MEMORANDUM

TO: City of Portland – Planning Board

FROM: Jim Wentworth, P.E.

DATE : February 14th, 2018

SUBJECT: Maine Medical Center – Constructability Review

This memo summarizes the review by Kleinfelder of the five options shown in the document labelled, *Visitor Garage Construction Option Comparison,* presented by Maine Medical Center and Turner Construction for the construction build out of the visitors parking garage. Other supporting documents that have been reviewed as part of this effort include:

* Maine Medical Center Construction Management Plan -Traffic and Road Closure studies: January 2nd, 2018
* Maine Medical Center Construction Management Plan - Logistics Plans and Studies-East Towers and Visitors Garage, Central Utility Plant: Last update February 27th, 2018, pages 1-29
* Maine Medical Center/Turner – Construction Management Plan-East Tower, Visitor Garage, Central Utility Plant. Last Updated February 27th, 2018
* 440 Ton Leibherr Crane Chart and Boom/Jib Configuration: February 5th, 2018
* Email from Dominic Gagnon with data assumptions for Option 1: CIP, and Option 2: South side retaining walls: February 9th, 2018
* Submitted Congress Street Cross Section with Crane Layout: February 12th, 2018

Upon reviewing the options, a main priority and focus during construction option comparison was safety of the general public, safety of the hospital staff, and safety of the contractor staff.

The following are each option listed with constructability comments and recommendation:

Option 1- Cast in Place (CIP)

* Cast in Place (CIP) concrete is not a preferred nor typical construction technique used in parking garage construction due to concrete quality control, longevity of structure, time/schedule, and overall increased cost. The existing MMC employee garage is a cast in place structure and has these maintenance and longevity issues. (i.e. efflorescence, concrete spalling, resistance to deicing chemicals)
* It has been determined by SGH Engineering that the overall structure was designed to handle an additional 3 stories at approximately 80-85 lbs. per square foot. Kleinfelder did not perform any calculations to verify these loading parameters. A CIP structure could likely weigh more than a precast based on some additional reinforcing steel and additional concrete in the post tensioning anchorage zones. This is solely based on engineering judgement and not calculations.
* Based on overall constructability for these long Double Tee beams the following are factors that would add cost and time into a CIP type structure:
  + Forming, concrete placement, concrete curing for Double Tee type beams would be labor intensive which would add cost and affect schedule.
  + A crane would still be needed to perform the work for lifting formwork materials, steel tendons, concrete, and other various construction materials, therefore impacts to traffic to Congress would occur.
  + There would be a need for post tensioning the tendons, grouting, and equipment/ jacks to perform this post tensioning in place. A post tensioning procedure would be very difficult to perform with accuracy in this type of location and environment. (i.e. Staging of post tensioning jacking equipment, worker falsework)
  + There is a high probability that the entire parking garage would need to be empty during this type of construction operations based on temporary falsework and shoring needs to cast the concrete in place would be from a bottom up approach. (All floors to be braced from ground up).

*Based on the information provided and reviewed,* ***Option 1 is not recommended.***

Option 2- South Side Approach

* Safety: The location of the Emergency room entrance/exit is located on the South side of the visitor parking garage and therefore general *public safety and emergency access* of this public service would be extremely limited if this option was chosen.
* Delivery and access of precast units (85’ long truck) to the South side would be limited based on turning movements associated with street configurations, on street parking, and utility pole locations around the area.
* There is limited safe area to operate any type of crane swing radius on this South side of the building.
* Overall staging area on the South side would be limited.
* Two retaining walls exists along the South side of the existing parking garage. Kleinfelder did not have access to as built plans of these two retaining walls nor was scoped to perform any structural check calculations on these two walls.
  + Based on the design loadings, per email of Dominic Gagnon February 9th, 2018 per SGH Engineering; the retaining walls as designed assumed a vertical surcharge pressure in the order of 500 pounds per square foot for the wall. It is reasonable to state that the 440 T Liebherr crane as proposed, alone with its frame weight of approximately 94,800 lbs. and allowable counterweight of 341,800 lbs. distributed over a total track area of 240 square feet (3’11”x30’8” each track), without accounting for the boom and precast units, has the ability to produce in excess of *1800 lbs. per square foot of surcharge*.
  + A slightly smaller crane than the 440T Liebherr could be used from this South side of the garage; however surcharge pressures of 1500-1800 lbs. per square foot would not be unreasonable to experience for the crane size needed to lift the 30 ton precast units.
  + MMC and Turner investigated a 600 Ton hydraulic crane for this option, also this crane was also ruled out due to wall surcharge capacity and overall site logistics.
* Temporary shoring of these two retaining walls is not a feasible option based on their location. Any type of shoring such a sheet pile type wall, soldier pile wall, or pile platform would need crane access to perform the temporary work as well. It is not known, but assumed, that there are also buried utilities in this section of roadway which would complicate any pile driving processes.

