

PARKWAY TOWERS MECHANICAL SYSTEM EVALUATION REPORT

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The Parkway Building at 1155 Ash Street in Denver Colorado is over 50 years old and the mechanical systems in the building have reached the end of their useful life. As such, critical systems are beginning to fail. Of particular concern are the piping systems which are degrading from both the inside and the outside. Piping leaks are occurring more frequently, sometimes causing considerable damage. During the investigation of the building we discovered that the piping systems were insulated with an asbestos containing material. This material appears to be concentrated at the elbows and other joints in the piping system.

The central plant in the building is mostly 50 years old and has reached the end of its useful life. The heating and cooling systems in the building have lasted an incredibly long time but now after 50 years we recommend that a major replacement effort be undertaken. We have generated four options to replace the mechanical systems each with an estimate of construction cost.

CENTRAL PLANT

The central plant for the Parkway Tower building consists of a 5,000,000 BTUH input steam boiler (1962), a 120 ton reciprocating water cooled chiller (1978), a cooling tower located on the 16th floor (est. 1978), a steam to water heat exchanger for the heating water (1962), an Everhot steam to domestic water heat exchanger (unknown), two main distribution pumps (1962), and a condenser water pump (1962). The two distribution pumps circulate water from the central plant to the fan coil units in each condominium. The condenser water pump circulates water from the cooling tower to the chiller in the cooling season. The building system is called a two pipe change over system. This type of system provides either heating or cooling water to the fan coil unit through piping risers with a supply and a return pipe. The system can handle only one temperature water at any given time. The Parkway Tower system was originally designed to provide for an automatic change over from heating to cooling and back. The piping was originally set up so that the east and west sides of the building could function independently. The building could be in heating on the east while cooling on the west. This control scheme was probably never functional and was abandoned long ago. The building now requires that the system be changed from heating to cooling or from cooling to heating manually twice a year. The entire building is either heating or cooling at any given time.

The boiler is more than 50 years old and has reached the end of its expected life. The maintenance required to keep it running is increasing. The condensate pumps are as old as the boiler and parts are becoming hard to find. The efficiency of any boiler decreases as the boiler ages regardless of how well it is maintained.

It is unlikely this boiler is running at more than 70% efficiency. The design of this system also requires that the boiler runs 24/7 throughout the year. During the cooling season this boiler is running just to produce domestic hot water. This is very inefficient and puts wear and tear on the boiler system. It should also be noted that this boiler represents a significant single point of failure for the building. If any part of the boiler fails then the building will have not domestic hot water or heat. This type of failure is happening all too frequently.

The chiller is about 35 years old and only 2 of the 4 compressors are operational. This chiller is at risk of needing expensive repairs and if we lose one more compressor you will no longer be able to cool the building. The cooling tower is also about 35 years old. We had the manufactures representative look over the tower. It is showing its age and will soon need to be replaced. The location of this tower, a room on the 16th floor makes it very difficult to replace in the same location and we suggest that a new location be found.

FAN COIL UNITS

Each unit has one or more fan coil units floor mounted along an interior wall. The fan coil units are original (1962) equipment in the building. Each fan coil consists of a fan which draws room air through a filter then blows that air across a water coil back into the room. The fan cycles on and off when there is a call for heating or cooling. The fan coil units have no control valves on the piping. This means that the heating or cooling water flows through the coils 24 hours a day seven days a week. This is wasteful on two levels. First the fan coil units act like a baseboard radiator heating or cooling the space when there is no call. Secondly the pumps in the central plant run full out 24/7. This puts undue wear and tear on the pumps while using too much electricity.

PIPING

The piping for the building serves a two pipe fan coil system. In the each season the piping delivers hot water to the fan coil units in each of the condominiums. The heating/cooling water is piped up a central main riser to the ceiling of the 14th floor. Here it is distributed horizontally to 14 separate vertical risers which run down to the 2nd floor. Piping also runs up to the 15th and 16th floors from the ceiling of the 14th floor. Each riser has a supply and return pipe along with a condensate drain line. The insulation on the piping in the risers is in poor condition and because of this condensation forms on the outside of the pipes in the cooling season. The condensation is causing a significant amount of rust on the outside of the pipes. In addition to this the piping is corroding on the inside. This corrosion is caused by the 51 years of use as well as varied chemical treatment. The combined effect is that the pipe wall is getting thinner and the piping is failing with

catastrophic results. There is no way to prevent this now short of replacing the piping.

