @ 3 to 5 mils DFT and one (i) coat Amercoat 450HPolyurethane @ 1.5 to 2 mils DFT to the inside surfaces of fan wheel housing section (surfaces inside of outer shell and outside of inner cylinder only)
- Exterior surfaces NOT included.
- Existing Orange painted surfaces (blade pass) to be sandblasted and painted per above specifications. Note: Blade Clearances will be verified and adjusted accordingly during re-assembly to meet Howden specifications.
- Flanged mating surfaces shall be sandblasted and painted per paint spec above
- Install Siemens G120, 300hp VFD Drives with new , PLC's, HMI panels and controllers. Program Controllers and integrate system with existing Dynac ES System
- Replace and upgrade the fuse, fuse holders, fuse distribution bus, contactors, wires, labeling, etc.
- Confirm full functionality of each VFD-PLC-HMI system ("Drive") and it's respective connection to the traffic control system ("The System")
- Download firmware and programs to HMI, PLC, VFD, confirmation of wiring termination, i/o relay-field devise checks, interlock checks, testing of communications protocol between HMI/PLC to the System, comprehensive functionality system test, and reporting will be recurring tasks performed on all new VFD Drive Units installed.
- Additional Engineering and labor to re-route all i/o back to the Dynac ES System
- Inspect Inlet & Outlet Dampers
- Lubricate Damper Bearings.
- **Option:** Repair or replace Damper Actuators if required.
- **All transportation costs**
- Receive Motors, Rotors and Blades
- Install Rotor with Refurbished/Coated Blades on Motor
- Install Motor with Rotor/Blades
- Re-assemble Fan Housings
- Supply new gasket material between Fan Housing and Diffuser.
- Reroute electrical controls for Motor heaters to VFD Fan Control cabinet.
- Provide Start-up assistance and balance Fans if required to within Howden specifications.

Item No. 2: Exhaust Fans

- Dis-assemble Fan housing
- Remove Motor and Fan Rotor w/Blades
- Remove Fan Blades
- Crate Fan Motor
- Crate Fan Hubs
- Ship Fan Hubs to Howden Shops (see Motor, Rotor and Blade Scope below)
- Ship Motors to Howden local Motor Shop for Inspection/Repairs
- Inspect Fan Housings prep and paint as required.
- Load and unload Fan housing sections required to be painted and transport to and from local shop for sandblasting and painting.

- Sandblast, apply one (1) coat Amercoat Zinc Primer @2.5 to 3.0 mils DFT, one (1) coat Amerlock 2 Epoxy @ 3 to 5 mils DFT and one (i) coat Amercoat 450HPolyurethane @ 1.5 to 2 mils DFT to the inside surfaces of fan wheel housing section (surfaces inside of outer shell and outside of inner cylinder only)
- Exterior surfaces NOT included.
- Existing Orange painted surfaces (blade pass) to be sandblasted and painted per specifications above. Blade clearances to be verified and adjusted during re-assembly to meet Howden specifications..
- Install Siemens G120, 300hp VFD Drives with new , PLC's,HMI panels and controllers. Program Controllers and integrate system with existing Dynac ES System
- Replace and upgrade the fuse, fuse holders, fuse distribution bus, contactors, wires, labeling, etc.
- Confirm full functionality of each VFD-PLC-HMI system ("Drive") and it's respective connection to the traffic control system ("The System")
- Download firmware and programs to HMI, PLC, VFD, confirmation of wiring termination, i/o relay-field devise checks, interlock checks, testing of communications protocol between HMI/PLC to the System, comprehensive functionality system test, and reporting will be recurring tasks performed on all new VFD Drive Units installed.
- All transportation costs
- Inspect Inlet & Outlet Dampers
- Lubricate Damper Bearings
- **Option:** Repair or replace Damper Actuators if required.
- Receive Motors, Rotors and Blades
- Install Rotor with Blades on Motor
- Install Motor with Rotor/Blades
- Re-assemble Fan Housings
- Supply new gasket material between Fan Housing and Diffuser
- Upgrade vibration monitoring probes to Standard Accelerometers, and associated hardware and all cables required
- Install new pressure differential switches on Fan casings
- Reroute electrical controls for Motor Heaters into VFD Fan Cabinets
- Provide Start-up assistance and field balance if necessary

Item No. 3: Variable Frequency Drive Replacement

The overall general scope of this project is to provide turn-key engineering services to replace original and obsolete Reliant drives with new Siemens G120 drives.
Project scope includes the following:

- Design and engineering (i.e., drawings, programming, and system integration)
- Supply and install three (3) new Siemens G120 300 hp VFDs, industrial controls, power, PLCs and HMI panel
- System integration with existing Dynac ES system
- Testing and troubleshooting
- Startup, commissioning, and training
- Removal and disposal of existing VFDs, main circuit breaker, contactors, older obsolete cabinet components

Equipment age and condition present risks to the successful startup and operation of the tunnel fans. As a result, this scope includes the complete removal of existing drives, power distribution components and controls including main circuit breaker, control relays, contactors, control transformers, etc. Some existing components will remain and include but are not limited to reusable pilot devices, switches and ground lugs.
All e-waste materials generated during this project will be disposed of in accordance with local State and Federal regulations for solid and hazardous waste disposal.

Additional materials included in this and scope:
1. Spare parts to be provided include:

- One spare drive complete with power module, control unit and operator panel;
- One complete PLC rack,
- One HMI

Parts will be stored at Fluid Technologies until system owner is ready to receive.
2. Software for PLCs, HMIs and Drives

Additional scope of work not included in the original proposal.
1. Additional review and re-engineering of ladder logic provided by H3 Tunnels staff on April 26, 2015.

Scope includes the following:

- Review, Redesign and Engineering of System PLC logic.
- Programing: Update existing VFD programming to meet H3 Staff requirements.
- Install programing modifications
- Testing and troubleshooting.