*Based on the information provided and reviewed,* ***Option 2 is not recommended.***

Option 3- North Side Approach, One lane.

* Congress Street is approximately 43’9”± curb to curb based on cross section provided by Turner.
* The sidewalk abutting the visitor garage is approximately 10’6”± in width.
* The sidewalk on the North side of Congress is approximately 11’ ±in width.
* The proposed 440 Ton Liebherr Crane is approximately 45 feet in length from front of track to back of counterweight. Taking up the majority of the roadway and 2-3± feet of the sidewalk.
* The Main boom on the crane cannot operate totally vertical and will use the 10’6”± sidewalk area plus to face the garage.
* The crane will need to face the building with track perpendicular to Congress Street.
* There is no available safe width for vehicles to travel through the area based on the crane parameters and needs.
* There is limited available width (7-8 feet ±) for protected pedestrian traffic.

*Based on the information provided and reviewed,* ***Option 3 is not feasible or recommended.***

Option 4- North Side Approach, Two lane (Road Closure)

* Safety-All work completed in closed section of road, no vehicular traffic. Overall safest for general public and contractor based on constructability.
* Similar site and crane parameters as Option 3.
* The 440 T Liebherr crane configuration is needed to reach up and over existing parking garage for capacity reasons to install the 30 Ton precast Double tee beams.
* Two other type of cranes where investigated: Mobile Hydraulic, and Tower Crane.
  + Each has limitations for this site due to 30T capacity which is less than required for the precast Double Tees.
* The 440 T Liebherr crane will have two sections of crane boom: Main Boom-161 feet, Jib-161 feet. (+- 320 lineal feet)
* Need length 300 feet of Congress from pedestrian skybridge to Weymouth to assemble crane boom and jib.
* Single phase power utility line exists at corner of Congress and Weymouth which will not affect boom assembly.
  + There is no additional street or sidewalk width with this crane configuration to safely use this option with emergency vehicular traffic.
  + Delivery of the 85 foot long precast units for this option from Weymouth to Congress is feasible.

*Based on the information provided and reviewed,* ***Option 4 is recommended.***

***Incentive/disincentives for allowable closure days, liquidated damages for end dates, traffic detours and signage, are all parameters that can be employed to minimize the closure efforts with Option 4.***

Option 5- Crane Placed in vacant Employee parking garage area

* + - Construction scheduling delays and logistics, based on additions onto visitor garage complete (2018), and new East Tower heliport complete (2019).
    - New employee parking garage on St. John needs to be constructed (2019) prior to demolition of existing employee garage.
    - A crane with 480 ± lineal feet of boom/jib would be needed to reach up and over elevator/stairwell that currently exists between two parking garages.
      * This is an additional ***160 lineal feet*** of boom/jib added to the current 440T crane configuration proposed.
    - Safety of general public working over ***LIVE*** stairwell.
    - Crane assembly along Congress has limitations on South side of pedestrian skybridge:
      * Approximate 500 plus lineal feet would be needed to assemble crane (From pedestrian skybridge into Valley Street
      * Closure of Congress to assemble crane.
      * Utility line interferences and needed relocations: Three phase lines at Congress and Forest, Congress and Gilman, Congress and Valley.
      * Hospital main electrical feed from Gilman

*Based on the information provided and reviewed,* ***Option 5 is not recommended.***

Schedule Overview

The overall construction schedule of an 8 week closure of Congress Street was reviewed and is listed below as *Schedule 1*. This schedule allows for 8 precast pieces set per day. It is realistic that 10 precast pieces may be set a day or even 12 pieces. It is also realistic that construction delays such as deliveries and/or adverse weather conditions may cause delays and allow only 6 pieces to be set per day.

Two other schedule scenarios were investigated based on 8 pieces per day.

*Schedule 2* assumes a 6 days a week schedule and resulted in a 7 week closure.

*Schedule 3* assumes a 7 days a week schedule and resulted in a 6 week closure.

***It is recommended that the 8 week schedule be allowed, but set with allowable penalties for not opening on time.***

It is not recommended to go to a 7 day work week as shown in Schedule 3. Consideration needs to be given in any schedule that as days get added to the work week there exists safety concerns with rested employees, decreased efficiency, a work area increase for complacency, as well as increase in cost premiums.

* *Schedule 1*
  + 8 week -5 day/week-8 pieces (assumed) per day-proposed
* *Schedule 2*
  + 7 week -6 day/week-8 pieces per day- Open by June 18th-19th
* *Schedule 3*
  + 6 week-7 day plus holiday-Open by June 8th-9th

**In conclusion, out of these above options that have been developed. Option 4 is the recommendation that Kleinfelder supports based on our review.**