ASBESTOS

During our investigation it was discovered that the piping in the building is insulated with a product that most likely contains asbestos. The steam to heating water heat exchanger in the mechanical room is insulated in a similar fashion as well. The suspected asbestos containing material (ACM) is largely located at the piping elbows and other joints. The condition of the ACM varies from flaking off to undamaged. The discovery of asbestos was a game changer in that the removal or abandonment of this piping and the ACM has profound effects on cost, schedule, and the reuse of the existing fan coil units. It should be noted that the suspected ACM exists both on the plumbing and the heating/cooling water piping. For every option we will propose we are assuming that the ACM in the garage level will be abated as there is no way to construct what we need and leave the ACM in place. There will still be ACM in the building regardless of which option is selected. The ACM on the plumbing piping which isn't in the garage, most of the piping in the ceiling spaces, along with the piping in the main riser chase do not need to be disturbed to replace the mechanical systems and are not included in the abatement options.

OPTIONS

Given the condition of the entire system the only reasonable options include the replacement of the mechanical systems in the building. We looked at several different systems. One option was to install a new gas fired furnace in each unit. The limited floor to floor space in the building makes it difficult to run ductwork, install flues and condensing units so that option was rejected. We also looked at a variable refrigerant flow system. This type of system would involve replacing the fan coil units with units that would look much like the old fan coil units except these units would be able to heat or cool anytime the owner wished. This system was rejected because the refrigerant would need to be routed around each floor horizontally. The limited floor to floor space in the building requires new piping to be routed through the building vertically in much the same manner as it is now. The cost of this system was also a factor as it was twice what our other systems are estimated to be.

In the end we settled on two different approaches. The first is to replace the system with a two pipe fan coil system like what is currently installed. The second system we considered is a water source heat pump system. The heat pumps would look like the existing fan coil units, but they would have the ability to heat or cool anytime during the year at the owner's request. We developed four options to

account for the fact that for each of the two options above we have the additional option to abate the asbestos or to leave it in place.

OPTION 1

The first option is to replace the existing fan coil units with new ones in the same location. This option would require us to remove the ACM on the piping in the pipe risers behind the existing fan coil units. To do this the existing fan coil units would need to be removed. The asbestos abatement contractor would be in charge of removing the piping and the fan coil units which they would then dispose of. We would replace the old fan coil units with new units because it is not practical or cost effective to abate the old units and reinstall them given their age and condition. New piping to service these fan coil units would be installed in the wall where the old piping used to run. The piping would be insulated to current building codes. A new control valve on each fan coil unit piping will eliminate overheating or overcooling of the space by allowing only as much flow as is required to meet the load. With this type of system cooling would be available in the cooling season and heat in the heating season.

The existing central plant would need to be replaced. The existing chiller would be removed and 3 high efficiency hot water boilers would be installed in that location. These boilers would run at 90% or better efficiency and provide heating water for the building and heat the domestic hot water as well. Only the boilers that are required to meet the load will run at any given time. Once this part of the plant is installed and proven the existing steam boiler will be removed and a new 120 ton high efficiency chiller will be installed. Supporting this chiller would be a new cooling tower which may be located on the parking level. New variable speed high efficiency main distribution pumps will also be installed.

The entire construction process will be designed to minimize downtime and inconvenience for the building occupants. Even with that effort it should be noted that some will feel that the inconvenience is significant.

ADVANTAGES

- The risk of catastrophic piping failure will be severely reduced.
- The risk of asbestos contamination would be significantly reduced.
- No additional space would be required in each unit.
- New fan coil unit controls will increase comfort.
- New fan coil unit controls will eliminate overcooling and overheating in the condominiums and reduce the amount of pumping energy that is used.
- The new central plant will have built in redundancy.

- The new central plant will be significantly more efficient and the building will see reduced energy costs.
- Maintenance costs and the risks of a major failure will be greatly reduced.

DISADVANTAGES

- The disruption caused by the abatement process.
- This type of system will only heat or cool when the main system is set for that. The swing seasons, spring and fall, will still have times when the system is delivering heating when the space requires cooling and vice versa.

OPTION 2

The second option is to replace the existing fan coil units with new ones in a different location probably on the same wall. This option would not require us to remove the ACM on the piping in the pipe risers behind the existing fan coil units. That piping would be abandoned in place. The existing fan coil units would need to be covered and permanently abandoned. The electrical service to the existing fan coil units would have to be extended to the new location using conduit mounted low on the wall. New pipe risers would need to be constructed next to the locations for the new units. The piping would be insulated to current building codes. A new control valve on each fan coil unit piping will eliminate overheating or overcooling of the space by only allowing as much flow as is required to meet the load. With this type of system cooling would be available in the cooling season and heat in the heating season.