2. Relocate fan motor heater circuits for the thirty two (3) fans.

Scope includes the following:

- Redesign and Engineering: Revise design, bill of material and electrical drawings to incorporate the fan motor heaters into their respective VFD cabinets.
- Power Distribution and Controls: Supply motor heater contactors, fuses, and fuse holders.
- Install Power Distribution and Controls: Install power distribution and control components, rewire circuits
- Testing and troubleshooting.

3. Upgrades from Original Design

Scope includes the following:

- Redesign and Engineering: Fuse Holder and Fuse Distribution Design.
- New contactors
- Controls Integrations: Additional i/o points verification, calibration, connection to controls system.

- Documentation upgrades for Controls Integration: (O&M's)

4. Replace existing UPS in each drive portal:
   ***UPS is needed to provide backup power to controls.

OTHER RECOMMENDED ADDERS THAT SHOULD BE CONSIDERED:

- Extended Warranty
- Service Contract
- Study to document H3 communication network:
  a. Document as is network infrastructure.
  b. Recommendation to upgrade network to IP based communications.

Item No. 4: Motor Inspection/Rebuilds Exhaust Fans & Supply Fans

- Perform incoming visual inspections
- Perform incoming electrical testing
- Dismantle Motor
- Perform incoming mechanical inspections
- Clean all parts
- Varnish treat and Bake Stator
- Growler test rotor for open and / or broken bars
- Furnish and install new Motor bearings
- Encoder operation test
- Replace Rotopulser Encoder
- Remount Motor Heaters per manufacturer recommendations
- Assemble Motor
- Paint motor per Howden specifications
- Prep Motor for shipment

Item No. 5: Fan Rotor/Blade Replacement Exhaust Fans

- Inspect Rotors as received
- Supply and Install all new Fan Blades
- Thermal Coat all new fan Blades
- Rebuild Hubs and replace parts as required
- Supply all new Blade Base Lock Plates and associated hardware
- Inspect, sandblast and coat hubs
- Supply new special bolts for mounting blades
- Mount Blades on Hubs and Balance Assembly in Shop
- Transportation included

Item No. 6: Fan Rotor/Blade Refurbishment Supply Fans

- Inspect Rotor and Blades as received
- Rebuild Hubs and replace parts as required
- Repair Fan Blades as required
- Re-anodize all Aluminum Fan Blades
- Sandblast prep and coat hubs
- Supply new special bolts required for mounting blades
- Transportation included.
- Mount Blades on Hubs and Balance Assembly in Shop

Item No. 7: Testing and Commissioning: Three (3) Fans

- Perform a test run of each fan to ensure that fan operates as intended and is suitable for long term operation. In particular the test run shall:
- Ensure that all diagnostic equipment is functioning as designed and is indicating properly in the control system. (Electrical by Plant)
- Ensure that the fans are operating as designed, all bearing temperatures, vibration data is within tolerance for long term continued service.
- Remedy any deviancies found during the test run.
- Field Balance Fans within Howden Specifications if required.
- Provide a detailed project report of the work performed: Within 30 days from the completion of the field work.

Option A: Repair Damper Actuator (As required)

- Field Labor to remove and re-install Auma Actuator
- In- house labor to inspect and evaluate repairs required
- Repair parts for Auma SA Actuator consisting of Seal Kit,4GTLS Geared Limit Switch, Declutch Assembly and Open & Close Torque Dials
- Repair parts if required; Motor, Worm Shaft, Worm Gear Assembly and Kirk Key Interlock

Option B: Replace Limitorque MX Series Actuator (As required)

- Replace MX-10,Nema 4X enclosure,480 VAC, On/Off Controls
- Replace QA Contacts (R1-R4) Top Mounted Hand Wheel
- Torque Nut Bore & Keyed Disconnect Switch
- Field Removal and Installation of Limitorque Actuator

Option C: Purchase Additional Sets of Exhaust Fan Blades

- Supply new Exhaust Fan Blades
- Coat new Fan Blades
- Supply new Locking Plates
- Supply new Special Bolts

- Transportation Included

HDOT - H-3 Harano Tunnel Scope of Work

- Plant to lock out and tag out fans as necessary, lock out damper actuators on both inlet and outlet dampers.
- Plant to provide unlimited access to the fans during the duration of Howden North America's work in order for us to complete the work in a timely manner
- Plant to allow for additional hours each day plus Saturdays as need to complete all 26 Fans on schedule.
- Plant to assist with gaining additional laydown/storage area for dis-assembly on the Honolulu side.
- Plant to dispose of all scrap, grease/lubricants, used oil and debris, provide dumpsters near the fans for us to place all materials. Plant to dispose of all materials. Plant to provide direction for proper dumpsters to be used for applicable debris and have dumpsters located within reasonable distance to the fans
- Plant to provide all fan parts required, including lubricants, grease and hub oil to support all disassembly and reassembly activities in work scope
- Plant to supply 110 volt power at fan.
- Plant will provide necessary operations support to conduct cold air fan runs for field balancing and operational check of both fans
- Plant to provide a "one point of contact" for each shift to coordinate and communicate with Howden Project Manager

Pricing for Fan Overhaul:

Howden will supply all tools, equipment, experienced field Union labor, and Howden Project Manager, Field Supt's/Engineers to perform the above scope of work during a planned 2015 outage based on the following prices shown in the table below depending on options selected.

Item No's.	Option	Description	Qty of Fans	Price:
1,2,3,4,5,6,7	Base Scope	Refurbishment/rebuild of three (3) fans, motors and new VFD's and system upgrades Scope described in Item's 1,2,3,4,5,6 and 7 above,	3 Exhaust Fans or 3 Supply Fans	$1,041,593.00 each $969,502.00 each

	A	Repair Auma SA Damper Actuator as required	1		$12,299.00 each
	B	Replace Damper Actuator with New Limitorque as required.	1		$11,528.00 each
	C	Additional Sets of Exhaust Fan Blades with Coating, special bolts and 16 locking plates.	2 Fans (Total of 16 Blades		$109,455.00
		Note: Cost of supplying Performance Bond for 100% of Contract Value Included in above Pricing			

Other Notes and Clarifications:

Note: This Firm proposal is valid for 30 days

1) As the OEM of the original fan assembly, Howden strives to provide mechanically safe and reliable rotating equipment to our customers, and will insure the highest level of workmanship provided by the seller.
   A. Howden shall respond to technical inquiries in a prudent and expeditious manner as agreed to on a case by case basis
2) Howden will not be responsible for any additional work beyond the scope outlined above. The cost for any unforeseen additional work shall be negotiated and agreed in writing by both parties (Howden North America, Inc. and HDOT). Any additional work as the result of delays or downtime outside Howden's control will be billed to HDOT on a negotiated basis
   A. Howden shall notify HDOT of any broken, damaged, worn items within the work shift it was found
3) The given price does not include any taxes. This will have to be determined during the negotiation stage.
4) The Fan is required to be available for field balancing and check out after completion of all work without having to de-mobilize and then return later for balancing. If a return trip would be required additional costs would apply.
5) No hazardous material handling is included or anticipated.
6) HDOT is responsible for any/all asbestos and lead paint remediation
7) Howden North America Aftermarket does not accept Liquidated Damages as Standard Business Practice and this quotation has no legal or cost provisions for the acceptance of Liquidated Damages.
8) Any major delays resulting from initial disassemble and "as found" condition requiring additional work and/or parts outside of work scope or unexpected repairs will be billed as an extra. These items will be documented in a separate report and submitted to HDOT in a timely manner for their review and approval

9) Howden shall provide a Project Team Leader (Steve Graeff Manager Turn Key) to lead the project and serve as one point of contact to all coordination and communication with HDOT of all field and shop work, including technical support and engineering services from any other Howden office.
10) Howden Project Team Leader shall meet with HDOT' Point of contact and other applicable personnel on a daily basis to review progress, issues and upcoming work. Howden shall provide a weekly written report covering progress, schedule updates, costs to date ,HNA Medina, OH shop updates, etc. Howden shall maintain an action items and/or issues list that will be reviewed during the daily meetings. This is to facilitate decision making, and to maintain project schedule.

Payment Terms:

- 20% Due upon Dis-assembly
- 20% Due upon completion of Receive and Inspect in Shops
- 20% Due upon completion of all shop work
- 35% Due upon completion of Re-assembly and Start-up
- 5% Due upon receipt of Final job report

Terms and Conditions:

This budgetary quote is subject only to the Terms and Conditions previously negotiated for Hawaii Department of Transportation PO No. 41098753. Unless otherwise negotiated and agreed to by HNA in writing. No other terms shall apply regardless of any statement on Buyer's documents to
the contrary.
Howden North America does not accept Liquidated Damages or in place warranty as standard business practice.
*If quoted deliveries do not meet your requirements, please advise.
For Prepay and Charge orders, there will be a 4% charge of the net selling price applied to Buyer's invoice as a separate item to cover the standard transportation and handling expenses to the first North American destination. In addition, any expense incurred by Seller because of special delivery arrangements requested by Buyer shall be billed to Buyer. Howden does not provide copies of freight invoices.
Pricing does not include Federal, State, Local, or Export taxes or duties.
Payment Terms are Net Forty-Five (45) days from invoice date.
Quote expires 30 days from noted and is subject to customer credit approval.
Minimum order value is $350.00.
Non inventory parts are not returnable; returned inventory parts are subject to restocking charges.

On behalf of Howden North America Inc., we greatly appreciate your interest in doing business with us. Howden is committed to providing the best quality products and services to our valued customers and we look forward to working with the HDOT on this valued project.

Should you have any questions or concerns regarding this proposal, please don't hesitate to contact us any time.

Kind Regards,

Steve Graeff
Manager, Turnkey
Howden North America, Inc.
(941) 661-9056
steve.graeff@howden.com

Additional contact Information:

Mauricio Salazar, Regional Sales Manager
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Depew, NY 14043
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Industrial Marketing Systems
Ms. Sharon Kilborn
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skilborn@aol.com

Section 2.7
Tunnel Ventilation System

Section 2.7 contains the following subsections:

2.7.1 System Summary
2.7.2 Tunnel Ventilation Fan and Duct System
- 2.7.2.1 Air Supply System
- 2.7.2.2 Air Exhaust System
- 2.7.2.3 Fan Operation
- 2.7.2.4 Damper System
- 2.7.2.5 Tunnel Airflow Patterns

2.7.3 Tunnel Ventilation Modes
- 2.7.3.1 Manual Mode
- 2.7.3.2 Semi-automatic Mode
- 2.7.3.3 Automatic Mode
- 2.7.3.4 Fire Mode
- 2.7.3.5 Tunnel Fire Mode

Introduction

All gasoline- and diesel-powered vehicles generate pollutants, such as carbon monoxide (CO). On open roadways, vehicle-generated pollutants are quickly dispersed into the atmosphere.

In vehicle tunnels, however, pollutants are confined, and if ventilation is not adequate, the contaminants in the tunnels may rise to hazardous levels. Therefore, vehicle tunnels are typically ventilated either by natural means, by a traffic-induced "piston" effect, and/or by mechanical equipment. This section describes the tunnel ventilation system at the Harano Tunnel facility.

In most vehicle tunnels, carbon monoxide is the pollutant of greatest concern. Carbon monoxide is an odorless, colorless, and poisonous gas that is produced by vehicle engine combustion. During normal tunnel operations, the Harano Tunnel ventilation system reduces carbon monoxide accumulation to safe levels. In fact, one of the primary roles of the tunnel ventilation system is to remove carbon monoxide from the tunnels. The ventilation system also removes other dangerous pollutants, including nitrogen oxides (NO_x) and hydrocarbons.