The existing central plant would need to be replaced as detailed in option 1.

ADVANTAGES

- The risk of catastrophic piping failure will be severely reduced.
- The risk of asbestos contamination in the garage would be significantly reduced.
- New fan coil unit controls will increase comfort.
- New fan coil unit controls will eliminate overcooling and overheating in the condominiums and reduce pumping energy requirements.
- The new central plant will have built in redundancy.
- The new central plant will be significantly more efficient and the building will see reduced energy costs.

- Maintenance costs and the risks of a major cost hit will be greatly reduced.

DISADVANTAGES

- This type of system will only heat or cool when the main system is set for that. During the spring and fall there will still be times when the system is delivering heating but the space requires cooling or vice versa.
- The new fan coil units will require additional space.
- The old fan coil units will need to stay. The cover and space required could be objectionable.
- The asbestos will still be present behind the walls of each unit.
- The electrical conduit between the old and new units will be visible.

OPTION 3

In this option water source heat pumps would be installed in the location the existing fan coil units are now. This option would require us to remove and dispose of the existing fan coil units and the ACM on the piping in the pipe risers behind them. This work would be the responsibility of an abatement contractor. The water source heat pumps would look a lot like the existing fan coil units but these units can heat or cool any time at the occupant's request.

The existing central plant would need to be replaced. The existing chiller would be removed and 3 high efficiency hot water boilers would be installed in that location. These boilers would run at 90% or better efficiency and provide heating water for the building and heat the domestic hot water as well. Only the boilers that are required to meet the load will run at any given time. After the boiler plant operation is proven the existing steam boiler will be removed. A new chiller is not required for this type of system as the compressors are in the heat pumps themselves. A new cooling tower would need to be installed. The boilers and cooling tower would work together to produce 80F water in a loop which the heat pumps gather heat from or reject heat to maintain the temperature in each space. An advantage of this type of system is that lower cost piping can be used and that piping does not need to be insulated. New variable speed high efficiency main distribution pumps will also be installed.

To support the heat pumps a new electrical feed will be required. That new feed will come from the main electrical room in the garage and power wiring will follow the piping up the risers to the heat pump units.

The entire construction process will be designed to minimize downtime and inconvenience for the building occupants. Even with that effort it should be noted that some will feel that the inconvenience is significant.

ADVANTAGES

- The risk of catastrophic piping failure will be severely reduced.
- The risk of asbestos contamination would be significantly reduced.
- No additional space would be required in each unit.
- New heat pump controls will increase comfort.
- New heat pumps will be able to provide heating or cooling as the occupant wants it no matter the season.
- New unit controls will eliminate overcooling and overheating in the units and reduce pumping energy requirements.
- The new central plant will have built in redundancy.
- The new central plant will be significantly more efficient and the building will see reduced energy costs.
- No chiller will be required.
- Maintenance costs and the risks of a major cost hit will be greatly reduced.

DISADVANTAGES

- The disruption caused by the abatement process.

OPTION 4

In this option water source heat pumps would be installed down the same wall but at a different location from the existing fan coil units. This option would not require us to remove the ACM on the piping in the pipe risers behind the existing fan coil units. The existing fan coil units would need to be covered and permanently abandoned. New pipe risers would need to be constructed next to the locations for the new units. The piping would not need to be insulated. The water source heat pumps would look a lot like the existing fan coil units but these units can heat or cool any time at the occupant's request.

The central plant would need to be replaced as detailed in option 3.

ADVANTAGES

- The risk of catastrophic piping failure will be severely reduced.
- The risk of asbestos contamination in the garage would be significantly reduced.
- No additional space would be required in each unit.

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- New heat pump controls will increase comfort.
- New heat pumps will be able to provide heating or cooling as the occupant wants it no matter the season.
- New unit controls will eliminate overcooling and overheating in the units and reduce pumping energy requirements.
- The new central plant will have built in redundancy.
- The new central plant will be significantly more efficient and the building will see reduced energy costs.
- No chiller will be required.
- Maintenance costs and the risks of a major cost hit will be greatly reduced.

DISADVANTAGES

- The new Heat pump units will require additional space.
- The old fan coil units will need to stay. The cover and space required could be objectionable.
- The asbestos in the walls behind the existing fan coil units will remain.