The Harano Tunnels are located in an area where prevailing trade winds often provide an adequate natural flow of ventilation from the Haiku side of the tunnels (the windward side of Oahu) to the Halawa side (the leeward side of Oahu). The tunnels provide an artificial conduit through the Koolau Range in which the air is funneled, resulting in a tunnel wind that often

exceeds five miles per hour. Occasionally, the wind flows in the opposite direction, from the Halawa side to the Haiku side. At other times, however, air pressure on each side of the Koolau Range is balanced and little or no natural ventilation flows through the Harano Tunnels.

Because the natural ventilation cannot be modified or controlled, it is not sufficient to ensure continuous, adequate ventilation of the Harano Tunnels and continual removal of pollutants. Therefore, the Harano Tunnels are designed with a mechanical tunnel ventilation system that provides safe CO levels within the tunnels by supplying fresh air to the tunnels and by removing polluted air. The mechanical ventilation system at the Harano Tunnel facility supplements the natural ventilation and provides ventilation whenever the natural ventilation is not adequate.

The tunnel ventilation system plays a crucial role in the effective operation of the tunnels. The system prevents the accumulation of toxic vehicle-generated pollutants, such as carbon monoxide. In addition, the tunnel ventilation system is designed to provide a very rapid flow of supply and exhaust air during an emergency in the tunnels, such as a tunnel fire. The tunnel ventilation system also maintains an acceptable level of visibility within the tunnels by removing smoke and other particulates.

The tunnel ventilation system is completely separate from the heating, ventilation, and air conditioning (HVAC) system, described in Section 2.8, and should not be confused with the HVAC system. The HVAC system provides ventilation to the portal buildings, Control Building, crosspassages and Maintenance Tunnel. The HVAC system also regulates humidity and air temperature in certain areas of the Harano Tunnel facility. In contrast, the tunnel ventilation system ventilates only the vehicle tunnels.

2.7.1 System Summary

The tunnel ventilation system at the Harano Tunnel facility is designed to provide a safe atmosphere within the tunnels by:

- Supplying fresh air to the tunnels, and by
- Removing polluted air

The tunnel ventilation system consists of:

- 32 supply and exhaust fans
- Supply and exhaust ventilation duct systems extending the entire length of each tunnel
- Fan damper and bulkhead damper systems
- Air monitoring devices, including carbon monoxide (CO) detectors
- Fan control system, including fan controls and equipment monitors

Each portal building contains four supply and four exhaust fans, as well as an air supply and exhaust ventilation duct system. Air within each duct is directed by a fan and damper located in that duct. Supply fans at each portal building draw fresh air into intake ducts. The supply air is sent to the tunnel through a supply duct located above the tunnel ceiling. The fresh air is discharged into the tunnel through supply vents, which are evenly spaced throughout the tunnel and are located near the tunnel floor.

There are a series of exhaust vents located in the ceiling of each tunnel. Exhaust fans at the nearest portal building draw tunnel air up into the exhaust vents. This air enters the exhaust duct, which is located above the tunnel ceiling and next to the supply duct. The exhaust air travels through the exhaust duct to the portal building, where the air is discharged at the roof level of the portal building.

The TOC Operator controls the 32 ventilation fans by using the DYNAC software. The Operator uses DYNAC to monitor the fans and to assign the tunnel ventilation system to one of four modes. The four modes are:

- *Manual Mode*
  If the fan system is placed in Manual Mode, the Operator may run each of the 32 fans at a "High", "Low", or "Off" setting, independent of the status of the other fans.

- *Semi-automatic Mode*
  In Semi-automatic Mode, the Operator chooses to run all of the fans in a tunnel at a predefined "step" level, from Step 0 (all fans off) to Step 7 (all fans on "High").

- *Automatic Mode*
  If the ventilation system is set to Automatic Mode, the Operator chooses to operate the fans in one of four sub-modes. Each sub-mode includes a predefined method of fan operation. The sub-modes include:
  1). Time of day
  2). Carbon monoxide level
  3). Vehicle count
  4). Predictive

- *Fire Mode*
  The Operator should set the ventilation system to Fire Mode if an emergency that requires a high level of ventilation, such as a fire, occurs inside the tunnels. If the ventilation system is set to Fire Mode, the fans will operate under predefined conditions, depending on the location of the fire, in order to control the movement of smoke or noxious gases away from motorists.

During normal conditions, the ventilation system usually operates in Manual Mode.

2.7.2 Tunnel Ventilation Fan and Duct System

Each vehicle tunnel contains an independent supply and exhaust ventilation fan and duct system. Each tunnel has eight supply and eight exhaust fans located at that tunnel's portal buildings, for a total of 32 supply and exhaust fans at the entire tunnel facility. There are four supply air fans and four exhaust air fans located in each portal building. Each fan is seven feet in diameter, is approximately 200 horsepower, and can move 210,000 cubic feet of air per minute at high speed.

The fans are numbered in sequential order and are located as follows:

- *Halawa Inbound Portal Building*
  Fans 1 - 4 (Supply Fans)
  Fans 5 - 8 (Exhaust Fans)

- *Halawa Outbound Portal Building*
  Fans 9 - 12 (Supply Fans)
  Fans 13 - 16 (Exhaust Fans)

- *Haiku Inbound Portal Building*
  Fans 17 - 20 (Supply Fans)
  Fans 21 - 24 (Exhaust Fans)

- *Haiku Outbound Portal Building*
  Fans 25 - 28 (Supply Fans)
  Fans 29 - 32 (Exhaust Fans)

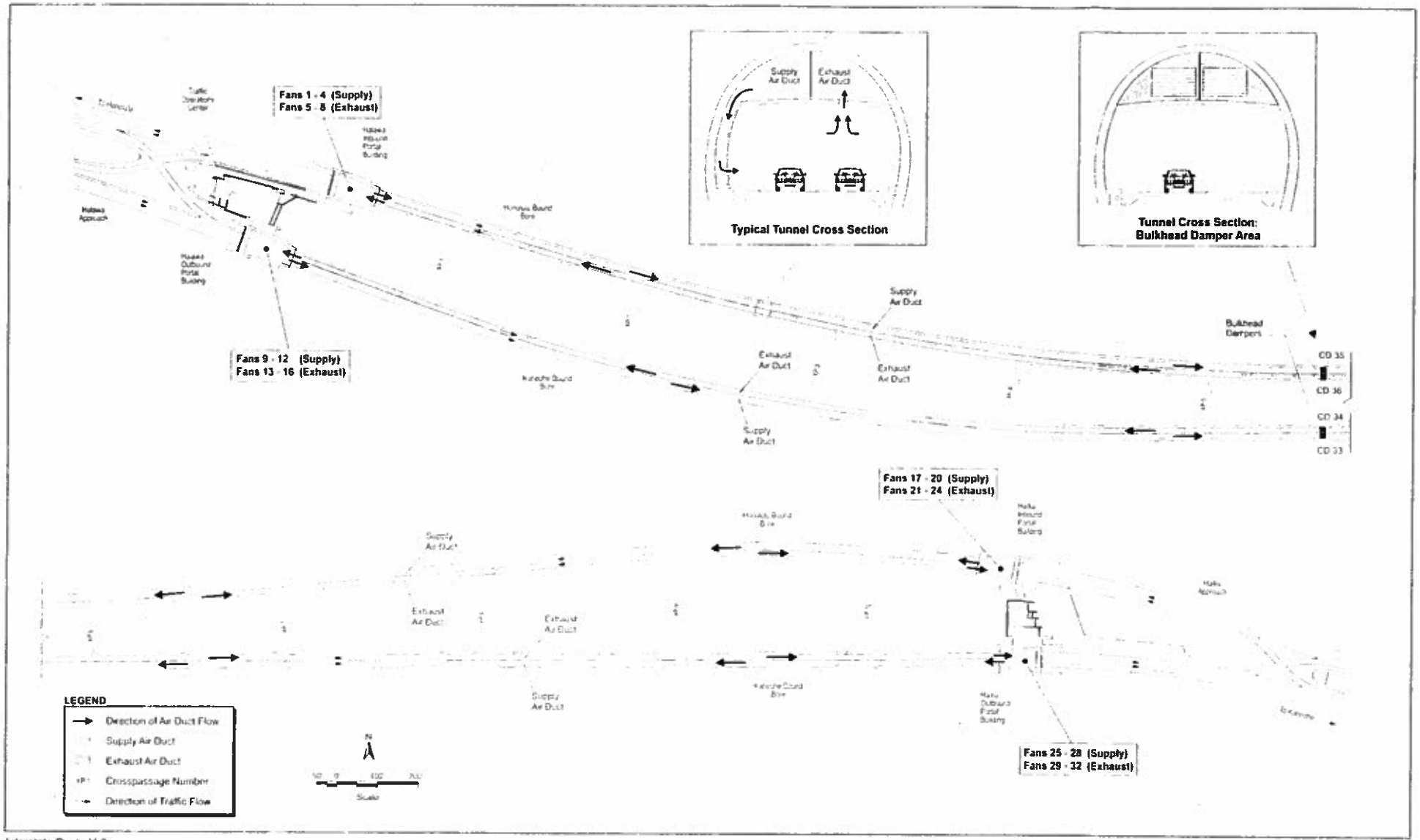
The basic components of the tunnel ventilation system are shown in Figure 2.7.2-1.

2.7.2.1 Air Supply System

Two supply fans are located on Level 2 and two supply fans are located on Level 3 of each portal building. Each supply fan draws fresh, outside air into its respective supply air duct. The four supply air ducts at each portal building merge into a single, large supply air duct that extends throughout the tunnel, above the tunnel ceiling. The supply duct and exhaust duct (see Section 2.7.2.2) are referred to as the *plenum*.

A series of supply air flues are located on the right side of each tunnel, spaced every five feet. Each supply air flue terminates in a supply air vent located near the floor of the tunnel. Fresh air travels through the supply duct above the ceiling, then down the flue and out the vent, providing an efficient air mixing throughout the length of the tunnel, as polluted air is exhausted through exhaust vents located in the tunnel ceiling (see Section 2.7.2.2).

The air supply system is shown in Figure 2.7.2.1-1. Figures 2.7.2.1-2 through 2.7.2.1-4 illustrate elements of the air supply system.



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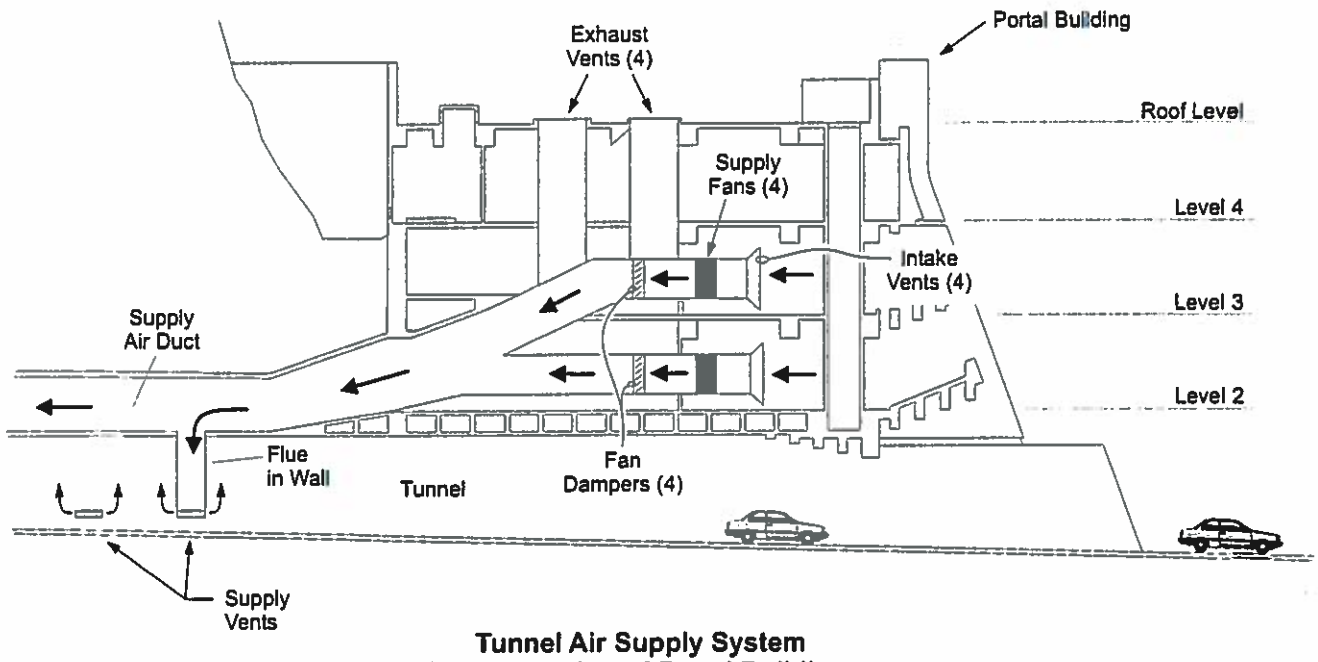
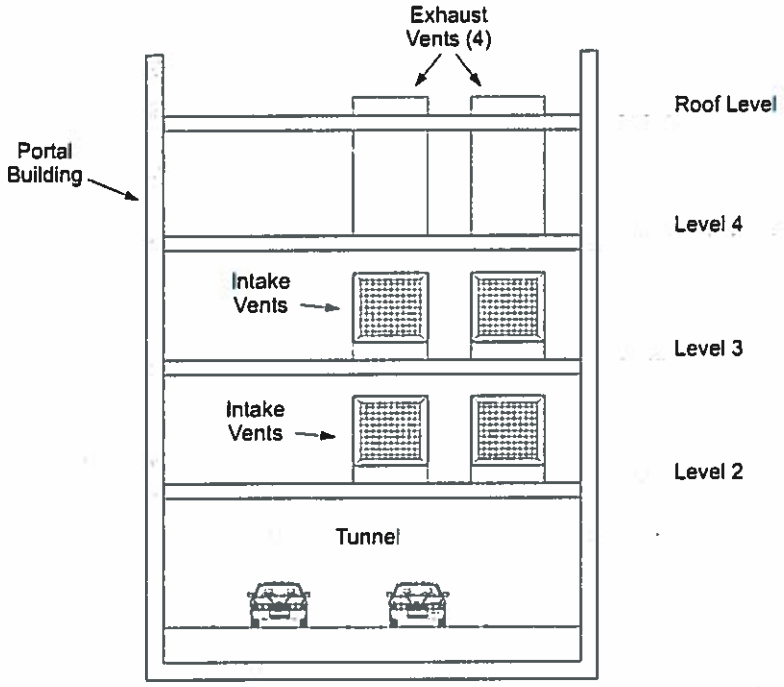


Tunnel Air Supply System
(Cross Section of Portal Building,
Viewed From Side)



Tunnel Air Supply System
(Cross Section of Portal Building,
Viewed From Approach)

Figure 2.7.2.1-2 *The tunnel supply ventilation fan system is located on Level 2 and Level 3 of each portal building. The exhaust air is discharged at the roof level.*

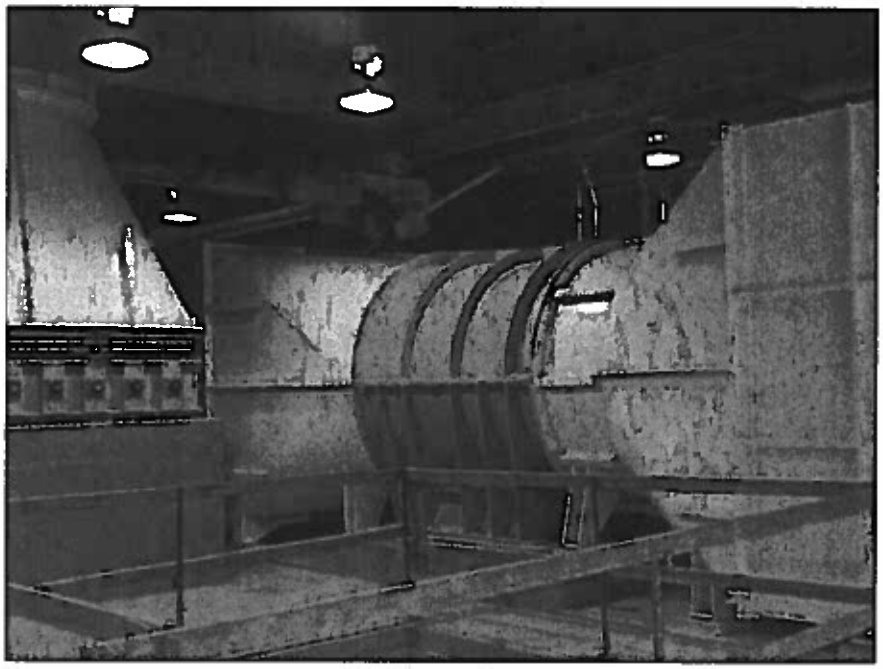


Figure 2.7.2.1-3 *A supply fan is located inside each portal building supply air duct (right). The fan is located within the darker area of the supply duct. An exhaust duct is shown on the left and leads to the roof.*

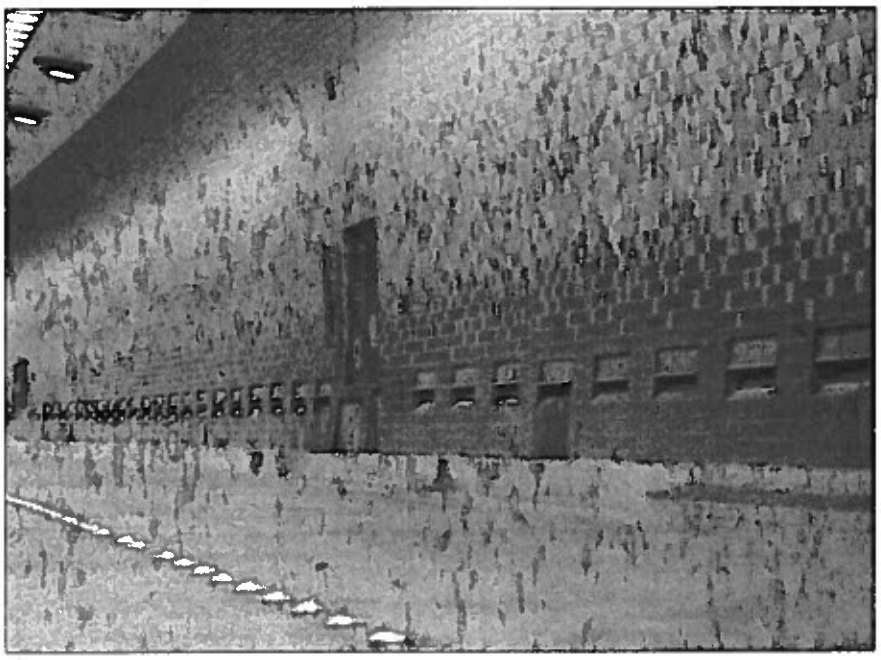


Figure 2.7.2.1-4 *Supply air is provided into each tunnel via a series of supply air flues. Supply air flues are located on the right side of each tunnel. The flue vents are a few feet above the roadway and extend throughout the entire length of each tunnel.*

2.7.2.2 Air Exhaust System

Exhaust vents are located on the ceiling of each tunnel, spaced every twenty feet (see Figure 2.7.2.2-1). Exhaust vents draw tunnel air into the exhaust fan and duct system. The exhaust air duct is located above the tunnel ceiling and adjacent to the supply air duct. The exhaust duct and supply duct (see Section 2.7.2.1) are referred to as the *plenum*. Exhausted air travels through the exhaust air duct towards the nearest portal building.

At the portal building, the exhaust duct divides into four smaller exhaust ducts. Each of the four exhaust ducts travel upward through the portal building to an exhaust fan. The exhaust fans are located on Level 4 of the portal building. Each exhaust duct extends above the roof level of the portal building, where the exhaust air is discharged into the atmosphere.

The air exhaust system is shown in Figure 2.7.2.2-2. Figures 2.7.2.2-3 and 2.7.2.2-4 illustrate elements of the air exhaust system.

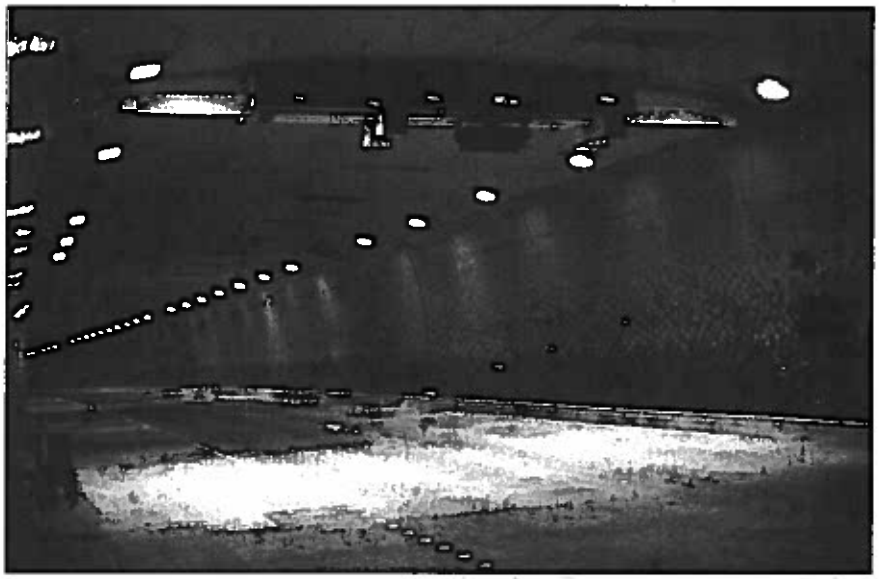
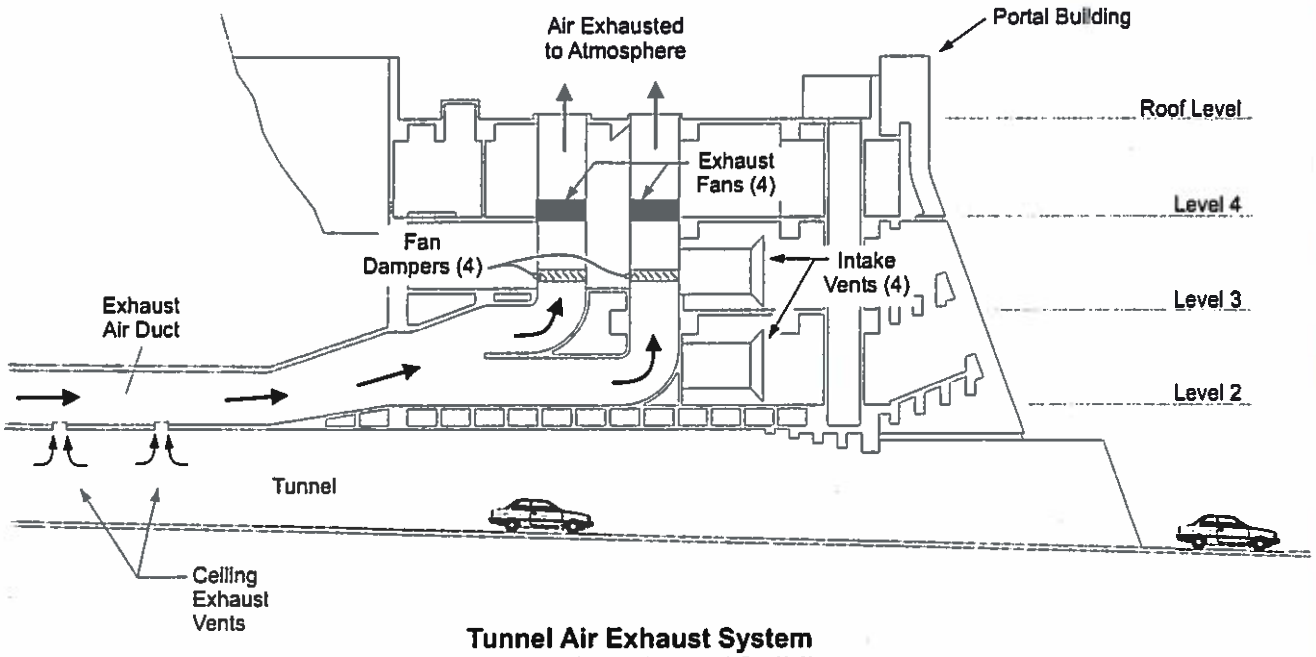
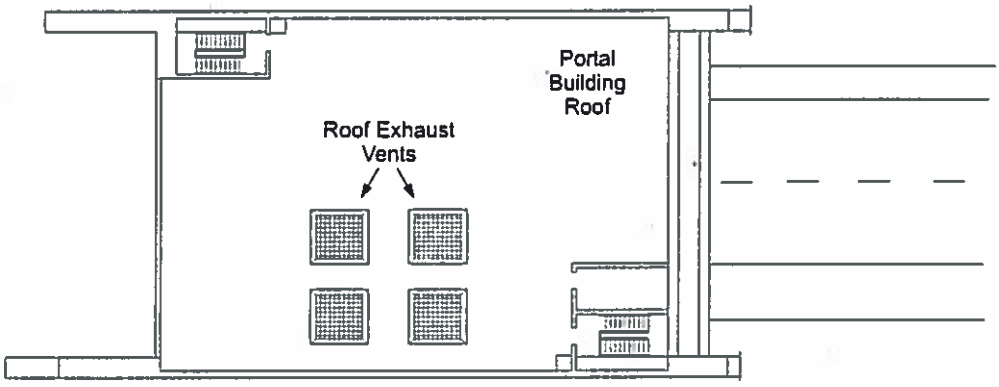


Figure 2.7.2.2-1 *Tunnel air is drawn up into the exhaust vents located on the ceilings of both tunnels. It is then discharged at each portal building roof.*



Tunnel Air Exhaust System
(Cross Section of Portal Building,
Viewed From Side)



Tunnel Air Exhaust System
(Portal Building Roof)

Figure 2.7.2.2-3 *An exhaust fan is located inside each portal building exhaust air duct. This photo shows three of the four exhaust ducts in a portal building (two in the foreground, one in the background). The ducts extend up to the portal building roof, where the air is discharged.*

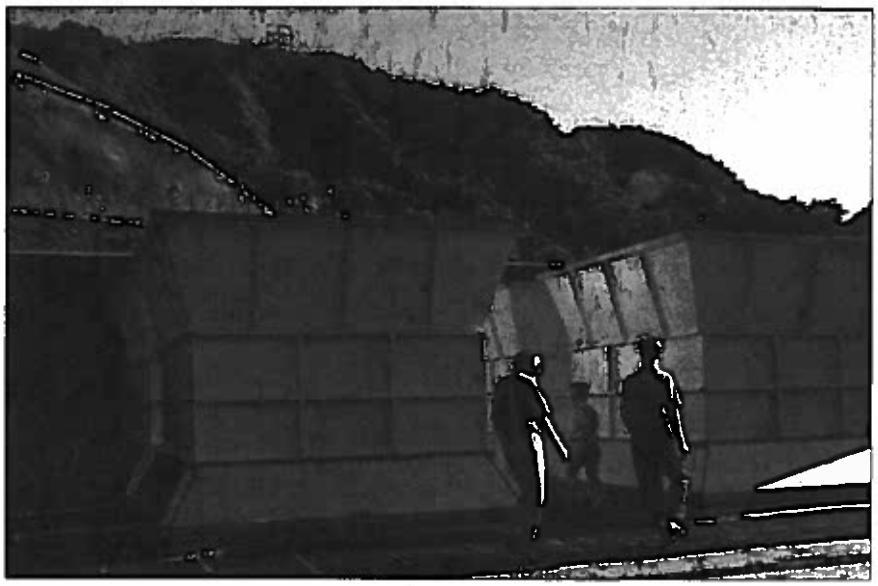


Figure 2.7.2.2-4 *Each portal building roof contains four exhaust vents. Exhausted air from the tunnel is discharged into the atmosphere here.*

ATTACHMENT C

Cost of Rebuilding Three Tunnel Ventilation Fans
2 Supply Fans and 1 Exhaust Fan

Rebuild three fans per Base Scope of Howden North America proposal dated 5-15-2015	$ 2,980,597
Contingency for repair/replacement of damper actuators and other necessary repairs, not included in Base Scope	$ 178,957
Hawaii G.E.T. tax	$ 140,446
TOTAL =	$ 3,300,000

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